

CONFERENCE ABSTRACTS

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Telepharmacy perceptions of artificial intelligence in clinical practice: A cross-sectional survey

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Background: Artificial Intelligence (AI) is increasingly being incorporated into healthcare with uses that include clinical decision support to medication safety monitoring and workflow automation. In pharmacy practice, AI has the potential to enhance medication optimization, improve efficiency, and strengthen clinical decision-making. However, successful integration relies on pharmacy service providers' perceptions, acceptance, and preparedness to adopt these technologies. Research examining pharmacists' attitudes toward AI remains limited, particularly in Canada. This study builds on a previously published 2024 survey of hospital pharmacists in Qatar to evaluate perceptions of AI, focusing on perceived usefulness, potential risks, effects on workflow, and intentions to adopt AI-enabled tools.

Method: An observational cross-sectional, anonymous electronic survey (Microsoft Forms) was conducted among all employees of a Canadian hospital telepharmacy company. The questionnaire, adapted from Shabana et al, collected data on sociodemographics, willingness, attitudes and perceived barriers toward AI. The survey was distributed via email by organisational leadership with voluntary participation encouraged over a two week period with reminders. Responses were measured using 5-point Likert scales. Data were analyzed using descriptive and inferential statistics, with results summarized as frequencies, percentages, and medians with interquartile ranges. Associations between variables were explored to assess

factors influencing attitudes and willingness to adopt AI, with statistical significance set at $p < 0.05$.

Results: Eighty telepharmacy employees responded (46.8%), mostly female (68.8%) and aged 35–54 years (70.0%), with most rating their pharmacy-specific AI knowledge as moderate (41.2% rated 3/5). Respondents demonstrated positive willingness to integrate AI (median score 46.5/65; IQR 43.0–52.0) and favourable attitudes toward its implementation (median score 50.5/70; IQR 45.75–55.0). Willingness was strongest for connecting healthcare provider systems (80.0% agree/strongly agree) and weakest for patient counselling (41.2% disagree/strongly disagree). Most respondents supported AI training for career development (78.8%), while the majority disagreed that AI always makes the best clinical choice (66.2%). The most frequently endorsed barriers were AI requiring human supervision (92.4%), regulatory and social limitations (91.1%), and challenges with patient empathy (88.6%). No significant associations were found between sociodemographic factors and willingness or attitude. Self-rated AI knowledge was the strongest predictor of both outcomes ($\rho = 0.395$ to 0.407 , $p < 0.001$). Endorsing more barriers was significantly associated with less positive attitudes ($\rho = -0.312$, $p = 0.005$) but not with willingness. On logistic regression, higher AI confidence was significantly associated with more positive attitudes (OR 7.45 to 8.71, $p < 0.01$), while prior AI tool use was not, suggesting that confidence rather than prior exposure drives readiness for AI adoption.

Conclusion: As AI becomes increasingly integrated into the pharmacy profession, understanding staff perceptions is essential for successful adoption. In this study, employees of a Canadian telepharmacy company generally viewed AI positively, recognizing benefits in practice. Adoption was influenced by prior experience and confidence with AI tools. Although the study did not reach its target sample size, the response rate provides meaningful insights. Findings highlight the need for education, organizational support, and future

research on strategies for effective AI adoption and implementation into pharmacy practice

Correlation between antibiotic consumption density and the proportion of drug-resistant bacteria in a regional teaching hospital

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Background: Faced with the increasingly serious problem of drug-resistant bacteria, actively understanding the correlation between antibiotic usage and the proportion of drug-resistant bacteria is an important issue for developing infection control measures. This study statistically analyzed the correlation between inpatient antibiotic consumption density and the proportion of drug-resistant bacteria, a key indicator of antibiotic resistance. To analyze the correlation between antibiotic consumption density and the proportion of drug-resistant bacteria, aiming to reduce the occurrence of drug-resistant bacteria through a tiered management model of the Antibiotic Management Program (ASP).

Method: This study statistically analyzed the inpatient use of carbapenem antibiotics (ertapenem, imipenem-cilastatin, and meropenem) and anti-MRSA antibiotics (vancomycin, teicoplanin, and linezolid) from 2022 to 2025. Inpatient antibiotic consumption density (Defined Daily Dose per 1000 inpatients per day, DID) was used as the unit of measurement. The proportion of drug-resistant bacteria refers to the percentage of the resistant bacterial strain among all isolates. The correlation between the two was determined using the Pearson correlation coefficient. Data were compiled by year and quarter, with a total of 12 observation points. The study was conducted using SPSS version 20.x, and a p-value < 0.05 was considered statistically significant.

Results: From 2022 to 2025, the consumption density of carbapenem antibiotics used in hospitalizations was significantly different from that of the index-resistant strains MDRAB+CRAB (Multidrug-resistant *Acinetobacter baumannii* + Carbapenem-resistant *Acinetobacter baumannii*) ($r = 0.2261$, $P = 0.3997$), MDRKP+CRKP (Multidrug-resistant *Klebsiella pneumoniae* + Carbapenem-resistant *Klebsiella pneumoniae*) ($r = 0.0817$, $P = 0.7636$), and MDRPA+CRPA (Multidrug-resistant *Pseudomonas aeruginosa* + Carbapenem-resistant *Pseudomonas aeruginosa*) ($r = 0.1687$, $P = 0.7636$). $r = 0.5324$, both showed no significant correlation. The density of anti-MRSA antibiotic consumption was not significantly correlated with the proportion of MRSA-resistant bacteria (Methicillin-resistant *Staphylococcus aureus*) ($r =$

0.0533 , $P = 0.8445$) or with the proportion of anti-MRSA-resistant bacteria (VRE, Vancomycin-resistant enterococci) hospitalized in 2024-2025 ($r = -0.5526$, $P = 0.1555$).

Conclusion: Although the consumption density of carbapenem and anti-MRSA antibiotics did not show a positive correlation with the proportion of drug-resistant bacteria, this may be because the main cause of increased resistance is not the amount of antibiotics used, but the implementation of infection control policies, community transmission of multidrug-resistant bacteria, or nosocomial cross-infection. In addition, it may be related to the time-lag effect or environmental and infection control factors (non-drug factors). Therefore, the rational use of antibiotics and strict infection control policies should continue to be implemented in tandem.

Evolution of a comprehensive anticoagulation network in eastern Thailand: Impact of university-hospital partnerships on clinical outcomes

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Background: Founded in 2009, the Faculty of Pharmaceutical Sciences at Burapha University (RxBUU) has emerged as a leading academic center in Eastern Thailand. With a commitment to integrate precision health into patient care, RxBUU has expanded its partnerships with Chonburi Hospital, a leading tertiary care center, to promote optimal anticoagulation therapy. A multidisciplinary anticoagulation service was initiated in 2006, featuring a team of physicians, nurses, physical therapists, and pharmacists. Initially, this service served warfarin patients admitted to the cardiac care center, but later broadened its scope to serve patients taking anticoagulation therapy within the organization and beyond.

Method: RxBUU has partnered with Chonburi Hospital to strengthen anticoagulation services through collaborative clinical training, including case discussions and pharmacotherapy conferences. For hospitalized patients, pharmacists were trained to assess appropriate drug selection and dosage regimen. Pharmacists helped mitigate

adverse drug reactions and drug interactions using the Clinical Decision Support System (CDSS). Prior to hospital discharge, pharmacists provided comprehensive counseling to all patients taking anticoagulation therapy. For outpatients, the anticoagulation service was integrated into different clinics: cardiology medicine unit, cardiovascular and thoracic surgery unit, and primary care unit. Pharmacists provided a pre-counseling session intended to assess medication-related problems and offer medication recommendations to physicians. After patients were seen by physicians, pharmacists dispensed medications and provided post-counseling. Regardless of service location, once medication-related problems were identified, patients were followed up using the telepharmacy service. This process was created to ensure appropriate monitoring to optimize patient outcomes. At each encounter, pharmacists recorded their interventions using “Warfarin and Non-vitamin K antagonist oral anticoagulants registry Network (WaNRN)”, a Thai registry database, in addition to the hospital’s database. These records facilitated effective communication of patient information and enabled Chonburi Hospital to become a regional hub for a comprehensive anticoagulation network. Four clinical outcome indicators were utilized to assess the impact of anticoagulation services: time in therapeutic range (TTR), adverse events, readmission, and drug-related problems.

Results: From 2006 to 2025, the Comprehensive Anticoagulation Network has provided services to 2,470 patients. Of these, 1,926 patients received warfarin, and 544 received Direct Oral Anticoagulants (DOACs), respectively. On average, pharmacists provided anticoagulation services to 145 inpatients each month. After hospitalization, patients continued to follow up every 3 months in the clinics. In compliance with Thailand’s health policy service plan, our network observed a mean time in therapeutic range (TTR) of 65.5%, exceeding the benchmark of 65%. The composite of ISTH major bleeding and thromboembolic events occurred at a rate of 1.0 events per year. Readmission due to warfarin complications has gradually declined to 2.3 events per year in 2026. Most common drug-related problems were reported to be drug-drug interaction (34%), over-dosed (28%), inappropriate dose adjustment (24%), and adherence problems (10%), respectively.

Conclusion: Originally started as a multidisciplinary anticoagulation service at Chonburi Hospital, the collaboration between RxBUU and Chonburi Hospital has expanded the service into a comprehensive Anticoagulation Network for Eastern Thailand. This university–hospital partnership has been associated with improved anticoagulation quality, reflected by higher TTR, fewer adverse events, and lower hospital readmission rates.

Detecting discrepant medications during discharge medication reconciliation in older adults at a geriatric center in Southwest Nigeria

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Background: Medication discrepancies during hospital discharge pose significant risks, particularly in older adults who are vulnerable to adverse drug events and hospital readmissions. Objectives: The aim of the study was to determine the prevalence and potential risks associated with medication discrepancies in older patients at a geriatric centre in Southwest Nigeria.

Method: A retrospective, single-center cohort study was conducted on the discharge medications of older adults from the geriatric centre of the University College Hospital in Ibadan between 2021 and 2024. Using the clinical pharmacist’s acquired medication history through a ‘brown bag’ review of the patients’ home medications, hospital medication administration records, and the medications on the physician’s discharge summary, the most accurate list of medications for the patients were compiled. Discrepancies were identified, removed, and properly documented. Descriptive and logistic regression analysis were used to analyze the data gathered for the study.

Results: A total of 247 discrepant medications were identified among the 144 participants. 113 participants (78.5%) had at least one discrepant medication and 31 (21.5%) had none. Majority of both males (84.5%) and females (74.4%) had discrepant medications while a smaller proportion of males (15.5%) and females (25.6%) had no discrepancies. The highest proportion of discrepant medications occurred among participants aged 70–79 years (36.8%), followed by those aged 80–89 years (33.3%) and 60–69 years (20.8%), with the lowest proportion observed in participants aged ≥90 years (9.0%), though they have the least number of study participants. Antihypertensives (22.7%), vitamins and supplements (16.6%), analgesics (15%), antibiotics (11%), and antiplatelet/anticoagulants (10%) were the most frequently implicated drug classes of the discrepant medications. Overall, 26 participants (18.1%) had at least one high-alert medication among the discrepant medications. Chi-square analysis revealed a statistically significant association between risk level and the occurrence of medication discrepancies ($\chi^2=10.796$, $p=.001$).

Conclusion: Medication discrepancies were highly prevalent among older adults in this study, affecting more than three-quarters of participants, with notable involvement across both sexes and predominance in the 70–79-year age group. The frequent implication of commonly prescribed drug classes, including antihypertensives, analgesics, and antithrombotic agents, as well as the presence of high-risk medications among the discrepant medications, underscores

the need for structured medication reconciliation, targeted pharmacist-led interventions, and age-specific strategies to enhance medication safety and optimize pharmacotherapy in geriatric populations especially during transitions of care.

Drug-drug interactions in discharge medications among older adults: Aretrospective evaluation

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Background: Drug–drug interactions (DDIs) and inadequate attention to medication reconciliation remain significant challenges in the pharmacological management of hospitalized older adults. **OBJECTIVES:** To determine the frequency and severity of DDIs (e.g. minor, moderate or major) in medications prescribed to older adults at hospital discharge. The study also aims to identify the most common drug classes, and evaluate patient-related risk factors (age, co-morbidities, gender and polypharmacy) associated with clinically significant interactions. Findings will inform recommendations to improve medication safety in older adults at discharge.

Method: A retrospective study was conducted using discharge medication records obtained from pharmacist-documented medication reconciliation for 191 older adults (mean age: 74.07±8.93 years) at the Chief Tony Anenih Geriatric Centre, University College Hospital. Potential drug–drug interactions (DDIs) were identified through a systematic review of discharge medication lists using multiple interaction screening databases, including Lexicomp, Epocrates, Drugs.com, Medscape, and WebMD. Interactions were cross-checked across these sources and classified according to severity. In cases of discrepancies, Lexicomp served as the primary reference, and only clinically relevant DDIs were included in the final analysis. Data were initially entered into Microsoft Excel and exported to IBM SPSS Statistics version 25 for analysis. Descriptive statistics (frequencies, percentages, medians, and standard deviations) were used to summarize the study variables. Binary logistic regression was performed to examine patient-related risk factors such as age, gender, comorbidities, and polypharmacy associated with clinically significant drug–drug interactions (DDIs). The chi-square test was used to assess the association with the severity of drug–drug interactions.

Results: Among 191 discharge prescriptions, the prevalence of DDI was 145 (76%) (69.8%-82.0% at 95% Confidence Interval). A total of 487 drug-drug interactions were identified: 92 (18%) minor, 336 (69%) moderate and 59 (12%) major interactions. Antihypertensives had the highest proportion of interactions among the drug classes 195 (20.4%), followed by anticoagulants/antiplatelets 15.6% and antibiotics (14.6%). Though antimalarials had a lower

frequency (1.6%), they have the highest frequency of occurrence among the major interactions. The 60-69 age group accounted for the highest volume of interactions 190 (39%) even across all severity levels. Female gender had a higher prevalence 107 (56%) of DDIs compared with males 84 (44%). The presence of chronic conditions is a predictor of DDIs and for patients with 3 or more, it was 100%. The mean medication count was 4.91±2.24 and DDIs increased with increase in the number of medications: 2 medications (26%), 5 medications (91%) and ≥7 medications (100%) prescribed which shows a positive correlation between the number of drugs prescribed and DDI. Further result showed a statistically significant association between the variables ($\chi^2 = 150.6$, $df = 18$, $p < 0.001$), indicating that the severity of interactions varies across different drug class groups.

Conclusion: The prevalence of DDIs is high among the participants in this study with polypharmacy and multimorbidity as primary drivers. Hence the need for targeted medication reconciliation, management of polypharmacy and screening of discharge medications for drug-drug interactions for older adults irrespective of age and gender during hospital discharge in older adults.

Artificial intelligence in pharmacy practice in Northern Ireland: A qualitative study of hospital pharmacists' perspectives, readiness, and barriers

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Background: Artificial intelligence (AI) represents a paradigm shift in healthcare delivery, with considerable potential to transform pharmacy practice through clinical decision support, medication optimisation, supply chain management, and administrative automation. Despite growing global interest, no prior study has examined hospital pharmacists' perspectives on AI integration in the Northern Ireland (NI) devolved health system, which has recently completed the rollout of a single integrated electronic health record (Encompass/Epic). This study aimed to explore attitudes, perceived benefits, concerns, and views on facilitators and barriers to AI adoption among NI hospital pharmacists, using the Unified Theory of Acceptance and Use of Technology (UTAUT) as a framework.

Method: A qualitative study employing semi-structured, one-to-one interviews was conducted between August and September 2025, in compliance with the Standards for Reporting Qualitative Research (SRQR). Ten purposively sampled pharmacists from the Southern Health and Social Care Trust participated, spanning specialities including

palliative care, mental health, care homes, medicines information, respiratory medicine, medicines governance, and pharmacy education, with different grades across various years of experience. Interviews were conducted via Microsoft Teams with live transcription. Inductive thematic analysis followed Braun and Clarke's six-phase framework. Codes were generated independently before consensus review. Reflexivity was maintained throughout.

Results: Five overarching themes were identified. (1) Perceived utility: all participants recognised AI's potential across clinical decision support, prescription checking, medication optimisation, personalised medicine, supply chain forecasting, administrative task automation, and pharmacy education. AI was consistently positioned as a recommendation and decision-support tool, with pharmacists retaining final clinical authority. (2) Perceived Risks: concerns included AI hallucination and inaccuracy, data security and consent, professional accountability and liability, and environmental impact. (3) Human-AI Complementarity: participants unanimously held that AI cannot replicate empathy, clinical nuance, or the relational dimensions of patient care; deskilling and complacency were perceived as significant risks requiring active mitigation. (4) Enablers: regulatory and legislative frameworks, practical AI literacy training, phased and piloted implementation, and NI's integrated Encompass/Epic platform were identified as critical facilitators; the regional academic and health technology ecosystem was cited as an underutilised asset. (5) Barriers: prominent barriers included the absence of pharmacy-specific regulatory guidance from the Pharmaceutical Society of Northern Ireland (PSNI), change fatigue following Encompass implementation, infrastructure and connectivity deficits, financial constraints, and workforce heterogeneity.

Conclusion: Northern Ireland hospital pharmacists demonstrate conditional readiness to embrace AI, contingent upon robust governance, professional regulation, comprehensive and sustained training, and equitable implementation. This study provides the first empirical evidence on AI adoption readiness in NI pharmacy. It makes a tangible contribution to FIP's global agenda on digital health transformation and future-ready pharmacy workforces. A coordinated regional strategy—spanning legislation, professional regulation, trust governance, education, and patient involvement—is required to ensure AI integration is safe, equitable, and clinically meaningful. The findings will directly inform the development of a co-designed national guide for AI integration in NI pharmacy practice. This model may be relevant to other health systems at comparable stages of digital maturity.

Optimising chemotherapy supportive care through pharmacy practice: Impact of adherence to chemotherapy-induced nausea and vomiting prophylaxis on quality-of-life in breast cancer patients in Ghana

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Background: Chemotherapy-induced nausea and vomiting remains one of the most distressing adverse effects of cancer treatment and significantly affects patients' quality of life. In low- and middle-income settings, challenges such as financial constraints, variable health literacy, and reliance on self-administered medicines may compromise adherence to antiemetic prophylaxis, particularly for delayed symptoms. Pharmacists play a central role in integrated, people-centred supportive cancer care by optimizing prophylaxis, patient education, and follow-up. However, evidence linking adherence to chemotherapy-induced nausea and vomiting prophylaxis with quality of life in resource-constrained settings remains limited. To assess adherence to acute and delayed chemotherapy-induced nausea and vomiting prophylaxis and examine its association with symptom control and quality of life among breast cancer patients receiving chemotherapy at a tertiary hospital in Ghana.

Method: A cross-sectional study was conducted among 184 adult breast cancer patients receiving chemotherapy at Korle Bu Teaching Hospital, Ghana. Adherence to acute prophylaxis was assessed using patient medical records, while adherence to delayed prophylaxis was measured using the Medication Adherence Report Scale and pill count method. Chemotherapy-induced nausea and vomiting was assessed using a validated patient-reported outcome tool, and quality of life was measured using the Functional Assessment of Cancer Therapy-Breast questionnaire. Descriptive statistics, Fisher's exact test, analysis of variance, and Pearson correlation analyses were performed.

Results: Adherence to acute chemotherapy-induced nausea and vomiting prophylaxis administered in the hospital setting was very high (98.5%), reflecting strong institutional compliance with antiemetic guidelines. Adherence to delayed prophylaxis was more variable, with 48.4% of patients demonstrating high adherence, 47.3% moderate adherence, and 4.3% low adherence. Educational level ($p = 0.03$) and mode of payment for healthcare ($p = 0.01$) were significantly associated with adherence to delayed prophylaxis. Overall, 61.4% of patients achieved complete control of chemotherapy-induced nausea and vomiting. Higher adherence levels were associated with lower incidence and intensity of delayed nausea and vomiting. A significant positive correlation was observed between adherence scores and overall quality of life ($r = 0.16$, $p = 0.03$). Patients with

high adherence reported higher mean quality-of-life scores compared with those with moderate or low adherence.

Conclusion: While acute chemotherapy-induced nausea and vomiting prophylaxis is effectively implemented within hospital settings, adherence to delayed prophylaxis remains variable and is influenced by educational and financial factors. Higher adherence is associated with improved symptom control and better quality of life. Pharmacy-led supportive care interventions, including targeted patient education, adherence monitoring, and financial counselling, are essential to strengthen integrated, people-centred and equitable cancer care and to optimize patient outcomes in resource-limited settings.

An evaluation of user experience and perceived educational impact of the QUESS 360 pharmacy solutions compounding learning management system

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Background: Continuous professional development is essential to support pharmacy professionals in maintaining compounding competencies aligned with evolving compounding practice requirements. QUESS 360 Pharmacy Solutions developed a learning management system (LMS) to deliver standardized, role-relevant compounding theoretical training. Evaluation of user experience and perceived educational impact is important to inform optimization and broader implementation of digital learning platforms in pharmacy practice. Objectives To evaluate user satisfaction, perceived relevance, usability, and self-reported learning outcomes associated with the QUESS 360 Pharmacy Solutions LMS.

Method: A post-training evaluation survey was administered to pharmacy professionals who completed compounding theoretical training modules through the QUESS 360 LMS. The survey used a 5-point Likert scale (Strongly Agree to Strongly Disagree) to assess content quality, relevance to professional roles, knowledge and skill development, interactivity, platform usability, and overall satisfaction. Descriptive statistics were used to summarize responses.

Results: A total of 1,099 respondents completed the evaluation. High levels of agreement (Agree or Strongly Agree) were reported across all domains: content met expectations (88.1%), relevance to professional role (89.4%), improvement in knowledge, skills, or abilities (87.4%), effectiveness of interactive learning elements (87.1%), ease of use and navigation of the LMS (88.0%), and overall satisfaction with theoretical training (87.7%). Neutral

responses accounted for approximately 9–10% of responses, while disagreement rates were consistently low (<2%).

Conclusion: The QUESS 360 Pharmacy Solutions LMS demonstrated strong user satisfaction, perceived relevance, and self-reported learning impact among pharmacy professionals. These findings support the LMS as an effective digital platform for standardized pharmacy education and workforce development.

Nationwide real-time monitoring of diabetes medication therapy adherence clinic (DMTAC): A data-driven approach to improve patient outcome in ministry of health facilities in Malaysia

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Background: The Diabetes Medication Therapy Adherence Clinic (DMTAC) is an ambulatory care service provided by the Ministry of Health (MOH) pharmacists to assist diabetic patients in achieving better glycaemic control and medication adherence. It offers personalized care, including counseling and education on medications, disease management, and lifestyle modifications.

Objective: The objective of this approach was to monitor DMTAC services in MOH facilities through a real-time data registry.

Method: A prospective data entry initiative has been conducted in MOH facilities, including hospitals and health clinics, since January 2023. The required data include demographic information, social status, HbA1c levels, and medication adherence monitoring. The data is analysed descriptively. The performance of HbA1c readings and adherence levels is compared at baseline (before recruitment) and post-completion (after completing four modules), and the results are visualized in real-time using bar charts and graphs on the Integrated Data Quality Use of Medicines (IDQUMC) website. Results and Conclusions: To date, approximately 13,014 patients have been monitored in real-time nationwide. Of these, 2,345 patients (83%) achieved a reduction in HbA1c levels, with a mean reduction ($\pm$ SD) of 2.2% ($\pm$ 1.8%). However, around 420 patients (14.9%) showed an increase, and 52 patients (1.9%) showed no change in HbA1c levels. These groups will be closely monitored and may require additional interventions. The remaining data is still being processed in the backend of the database and will be available once the pre- and post-HbA1c data is complete.

Results: To date, approximately 13,014 patients have been monitored in real-time nationwide. Of these, 2,345 patients (83%) achieved a reduction in HbA1c levels, with a mean reduction ($\pm$ SD) of 2.2% ($\pm$ 1.8%). However, around 420 patients (14.9%) showed an increase, and 52 patients (1.9%) showed no change in HbA1c levels. These groups will be closely monitored and may require additional interventions. The remaining data is still being processed in the backend of the database and will be available once the pre- and post-HbA1c data is complete.

Conclusion: The live data registry enhances awareness by enabling real-time monitoring of patient performance and serves as a comprehensive data pool for DMTAC services nationwide, which could help in strategizing and strengthening pharmaceutical services. More data could be included in the future to involve other clinical outcome monitoring, including the expansion to other pharmacist intervention monitoring programs.

Efficacy of statin therapy in patients with hyperlipidemia: A retrospective study

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Background: Hyperlipidemia is one of the most common and modifiable risk factors for atherosclerotic cardiovascular disease (ASCVD). Elevated low-density lipoprotein cholesterol (LDL-C) is considered a major contributor to the development of ASCVD. The aim of this research is to evaluate the clinical efficacy and safety of statin therapy in patients with hyperlipidemia.

Method: This retrospective study included patients who received statin therapy between January and December 2025 due to total cholesterol (CHOL), high-density lipoprotein cholesterol (HDL-C), or low-density lipoprotein cholesterol (LDL-C) levels exceeding treatment targets. Outcomes assessed included lipid profiles (CHOL, HDL-C, LDL-C, and triglycerides [TG]), liver function, and adverse drug reactions (ADR). Descriptive statistical analysis was used to evaluate patient characteristics, lipid changes, and the incidence of adverse events.

Results: A total of 64 patients were included, with a mean age of 60.88 years. Among them, 27 were male (42.19%) and 37 were female (57.81%). All patients had at least one chronic comorbidity. The most common condition was the coexistence of hypertension, hyperlipidemia, and diabetes mellitus ($n = 22$), followed by hyperlipidemia with hypertension ($n = 13$), hyperlipidemia with diabetes mellitus ($n = 11$), hyperlipidemia with hypertension and cardiovascular

disease ($n = 4$), and pure hypercholesterolemia ($n = 4$). The mean lipid profile values before and after treatment were as follows: total cholesterol decreased from 199.43 mg/dL to 179.42 mg/dL; HDL-C increased from 54.32 mg/dL to 55.34 mg/dL; LDL-C decreased from 105.39 mg/dL to 88.61mg/dL; and TG decreased from 182.31 mg/dL to 163.78 mg/dL. After six months of statin therapy, 75% of patients achieved the target LDL-C level. Regarding adverse events, one patient was observed to have an elevation in alanine aminotransferase (ALT).

Conclusion: Statin therapy effectively improved lipid profiles and helped patients with hyperlipidemia achieve LDL-C treatment targets, supporting its role as an essential strategy for ASCVD prevention. Although statins may cause adverse effects, these are generally mild and manageable, allowing most patients to use them safely. Poor medication adherence was identified as the primary reason for failure to achieve treatment goals, highlighting the importance of patient education and regular follow-up to ensure optimal therapeutic outcomes and medication safety.

Enhancing Medication Reconciliation in elective surgical patients: Increasing Capacity Without Additional Resources

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Background: Medication reconciliation (MedRec) is a critical safety process mandated by various agencies (ex.: Institute for Safe Medication Practices, Accreditation Canada, etc.) to identify and resolve medication discrepancies during transitions of care. At the Centre hospitalier de l'Universit   de Montr  al (CHUM), three equivalent full-time (EFT) Pharmacy Assistants (PAs) traditionally performed MedRec by telephone for elective surgical patients. This approach duplicated information already collected by preoperative clinic nurses.

Objective: To describes the structural reorganization, without additional human or financial resources, of the MedRec process for elective surgical patients within the pharmacy department and to assesses its organizational and clinical impacts.

Method: An iterative continuous improvement project was conducted from October 2024 to November 2025. The redesigned process relied on medication information in the Quebec Health Record (DSQ) that had been annotated by the nurse after the patient interview, thereby reducing duplication in patient interviewing. The project followed six phases: needs assessment, planning, stakeholder mobilisation, sector restructuring, process standardisation,

and monitoring/control. Ten strategic orientations were defined, including the implementation of telework, the creation of a dedicated MedRec sector with a designated team lead, paperless documentation (O-Word), and the use of productivity indicators. Data on MedRec completion (via Opera/BDM software) were compared before and after implementation.

Results: Eight of the 10 planned orientations have been fully successfully implemented. The mean number of MedRecs recorded in patient files increased significantly from 13.5 to 22 per day (+63%; $p < 0.0001$), representing approximately 2,000 additional MedRecs per year. Reported organizational and practice-related benefits included greater availability of up-to-date medication lists for postoperative prescribing, reduced workload for medical archives through paperless documentation, and reduced paper use.

Conclusion: A resource-neutral organizational redesign based on interprofessional collaboration and process standardization substantially increased MedRec capacity for elective surgery patients while maintaining stable resource levels. Next steps will focus on consolidating performance indicators and standardising technical validation to ensure the long-term sustainability and quality of pharmaceutical practices.

Canadian healthcare workers' exposure to hazardous drugs: A 15-year retrospective

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Background: The risk of healthcare workers being exposed to hazardous drugs has been known since the 1970s. Exposure typically occurs by touching drug-contaminated surfaces which can lead to reproductive toxicities and cancer in exposed workers. There are no acceptable occupational exposure limits and, therefore, it is important to keep exposure as low as reasonably practicable. In 2011, we conducted a pilot study to ascertain the likelihood of dermal (skin) exposure at local hospitals. We found that some healthcare workers had detectable levels of hazardous drug residue on their hands. Given the potential for exposure, it prompted us to undertake various research studies to better understand the exposure risk as well as identify or evaluate mitigation strategies to reduce the risk amongst Canadian healthcare workers. The purpose of this presentation is to provide an overview of the body of scholarly work surrounding Canadian healthcare workers' exposure to hazardous drugs over the past 15 years.

Method: Although this presentation discusses a series of cross-sectional studies, most are related to surface contamination. Collected surface wipe samples were

analyzed via high-performance liquid-chromatography tandem mass spectrometry using a validated method. Over the years, the method has been refined to allow for the simultaneous detection of multiple hazardous drugs from a wipe which provides a more accurate assessment of risk. Moreover, the sensitivity of the method was improved where the contamination levels are reported at the picogram level (previously nanograms). The improved sensitivity allows one to determine if surface contamination remains a concern despite the implementation of several control measures.

Results: In 2011, we found that different job categories are at risk of exposure to hazardous drugs since contamination was prevalent in multiple departments. Cleaning protocols examined in 2012 could result in higher contamination levels post-cleaning. In 2013, we determined that the highest contamination levels were in the pharmacy but there is no apparent association between contamination and the amount of drug handled. In 2014 and 2015, we confirmed that uptake of hazardous drugs is possible as detectable levels on the hands and urine of healthcare workers were found. Analytical methods were refined in 2015 and 2017 to improve the quantification of drug concentrations and, in 2020, a kit was assembled to facilitate the collection of surface wipe samples. We tested a qualitative screening tool in 2023 to assist with identifying surface contamination and, in 2025, we reported that engineering controls are effective in reducing contamination over time. More recently, we determined that surface contamination remains despite several control strategies being in place.

Conclusion: Hazardous drug contamination levels have demonstrated a reduction over time. Along with this, the percentage of non-detects has increased. This suggests that exposure control programs are working and the risk of occupation exposure is lessened. However, complete elimination of hazardous drug contamination does not seem possible. In fact, the maximum drug contamination levels found in our latest study suggest that some exceed the international technical standard of 100 pg/cm². Therefore, routine environmental monitoring is recommended to continually assess drug contamination levels.

Pharmaceutical feasibility of implementing vitamin D supplementation strategies from ICU trials into clinical practice

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Background:

Objective: This study aimed to evaluate the pharmaceutical feasibility of implementing vitamin D supplementation strategies derived from ICU clinical trials in routine critical

care practice. We hypothesized that trial-based high-dose regimens may present practical and medication-use challenges when applied using commonly available formulations.

Method: A structured, practice-oriented pharmaceutical analysis was conducted based on vitamin D supplementation regimens reported in major ICU RCTs. Trial dosing strategies were translated into real-world administration scenarios using commercially available, bottle-based drop vitamin D3 formulations used in hospital practice. Feasibility was assessed from a hospital pharmacy perspective, focusing on dose translation, ICU medication administration workflow, packaging design, and potential medication-use risks. No patient-level data, clinical interventions, or outcome measurements were involved.

Results: High-dose vitamin D regimens reported in ICU trials frequently required complex dose conversions and prolonged administration when applied to drop-based formulations. Although certain products allowed direct access by removing the bottle cap, packaging design alone did not sufficiently reduce workflow burden or dosing variability. Key challenges identified included dose conversion complexity, inter-operator variability, and integration into existing ICU medication-use processes.

Conclusion: Effective implementation of vitamin D supplementation in ICU settings requires consideration of pharmaceutical feasibility in addition to clinical efficacy. This practice-oriented evaluation highlights medication-use challenges associated with drop-based dosing and underscores the essential role of pharmacists in developing standardized protocols to support safe translation of trial-based regimens into critical care practice. Future research should integrate feasibility assessments into the design of nutritional and pharmacological interventions for critically ill patients.

Stability evaluation of traditional Chinese medicine decoction bags under refrigerated storage: A hospital-based study

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Background: Traditional Chinese medicine (TCM) herbal decoction bags are widely prepared and dispensed in hospital pharmacy settings in Taiwan to support individualized and integrative therapeutic regimens. Unlike conventional TCM

dosage forms such as pills, powders, and tablets, whose stability requirements are clearly defined in regulatory frameworks, there are currently no specific stability guidelines for decoction bags prepared on-site within healthcare institutions. Given the aqueous nature of decoctions and their susceptibility to physicochemical degradation and microbial contamination, systematic stability evaluation is essential to ensure product safety, quality consistency, and therapeutic reliability. Establishing scientific evidence to support appropriate storage duration is therefore a critical component of hospital-based pharmaceutical quality assurance.

Objective: This study aims to evaluate the physicochemical and microbiological stability of three commonly prescribed TCM decoction bags (Anti-Allergy Tea, Heat-Relief Vitality Drink, and Ginseng Ophiopogon Drink) under refrigerated storage conditions and to propose evidence-based storage period recommendations for clinical use.

Method: Three independent batches of each decoction were prepared by the Department of Pharmacy of a regional teaching hospital in accordance with standardized compounding procedures. Finished products were packaged in sterile decoction bags and stored at 4°C ± 2°C. Stability testing was conducted at predefined intervals: 0, 7, 14, 30, 60, and 90 days. Physical evaluation included organoleptic assessment (color, clarity, and odor) and visual inspection for precipitation or turbidity. Chemical stability was assessed through pH measurement and quantitative analysis of selected representative marker compounds using validated high-performance liquid chromatography (HPLC) methods. Chromatographic conditions were optimized to ensure specificity, precision, and reproducibility. Microbiological quality was evaluated by total aerobic microbial count and specific pathogen testing, including *Escherichia coli* and *Salmonella* spp., in accordance with pharmacopeial standards. All quantitative data were expressed as mean ± standard deviation. Statistical analysis was performed using one-way analysis of variance (ANOVA) to determine whether significant changes occurred over the storage period. A significance level of $p < 0.05$ was applied.

Results: The study generated comprehensive stability profiles for the three decoction formulations under refrigerated conditions. Data described temporal trends in organoleptic properties, pH variation, marker compound retention, and microbiological safety. Statistical analysis identified critical time points at which significant degradation or microbial risk may emerge.

Conclusion: This hospital-based stability study provides structured scientific evidence to support quality management of TCM decoction bags prepared in healthcare institutions. The findings will facilitate the establishment of standardized storage recommendations and operational procedures, strengthen pharmaceutical quality assurance systems, and enhance patient safety. Furthermore, the generated dataset will contribute to the advancement of evidence-based TCM

pharmaceutical practice and provide a foundation for academic dissemination and future regulatory development.

Implementation of smart infusion pumps equipped with Dose Error Reduction Software (DERS) or enhanced medication safety and quality of care

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Background: Infusion related medication errors, especially with gravity-fed infusion devices, pose risks such as accidental free flow, inconsistent delivery rates, and dosing inaccuracies. These devices can cause significant patient harm, often resulting in adverse drug events. Smart infusion pumps are portable electronic devices that deliver medications at controlled rates and address these issues. Smart infusion pumps equipped with Dose Error Reduction Software (DERS) are designed to minimize these risks by utilizing drug libraries and predefined dosing limits to prevent dosing, infusion rate, and drug selection errors. While smart pumps have been introduced in various wards at Shifa International Hospital, the full potential of this technology has not been realized due to limited DERS usage. The objective of this study was to implement a DERS drug library on existing smart pumps to enhance medication safety and the overall quality of care.

Objective: To reduce medication errors and improve patient safety through the development and implementation of a comprehensive DERS drug library in smart infusion pumps at a tertiary care hospital.

Method: A DERS drug library was developed with over 25 commonly used medications, including inotropes, vasopressors, sedatives, and analgesics. The drug library was uploaded in MICU and SICU wards. Nursing staff were trained on the correct utilization of smart pumps. DERS compliance data was collected for three months (June to August). Concentration adherence and errors like wrong patient, wrong line, and wrong rate were monitored. Ongoing compliance was tracked, and results were shared with nursing staff to address variations.

Results: DERS compliance improved progressively over the study period, starting at 41% in June, rising slightly to 44% in July, and significantly increasing to 75% in August following additional staff training. Concentration adherence also saw improvement, with compliance rising from 58% in June to 90% by August, indicating better alignment with the standard concentrations set in the drug library. Other parameters, including error rates related to wrong patient, wrong line, and wrong rate, remained consistent throughout the study.

Conclusion: The pilot implementation of DERS in smart infusion pumps shows significant improvements in compliance and medication safety. Continued training and monitoring will further optimize the use of this technology. Future plans include hospital-wide expansion of DERS, EHR integration, and ongoing compliance monitoring to sustain improvements in patient care.

Comparative global point prevalence survey of antimicrobial consumption in a tertiary hospital in Ghana, West Africa

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Background: The Global Point Prevalence Survey (Global-PPS) of Antimicrobial Consumption and Resistance is a free web-based tool which also compares quantity and quality antimicrobial prescribing and resistance in patients across the globe. The Global-PPS creates global awareness about antibiotic use and resistance and is instrumental in planning and supporting national and local stewardship interventions in a range of resource and geographical settings. The Korle Bu Teaching Hospital (KBTH) is the largest referral tertiary hospital in Ghana. It is also the third largest hospital in Africa and the largest referral facility in West Africa. The hospital has 17 clinical and diagnostic departments. These include Internal Medicine, Child Health, Obstetrics and Gynaecology, Surgery, Family Medicine, Orthopedic /Trauma centre Centre and the Accident & Emergency. Other Directorates include Pharmacy, Finance, General Services, Human Resource, Medical Affairs, Nursing and Administration. The hospital has actively had some Global Point prevalence surveys since 2019 in all departments, with over 2000 bed capacity. The 2019 Global-PPS involved data across all departments in the hospital. This was repeated in the 2025 Global-PPS to compare the antimicrobial consumption pattern and the quality indicators for antibiotic use.

Method: This was a retrospective study comparing the data collected among 988 study participants at KBTH during the 2019 Global PPS and 838 participants during the 2025 Global PPS. The 2019 survey was in May while that of 2025 was in June. Medical records of all patients on admission at 0800 hours on the survey days were reviewed for antimicrobial consumption. Data on antimicrobial use, diagnosis and presence of quality indicators were recorded. Administrative approval was obtained from all the departments.

Results: The percentage of patients on at least one antimicrobial was 53.3% (527/988) in 2019 and 52.3%

(438/838) in 2025. Pneumonia was the most common infection for which antimicrobial was prescribed in both years. Amoxicillin with beta-lactam inhibitor was the most prescribed antimicrobial in 2019 while the third generation cephalosporins were the most prescribed in 2025. There has been a decrease in healthcare-associated infections from 26.6% in 2019 to 22.7% in 2025, with empiric antibiotic prescribing increasing from 91.9% in 2019 to 93.6% in 2025. Guideline compliant was the highest quality indicator in the ICU and Surgical wards in 2019 and 2025 respectively

Conclusion: The results from these comparative surveys emphasize the need for regular antimicrobial stewardship activities across all Departments to monitor antimicrobial use in the hospital. This can be achieved by forming Antimicrobial Stewardship Committees or Teams in the hospital.

Evaluation of rational drug use based on WHO/INRUD core drug use indicators in a tertiary hospital in Ghana: A cross sectional study

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Background: Rational Drug Use promotes safe, efficient and cost-effective utilization of medication which aims to achieve definite therapeutic outcomes. The World Health Organization (WHO) and International Network for Rational Use of Drugs (INRUD) Core Drug Use Indicators are measures used to evaluate irrational drug use practices in health facilities. The WHO Core Drug Use indicators are categorized into prescribing, patient care and health facility indicators. However rational drug use in Ghana faces some challenges including polypharmacy, high antibiotics and injections use. There is therefore the need to assess an improvement or otherwise of rational prescribing in line with the required WHO Indicators.

Objective: To evaluate the Rational Drug Use based on the WHO/INRUD Core Drug Use indicators

Method: A cross-sectional study was conducted on patients aged 18 and above, who received medication at the Internal Medicine Department of the Korle Bu Teaching Hospital from November 2025 to January 2026. The Korle Bu Teaching Hospital is the largest referral health facility in Ghana with 17 clinical and diagnostic departments including the Department of Internal Medicine. The Department of Internal Medicine is one of the largest departments with nine specialties including cardiology, gastroenterology, endocrinology,

neurology, respiratory, rheumatology, nephrology, infectious diseases and dermatology. A total of 2,382 prescriptions were collected from eligible patients and evaluated using the WHO/INRUD core drug indicators (prescribing, patient care and health-facility indicators). Data was reviewed and entered into excel for descriptive analysis.

Results: The study findings revealed that the average number of drugs prescribed per encounter was 4.0 which is higher than the WHO reference range (1.6-1.8). The percentage of drugs prescribed by generic names (95%) and Essential Medicine list (94%) were close to WHO reference (100%). The percentage of antibiotics (18.6%) and injections (49%) per encounter exceeded the WHO standards (antibiotics 20.0-26.8) and injections (13.4-24.1) respectively. Among the patient care indicators, the average consultation time (15mins; reference ≥ 10 mins) and the average dispensing time (420 seconds; reference ≥ 180 seconds) met WHO references. However the percentage of medicines dispensed (65%) and percentage of patients with dosage knowledge (79%) did not meet the WHO reference values (100%). Facility indicators such as key medicines in stock (95%) and presence of a formulary or Essential medicine conformed to the WHO optimal value of 100%.

Conclusion: The research concludes that some of the WHO/INRUD prescribing (percentage of injections) and patient care indicators (percentage of medicines dispensed and dosage knowledge) deviated from the optimal values in a teaching hospital in Ghana. There is the need for organization of continuous professional development programs on rational prescribing for physicians and pharmacists to avoid polypharmacy; overprescribing of injections and improve patient counselling respectively.

Clinical experience with Tirofiban as adjunctive antiplatelet therapy in acute ischaemic stroke: A single-centre retrospective study

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Background: Tirofiban is a reversible intravenous glycoprotein IIb/IIIa receptor antagonist that rapidly inhibits platelet aggregation, with recovery of platelet function within several hours after discontinuation. Although primarily approved for acute coronary syndromes, tirofiban has increasingly been used off-label in the management of acute ischaemic stroke (AIS), particularly following intravenous thrombolysis and/or endovascular thrombectomy (EVT). In clinical practice, tirofiban may be considered when residual thrombus, significant intracranial arterial stenosis, re-occlusion, or neurological deterioration is observed after reperfusion therapy. However, evidence regarding its safety,

efficacy, and optimal timing remains inconsistent, especially in patients with intracranial atherosclerotic disease, which is common in Asian populations. This study reports real-world clinical experience with tirofiban use in patients with AIS at a tertiary medical centre.

Method: This single-centre retrospective study included patients with AIS who received tirofiban between May 2024 and May 2025. Tirofiban was administered as an intravenous bolus of 10 µg/kg, or intra-arterially at 5–10 µg/kg during EVT, followed by continuous intravenous infusion at approximately 0.1 µg/kg/min for 24 hours. Data collected included patient demographics, indications for tirofiban use, National Institutes of Health Stroke Scale (NIHSS) and Glasgow Coma Scale (GCS) scores before and after treatment, occurrence of intracranial haemorrhage or major bleeding, in-hospital mortality, and functional outcome at discharge assessed using the modified Rankin Scale (mRS). Stroke aetiology was classified according to the TOAST criteria.

Results: Twelve patients were included, with a mean age of 64 years; 58% were male. Most patients had multiple cardiovascular risk factors. Indications for tirofiban use included neurological deterioration despite dual antiplatelet therapy without prior intravenous thrombolysis or EVT (17%), deterioration after EVT (8%), and significant residual stenosis or thrombus identified during EVT (75%). Seven patients had complete pre- and post-treatment NIHSS data, all of whom demonstrated neurological improvement, with a mean NIHSS reduction of 6.8 points. No cases of symptomatic intracranial haemorrhage or other major bleeding events were observed, and all patients survived to hospital discharge. At discharge, 33% of patients achieved favourable functional outcomes (mRS ≤2), while 50% had poor outcomes (mRS ≥4). Large-artery atherosclerosis was the predominant stroke subtype.

Conclusion: In this real-world single-centre experience, tirofiban used as adjunctive antiplatelet therapy in selected patients with AIS, particularly those with residual thrombus or suboptimal reperfusion following EVT, was associated with short-term neurological improvement and a favourable safety profile. No significant haemorrhagic complications were observed using dosing regimens consistent with published studies. Given the small sample size and heterogeneity of patient characteristics, larger multicentre prospective randomised trials are required to further clarify the clinical efficacy, optimal timing, and patient selection for tirofiban in the acute management of ischaemic stroke.

Utility of regular D-dimer measurement in patients receiving VEGF inhibitors

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Background: Vascular endothelial growth factor (VEGF) inhibitors are associated with serious adverse events including thromboembolism. D-dimer is widely used as a biomarker for diagnosing thromboembolic events. Although its utility is well-documented in patients receiving bevacizumab, evidence regarding other VEGF inhibitors, such as ramucirumab, remains limited, and no consensus exists on optimal monitoring frequency. In December 2023, Fukuoka Tokushukai Hospital implemented routine D-dimer monitoring following the administration of VEGF inhibitors. This study evaluated the impact of this routine monitoring protocol on early detection and management of thromboembolic events.

Method: We retrospectively reviewed the medical records of cancer patients who received VEGF inhibitors at our hospital. Patients were divided into a pre-implementation group (December 2022 to November 2023) and a post-implementation group (December 2023 to November 2024) based on the introduction of routine D-dimer testing. We assessed chemotherapy regimens, D-dimer measurement rates and values, and the incidence of adverse events, with particular focus on thromboembolic events. Adverse events were graded using the Common Terminology Criteria for Adverse Events (CTCAE) version 5.0. Statistical comparisons were performed using the Chi-square tests.

Results: The analysis included 437 administrations in the pre-implementation group (bevacizumab, 356; ramucirumab, 81) and 469 in the post-implementation group (bevacizumab, 373; ramucirumab, 96). The D-dimer measurement rate increased significantly from 5.5% (24/437) to 74.0% (347/469) after implementation ($p < 0.01$). In the post-implementation group, D-dimer levels were ≥0.5 µg/mL in 79.3% (275/347) and ≥1.0 µg/mL in 59.7% (207/347) of the measured cases. Among the 47 patients with D-dimer levels ≥1.0 µg/mL, additional imaging studies were performed in 10 patients (21.3%), a cardiology review was requested in 2 patients (4.3%), and postponement or discontinuation of VEGF inhibitors occurred in 3 patients (6.4%). The incidence of thromboembolism in the post-implementation group was 6.6% (4/61 patients), with all affected patients exhibiting markedly elevated D-dimer levels at the onset.

Conclusion: The introduction of routine D-dimer measurements markedly increased testing rates from 5.5% to 74.0% potentially enabling the earlier detection and

management of thromboembolism in patients receiving VEGF inhibitors. D-dimer levels exceeding 1.0 µg/mL prompted additional diagnostic evaluation and treatment modification, suggesting this threshold may have clinical utility for risk assessment. Further studies are needed to determine optimal D-dimer cut-off values and identify predictive factors for thromboembolism to establish safer and more efficient treatment protocols.

Impact of an inhaler-to-nebuliser therapeutic interchange on pharmacy operations and medication administration in hospitalised patients

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Background: Inhaled therapies are commonly prescribed in the inpatient setting; however, the use of metered-dose and dry-powder inhalers presents unique operational challenges. Inhalers are frequently patient-specific, easily misplaced during transfers of care, and not routinely stocked in automated dispensing cabinets, resulting in delays in medication availability. These factors contribute to increased pharmacy workload, higher pharmaceutical waste, and medication administration delays, which may negatively impact patient safety and quality of care. Additionally, single-patient inhalers are often discarded at discharge despite limited utilisation, further increasing waste. Therapeutic interchange from inhalers to nebulised formulations has been explored primarily as a cost-containment strategy or as a means to reduce respiratory therapy workload; however, limited data exist evaluating the downstream impact on pharmacy operations and medication administration outcomes. Understanding the effect of formulary decisions on medication availability, pharmacy workload, and administration timeliness is critical to optimising inpatient medication-use processes. This study aimed to evaluate the implementation of an inhaler-to-nebuliser therapeutic interchange and describe its impact on pharmacy operational workload, pharmaceutical waste, and medication administration trends.

Method: This was a retrospective, before-and-after study designed to evaluate the impact of an inhaler to nebulizer formulary conversion. The study was conducted at 3 hospitals within the Brown University Health System in Providence, Rhode Island. The pre-implementation period occurred from March to May 2025, and outcomes were compared with a post-implementation period from September to November 2025, allowing time for workflow stabilisation following formulary conversion. Data was collected retrospectively using PowerBI. Primary outcomes included frequency of medication administration record (MAR) non-administration events attributed to “medication not available” and the

average daily number of pharmacy medication messages requesting re-dispensing of inhaled therapies. Secondary outcomes included estimates of pharmaceutical waste related to inhaler utilisation. Outcomes were summarised using descriptive statistics.

Results: Following formulary conversion, MAR non-administration events documented as “not given” due to “medication not available” decreased by 81% (from 667 to 124 events). Average daily medication messages requesting re-dispensing of included inhaled products decreased by 84% (from an average of 19 per day to 3 per day), reflecting a substantial reduction in pharmacy operational workload. Prior to implementation, 91% of dispensed inhaler doses were wasted on average due to partial utilisation and discharge-related disposal; this waste was eliminated following removal of inhalers from the formulary. Nebulised medications were routinely stocked in automated dispensing cabinets, improving medication accessibility at the point of care.

Conclusion: An inhaler-to-nebuliser therapeutic interchange resulted in meaningful improvements in inpatient medication-use processes, including reductions in pharmacy re-dispensing requests, electronic medical record medication messages, and medication non-administration events due to unavailability. Elimination of inhaler-related waste and improved point-of-care access to nebulised therapies contributed to operational efficiency and more reliable medication administration. While this study was limited by its descriptive design and lack of patient-level clinical outcomes, findings support formulary standardisation as an effective strategy to optimise pharmacy operations and enhance patient care.

Empowerment, mentorship and health promotion through world pharmacist day celebration

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Background: World Pharmacists Day is marked on 25th September each year to celebrate the dynamic roles of pharmacists in enhancing healthcare delivery. The 2025 celebration at the University of Ghana Medical Centre (UGMC) aimed to promote professional empowerment, student mentorship, interdisciplinary collaboration and community health outreach. KEY ACTIVITIES PROFESSIONAL EMPOWERMENT: A field trip to a pharmaceutical industry was organized to provide 28 pharmacy staff with experiential

learning in pharmaceutical production and quality systems. The initiative aimed at bridging the gap between clinical pharmacy practice and pharmaceutical manufacturing operations. Participants gained insight into Good Manufacturing Practices (GMP), physicochemical and microbiological analysis, skilled workforce, production capacity planning, utility systems and documentation frameworks. The visit enhanced staff competence, strengthened teamwork, intersectoral collaboration and created opportunities for networking, training and professional development.

Mentorship and Capacity: Building: In collaboration with the Medical Training and Simulation Directorate, 60 pharmacy students were trained in basic life support skills, including airway clearance and cardiopulmonary resuscitation. Four pharmacists with professional expertise in technology, community, academia and hospital pharmacy practice were invited to share their experiences with 350 pharmacy students during mentorship programmes. The speakers highlighted the need for students to utilize training, networking, leadership, volunteerism, entrepreneurial skills and business acumen to carve successful career niches. Facilitators expatiated on utilizing personality, values, experience, opportunities, challenges, technology and research to propel career advancement.

Community Health Outreach: Two health screening programmes involving 301 individuals across corporate and religious groups (n=140, 46.5% and n=161, 53.5% respectively) were undertaken. These programmes aimed at patient education on chronic diseases (cerebrovascular accident and chronic kidney disease), early disease detection, prevention and appropriate referrals. The programmes provided free medical assessments, risk evaluation and pharmacist-led education and counselling, supported by a multidisciplinary team. Medical tests such as blood pressure and glucose measurement, lipid profiles, kidney and liver function tests, hepatitis B screening, eye, breast and prostate examinations were undertaken. Pharmacist-designed risk assessment evaluation of lifestyle factors revealed that physical inactivity, high intake of saturated foods, obesity, and high blood pressure were common among participants. Individualized counselling followed risk assessment for all attendees. More than half of the participants (n=218, 72%) were referred for further medical care due to deranged vital signs, physical and laboratory tests. Elevated blood pressure (BP) was recorded in 80 participants (26%) out of which 46% of them (n=37/80) had BP $\geq 160/100$ mmHg and 45% (n=36/80) had no prior medical history of hypertension. This emphasized the need for further confirmatory tests and prompt management. After sampling 113 participants to evaluate the programmes, majority found the screening to be very beneficial (n=107, 93.8%) and anticipate a strong influence on their health choices (n=100, 88.5%). The positive feedback supports institutionalization of periodic pharmacist-led screening programmes as part of UGMC's preventive health strategy.

Conclusion: The 2025 World Pharmacists Day celebration demonstrated the expanding role of pharmacists in professional development, student mentorship and preventive healthcare delivery. Pharmacist-led community screening facilitated early detection of non-communicable diseases and reinforced the strategic contribution of pharmacy practice to health promotion in Ghana.

Assessment of compliance with aidet communication framework utilization by pharmacists during discharge counselling

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Background: Health communication models guide the development of effective strategies to improve health behaviours and outcomes. The AIDET (Acknowledge, Introduce, Duration, Explain, Thank you) framework has been adopted at the University of Ghana Medical Centre (UGMC) to enhance patient-provider communication, build trust, and improve understanding of clinical conditions and treatment plans. Pharmacists at UGMC are trained to apply AIDET during service delivery; however, data on compliance with the framework during discharge counselling remain limited.

Objective: This research aimed at assessing compliance with utilization of AIDET communication framework by pharmacists during discharge counselling

Method: A stratified sampling approach was used to recruit 260 participants from the Internal Medicine and Neurosurgery wards of UGMC between 1st June and 30th September 2022. Independent investigators collected participant biodata and counselling duration from electronic medical records using a structured tool. A disguised observational approach was employed to assess pharmacists' compliance with the AIDET framework by recording the use of its five components. Each component was scored, and a cumulative AIDET score was computed. Patients were subsequently interviewed to assess satisfaction with discharge counselling. Data were analysed using SPSS version 27. Continuous variables were summarized using means $\pm$ standard deviation or medians (interquartile range) and compared using appropriate parametric or non-parametric tests. Categorical variables were analysed using the χ^2 test, with statistical significance set at $p < 0.05$. Ethical approval and informed consent procedures were adhered to.

Results: A total of 260 participants were included in the study. The majority were female (n = 107, 56.5%). The mean age of participants was 55.47 ± 1.20 years (range: 16–96 years), with

most participants ($n = 125$, 65.8%) aged between 40 and 79 years. More than half of the participants were employed ($n = 113$, 59.6%) and married ($n = 102$, 54.2%). Evaluation of AIDET indicators during discharge counselling showed 100% compliance among pharmacists. Four of the five indicators were consistently applied: appreciation of the client ($n=258$, 99.2%), stating the purpose of interaction ($n=259$, 99.6%), self-introduction of the pharmacist ($n=248$, 95.4%), and acknowledging the patient ($n=260$, 100%). However, duration of counselling was addressed in only 0.4% ($n=10$) of sessions. No significant association was observed between patient age and overall AIDET scores ($t_b = 0.021$, $p = 0.684$). Comparing pharmacists' AIDET scores with patients' likelihood of recommending discharge counselling ($N = 260$) using the Mann–Whitney U test showed a significant difference ($U = 1352.500$, $p < 0.001$). However, comparison across patient genders revealed no significant difference in AIDET scores ($U = 8341.000$, $p = 0.887$). A Kruskal–Wallis test indicated a significant difference in AIDET scores across age groups ($\chi^2 = 16.812$, $p = 0.032$). Post-hoc analysis with Bonferroni correction showed that scores differed significantly between patients aged 20–29 and 30–39 ($p = 0.045$).

Conclusion: Pharmacists achieved high compliance with AIDET communication framework use with four (Acknowledgement, Introduction, Explain and Thank you) out of five components mostly expressed. High AIDET score results in patients' recommending discharge counselling service.

Evaluating patient satisfaction following pharmacist-led discharge counselling at a tertiary hospital in Ghana

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Background: Medication counselling by pharmacists empowers patients with requisite knowledge on medicines, enhances medication adherence, reduces medication errors and readmissions. Client satisfaction with pharmaceutical services often results in enhanced customer loyalty, patient retention, productivity and profitability, increase staff morale and decreased lawsuits.

Objective: This research aimed to assess components of counselling and patient satisfaction with discharge counselling services offered by pharmacists at University of Ghana Medical Centre, Accra (UGMC).

Method: This was a cross-sectional study on 260 patients sampled from medical ward at UGMC from 1st June to 30th September 2022. Data collated with structured questionnaire included biodata, employment and insurance status. Independent researchers observed, recorded and transcribed discharge counselling of patients by pharmacists. Components of counselling (dosage regimen, medication storage, etc.) were documented using a structured data collection tool with follow-up telephone interviews done to ascertain patient satisfaction with counselling. Each positive response to a counselling indicator was given a single score to generate a cumulative patient satisfaction score. Informed consent was required from pharmacists (5 in all) and patients. Ethical approval from UGMC Institutional Review Board, and inform. Data were analyzed with Statistical Package for Social Science (SPSS-18M 27) software.

Results: Most patients were females ($n=107$, 56.5%). More than half of participants were married ($n=103$, 54.2%) or employed ($n=113$, 59.6%). About 94.6% of participants were medically uninsured ($n=180$). Mean number of discharge medicines was 5.34 ± 1.43 medicines. Patients spent an average of 6.23 ± 0.301 days on admission. Pharmacists used 7.0782 ± 0.22835 minutes on average to counsel patients. Patient satisfaction score yielded a mean score of 5.6654 ± 0.04076 out of 6 (over 90% satisfaction rate per indicator). Significant association was observed between overall satisfaction level and pharmacist's use of appropriate language ($p = 0.024$, OR = 6.75, 95% CI = (1.60, 28.48)), provision of adequate information ($p < 0.001$, OR = 18.56, 95% CI = (5.075, 67.871)) and recommendation of medication counselling ($p < 0.001$, OR = 295.2, 95% CI = (29.754, 2928.790)). There was no significant association between the overall satisfaction level and appropriateness of environment ($p = 0.535$), response to queries ($p = 0.421$) and counselling time ($p = 1.000$). Pharmacists mostly counselled participants on posology and follow up appointments (100% communication rate) but rarely provided information regarding storage conditions ($n=12$, 6.5%), guidance for missed doses ($n=0$, 0%) and implications of nonadherence ($n=1$, 0.5%). Although 51.9% of participants ($n=99$) received high-risk medicines, only 28.3% ($n=28/99$) received adequate counselling on these medicines.

Conclusion: Patient satisfaction rate across all selected indicators was high. However, pharmacists counselled patients mostly on posology and follow up appointments but rarely on high-risk medication counselling, storage conditions and guidance for missed doses. Adequate training of pharmacists is thereby required to improve counselling on medication storage, medication adherence and use of high-risk medicines by patients. In addition, pharmacists who used appropriate language and provided adequate information significantly influenced patients' satisfaction with counselling service and these satisfied patients ultimately recommended counselling service to others.

Drug information queries in a Ghanaian tertiary hospital: Mapping sources and identifying barriers

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Background: Drug information services are crucial for promoting rational medicine use, preventing medication errors and ensuring positive health outcomes. Complexity of current pharmacotherapy, characterized by continuous inclusion of new medicines, sophisticated dosage regimens, and growing recognition of medication-related problems require continuous availability of accurate, evidence-based and timely drug information services within clinical settings. Provision of drug information services by pharmacists guarantee patient safety through optimization of therapy, reducing adverse reactions and medication related problems.

Objective: The study sought to assess types, sources, facilitators and barriers of information queries at University of Ghana Medical Centre (UGMC).

Method: This was a prospective, descriptive study conducted from 1st October to 31st December 2025 at the Internal Medicine Pharmacy of UGMC. All medication-related queries received during this period were documented using a structured data collection tool. Collected data included the profession of the enquirer, mode of query receipt, type of query, therapeutic class of medication, and time required to provide responses. Additionally, resources utilized by pharmacists, query difficulty level, and barriers and facilitators to handling medication queries were recorded. Data were analyzed using Statistical Package for Social Science (SPSS-IBM 27) software. Ethical approval was obtained from the UGMC Institutional Review Board prior to commencement of the study.

Results: Altogether, 190 medication-related queries were received, mostly from physicians (n=110, 58%) and nurses (n=76, 40%). The average time spent responding to queries was 7 ± 13.43 minutes (range 1–90 minutes). Queries primarily concerned reconstitution and administration of medicines (n=146, 77%), dose or dosage regimen (n=55, 29%), medication availability (n=30, 16%), medication selection (n=19, 10%), and pharmacology (n=11, 6%). Antimicrobial agents (n=55, 29%) and inotropes (n=13, 7%) were the most frequently queried therapeutic classes. Most queries were received in person (n=113, 70%) or via phone (n=51, 27%) and were predominantly for patient care (n=184, 97%). Pharmacists used the internet (n=59, 31%), Micromedex/Medscape (n=53, 28%), British National Formulary (n=17, 9%), and product-specific literature (n=10, 5%) to answer queries. Queries were generally rated as easy (n=156, 82%), with delivery facilitated by credible sources

(n=96, 50%), reliable internet (n=96, 50%), ease of access to resources (n=86, 45%), and peer support (n=29, 15%). Most pharmacists reported no barriers (n=161, 85%), though increased workload (n=10, 5%) and inconsistencies between information sources (n=13, 7%) were reported to impede drug information delivery.

Conclusion: Drug information services by pharmacists are readily accessible and highly utilized by physicians and nurses, primarily for patient care. The findings of this study provide a clear profile of drug information needs at UGMC. The results will inform training of healthcare providers in relation to medication reconstitution and administration as well as to improve easy accessibility to essential medication resources.

Assessment of surgical antimicrobial prophylaxis prescribing using WHO AWaRe Classification: A longitudinal point prevalence survey in a Ghanaian tertiary hospital.

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Background: Antimicrobial resistance (AMR) is a growing global health threat and is associated with adverse medical, social and economic consequences. Surgical site infections are a prevalent cause of nosocomial infections, and antimicrobial stewardship programs (ASP) play a critical role in optimizing antimicrobial therapy. Point prevalence studies (PPSs) have been established as a convenient, low-cost and valid method for monitoring the antibiotic use in clinical settings.

Objective: This study sought to assess the antibiotic prescribing pattern for surgical prophylaxis surgery using the WHO Access, Watch, and Reserve (AWaRe) classification.

Method: Three-point prevalence surveys were conducted in 2021, 2023, and 2024 using the World Health Organisation's Global point prevalence survey tool. Medical records of all in-patients on admission at 0800 hours on a specific day were reviewed for antimicrobial use. Data on antibiotics prescribed for surgical prophylaxis were gathered and examined according to the WHO 'AWaRe' categories and documented using a web-based data collection tool on the Global Point Prevalence Survey platform. Data were exported and analyzed using Excel 2026 and compared using descriptive statistics.

Results: A total of 101 surgical patients were assessed and they demonstrated a persistently high prevalence of

antimicrobial prescribing for surgical prophylaxis, which declined over time from 78.6% [n=11/14] in 2021 to 56.6% [n=30/53] in 2024. Single-day prophylaxis proportions increased from 16.7% (n=1/6) in 2021 to 53.9% (n=7/13) in 2023. Prolonged prophylaxis (>1 day) increased markedly in 2024 to 89.7% (n=26/29) from 83.3% (n=5/6) in 2021. Ceftriaxone was the most frequently prescribed antimicrobial, accounting for 36.4% (n=12/33) of prescriptions. Analysis using the WHO AWaRe classification showed a sustained increase in antibiotic use from the Watch category, rising from 40.0% (n=2/5) in 2021 to 77.8% (n=7/9) in 2023 and remaining high in 2024 (63.2%, n=12/19) largely due to the use of ceftriaxone and cefuroxime. In contrast, Access antibiotic utilization declined from 60.0% (n=3/5) in 2021 to 22.2% (n=2/9) in 2023, with only partial increment observed in 2024 (36.8%, n=7/19). Assessment of prescribing quality indicators showed improved documentation of indication, increasing from 66.7% (n=6/9) in 2023 to 100% (n=19/19) in 2024, while documentation of stop or review dates declined from 80.0% (n=4/5) in 2021 to 44.4% (n=4/9) in 2023, with partial improvement in 2024 (68.4%, n=13/19). Guideline compliance remained consistently high (>85%) across all survey years.

Conclusion: Despite significant improvement in prescribing quality indicators, the longitudinal analysis shows persistent challenges in surgical antimicrobial prophylaxis (SAP) at UGMC, characterized by inappropriate prolongation of therapy, and a substantial shift toward Watch category antibiotics, particularly ceftriaxone. While documentation of prescription rationale improved, declining documentation of stop/review dates highlights a gap in antimicrobial stewardship practices. This finding presents an urgent need for targeted interventions, including adherence to the shortest effective duration and promotion of the use of Access category antibiotics to align SAP practices with WHO AWaRe recommendations and mitigate antimicrobial resistance.

Enhancing hospital pharmacy practices to improve medicine availability and patient care at a Ghanaian teaching hospital

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Background: Timely and efficient pharmacy operations are critical for continuous medicine availability and quality patient care. In Ghana, public procurement often faces delays, bureaucracy, and stock-outs, highlighting the need for systems that enable rapid and responsive medicine supply. This study explores pharmacy staff perceptions of systems supporting medicine availability and their influence on patient care at the University of Ghana Medical Centre (UGMC).

Objective: To assess pharmacy staff perceptions of systems supporting medicine availability and their impact on patient care.

Method: A mixed-methods approach was used to evaluate pharmacy staff perspectives on medicine supply systems and patient care outcomes at UGMC. All staff involved in medicine supply and pharmacy operations were invited using census sampling. Data were collected via a pretested questionnaire capturing demographics, perceived benefits, and challenges of pharmacy practices, using Likert scales, multiple-choice, and open-ended questions. Quantitative data were analysed in SPSS v27 and presented as frequencies, percentages, and means, while open-ended responses underwent thematic analysis. Ethical approval was obtained, and informed consent secured.

Results: Thirty respondents participated, predominantly aged 25–34 years (n=19, 63.3%), with equal representation of males and females. Most were from the Pharmacy Directorate (n=26, 86.7%), with a few from Operations (n=2, 6.7%) and Audit, Procurement, and Human Resource Directorates (n=1 each, 3.3%). Health sector experience ranged from 4–6 years (n=13, 43.3%) to over 10 years (n=8, 26.7%), while UGMC tenure ranged from 1–3 years (n=12, 40%) to 4–6 years (n=16, 53.3%). Most held a first-degree qualification (n=19, 63.3%). Staff were actively engaged in pharmacy operations, including receiving medicine requests (n=22, 73.3%), vendor communications (n=26, 86.7%), documentation (n=25, 83.3%), processing medicines into HealthPro (n=24, 80%), and billing patients (n=23, 76.7%). Regarding perceptions of the current medicine supply systems, respondents indicated these reduce delays due to bureaucratic processes (n=12, 40%), support efficient service delivery (n=15, 50%), and facilitate decentralised decision-making (n=12, 40%). Benefits for patient care included improved availability of rare medicines (n=28, 93.3%), specialised medicines not stocked centrally (n=28, 93.3%), reduced overstocking of slow-moving medicines (n=20, 66.7%), continuity of care (n=29, 96.6%), improved availability of life-saving medicines (n=29, 96.6%), reduced referrals (n=28, 93.3%), and enhanced patient trust and patronage (n=14–28, 46.7%–73.4%). Respondents also reported improved pharmacist autonomy (n=20, 66.7%), better planning for patient medicine needs (n=26, 86.7%), and easier tracking of consumption patterns (n=19, 63.3%). Challenges included weak financial control (n=26, 86.7%), bureaucratic approvals (n=24, 80%), and poor integration with inventory systems (n=24, 80%). Qualitative feedback highlighted that systems facilitate timely medicine provision, support emergency responses, and reduce patient dissatisfaction, although higher medicine costs were noted.

Conclusion: Pharmacy staff recognise that effective medicine supply systems enhance operational efficiency, continuity of care, and patient trust. However, financial, bureaucratic, and system integration challenges, alongside economic constraints, limit optimal performance. Strengthening these systems through streamlined processes, improved funding,

and enhanced integration with inventory management could further improve patient care and medicine availability in UGMC.

Low investment, high return: Impact of a "targeted overtime" clinical review model on medication safety in a district hospital

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Background: In district hospitals, clinical pharmacy services are often constrained by staffing shortages and heavy dispensing workloads. At our institution, inpatient services are staffed by only three pharmacists, leaving minimal capacity for in-depth medication review during routine hours. To address this, we implemented a "Targeted Overtime Model" to decouple clinical assessment from dispensing duties.

Objective: To evaluate the cost-effectiveness and clinical impact of allocating dedicated off-hours for medication review compared to routine workflow.

Method: We conducted a retrospective pre-post intervention study from July to December 2025. Pre-Intervention (Jul-Aug): Pharmacists performed reviews during routine hours amidst dispensing interruptions. Post-Intervention (Sep-Dec): A dedicated overtime schedule was introduced. We invested an average of 23 hours per month (approx. 7 hours/week) specifically for clinical review. We compared the detection of complex drug-related problems (DRPs) and physician acceptance rates between the two periods.

Results: A total of 11,537 assessments were analyzed. With a modest investment of ~91 total overtime hours over four months, the quality of care improved significantly. In the post-intervention phase, the detection of time-intensive DRPs surged: therapeutic duplication interventions increased 5-fold, and medication de-escalation recommendations increased 3-fold. The overall physician acceptance rate rose from 85.1% (Pre) to 88.0% (Post), reflecting higher trust in the comprehensive reviews conducted during zero-distraction periods.

Conclusion: This study demonstrates that a minimal strategic investment, averaging just 7 hours of dedicated time per week, can yield disproportionately high returns in patient safety. For resource-limited district hospitals, this "Targeted Overtime Model" offers a scalable and cost-effective solution to optimize antibiotic stewardship and complex medication management.

Analysis the efficacy of SGLT2 inhibitor therapy in patients with type 2 diabetic kidney disease at the PreESRD clinic of a teaching hospital in Taiwan

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Background: The prevalence of diabetes in Taiwan has been rising year by year, currently reaching about 12.3%, with an estimated number of patients reaching 2.3 million. More than 90% of these patients have type 2 diabetes, and about 40% of diabetic patients will develop chronic kidney disease. SGLT2 inhibitors work by reducing the reabsorption of filtered glucose and sodium by the kidneys, while lowering intraglomerular blood pressure, reducing proteinuria, slowing down glomerular hyperfiltration rate, and slowing down or improving early diabetic nephropathy. However, a common side effect is urinary tract infection. Observe the efficacy and side effects of medication after patients take it, so as to improve the safety of medication use.

Method: We will collect data from adults aged 18 years or older (inclusive) between January 1, 2025 and September 30, 2025, regardless of gender, who are diagnosed with type 2 diabetes, have an eGFR < 60 ml/min/1.73m² or proteinuria >30 mg/dl, have been prescribed SGLT2 inhibitors, and have been taking them for 3 months or more.

Results: A total of 63 cases were collected, with a male-to-female ratio of 44:19 (69.8%:30.2%) and an average age of 69.7 (SD12.2). The largest group was aged 70-79 with 21 cases (33.3%), followed by aged 60-69 with 17 cases (26.9%). The mean eGFR was 38.6 (SD 16.3), and 35 patients (55.6%) had proteinuria with a mean proteinuria of 223.0 (SD 234.9). After 3 months (inclusive) or more of medication, the mean eGFR was 41.9 (SD 17.6) and the mean proteinuria was 122.1 (SD 139.0). Eight patients (12.7%) showed no change in eGFR, while ten (15.9%) showed a worsening of eGFR. One patient (2.9%) showed a worsening of proteinuria.

Conclusion: SGLT2 inhibitors improved type 2 diabetic nephropathy in 45 patients (71.4%) with improved eGFR, while 35 patients had proteinuria. The data distribution varied greatly, with one patient initially showing 1864, which decreased to 225 after 6 months of follow-up, and only one patient (2.9%) showed a worsening of eGFR. The lack of a reported urinary tract infection may be due to special health education provided to patients during the case period, emphasizing the importance of drinking plenty of water.

Availability, storage, and supply chain performance of malaria commodities in Ghana: A cross-sectional facility assessment

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Background: Malaria continues to be a leading cause of morbidity and mortality in Ghana, disproportionately affecting children under five and pregnant women. Sustained programmatic investments have strengthened malaria control efforts, yet supply chain gaps threaten uninterrupted access to quality-assured medicines, diagnostics, and preventive commodities at the facility level.

Objective: To assess malaria commodity availability, storage conditions, inventory management practices, and supply chain performance across public health facilities in Ghana.

Method: A cross-sectional facility-based survey was conducted in December 2025 across 144 public health facilities, with nine purposively sampled per region in all 16 administrative regions of Ghana. Trained supervisors carried out physical stock verification, storage inspections, and inventory record reviews using a structured mobile tool. Data were validated prior to analysis and analysis done with SPSS® 20.

Results: Availability of priority malaria commodities was moderately high: Artemether/Lumefantrine 24s (78.5%), Sulphadoxine-Pyrimethamine (81.2%), malaria rapid diagnostic tests (80.6%), and insecticide-treated nets (88.2%). In contrast, paediatric ACT formulations were critically scarce, with availability between 5.6% and 36.1%. Only 42.8% of facilities received full order quantities from Regional Medical Stores, indicating significant supply fulfilment challenges. Storage infrastructure largely complied with national standards. The majority of facilities (92.4%) had a well designated stores with shelves and/or pallets (87.5%) and 61.8% with adequate storage space. However, dust-free storage was observed in 77.8% of facilities, roof leakages in 9.7% of facilities and fire safety equipment was present in only 50.0%. Inventory control cards were available in 92.4% of facilities, though appropriate completion was documented in 75.0%.

Conclusion: While overall availability of key malaria commodities is acceptable, critical deficiencies in paediatric ACT formulations, RMS supply fulfilment, and storage safety measures remain. Addressing these gaps through targeted programmatic interventions is essential to strengthen supply chain reliability, improve storage safety, and ensure equitable access to malaria treatment across all facility levels in Ghana. Sustained action will be vital to achieving the objectives of the national malaria elimination programme in reducing the

burden of the disease as the country works towards malaria elimination.

A case report: Administration route error of Benzyl penicillin in a Ghanaian female infant

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Background: Benzyl penicillin is a beta-lactam antibiotic used in the treatment of infections such as syphilis, streptococcal disease, and for rheumatic fever prophylaxis. Certain formulations, particularly benzathine penicillin G, are intended exclusively for intramuscular (IM) administration due to their low solubility and prolonged release profile, which ensures sustained therapeutic levels. Intravenous (IV) administration of these IM-only preparations is contraindicated and has been linked to serious adverse outcomes, including anaphylaxis, cardiorespiratory arrest, and death. Medication errors involving incorrect administration routes remain an important cause of preventable harm in paediatric patients. This report describes a life-threatening benzyl penicillin administration route error and highlights the need for stronger medication safety practices.

Case A two-month-old female infant with bilateral corneal opacity noted since birth was scheduled for surgical review at a paediatric eye clinic but was referred to the paediatric emergency unit after presenting with fever, weakness, and rapid breathing. On admission, she received supportive care including intranasal oxygen and paracetamol. Investigations performed included chest X-ray, echocardiography, full blood count, and Venereal Disease Research Laboratory (VDRL) testing. Both mother and infant tested positive, suggesting congenital syphilis, and the infant was prescribed IM benzyl penicillin 200,000 IU. The mother reportedly had a previous positive result but had not received treatment. On the sixth day of admission, the prescribed IM dose was inadvertently administered intravenously. Shortly afterward, the infant developed respiratory arrest, seizures, and signs consistent with anaphylactic shock. Emergency resuscitation was immediately initiated. Management included bag-mask ventilation, a 20 ml/kg bolus of normal saline, and a loading dose of intravenous phenobarbitone for seizure control. Intramuscular adrenaline was then administered with good clinical response. After stabilization, the patient was transferred to the Paediatric Intensive Care Unit for close monitoring and further management. Rapid recognition and intervention were critical in preventing a fatal outcome.

Discussion This case illustrates the potentially fatal consequences of administering IM-only benzyl penicillin intravenously, particularly in infants who are vulnerable to rapid physiological deterioration. Route errors may arise from confusion between formulations, unclear prescribing

instructions, inadequate documentation, or failure of verification processes during drug administration in busy clinical settings. Preventive strategies should include standardized prescribing practices, clear labeling of IM-only medications, independent double-checks before administration, and regular staff training on high-risk medicines. Clinical pharmacists play a vital role in reducing medication errors through prescription review, medication reconciliation, participation in ward rounds, and education of healthcare staff. Their involvement supports early identification of potential drug therapy-related problems and contributes to system improvements and safer medication use.

Conclusion: Inadvertent IV administration of IM benzyl penicillin in this infant resulted in anaphylactic shock, seizures, and cardiorespiratory arrest but was successfully managed with prompt resuscitation and intensive monitoring. The case underscores the importance of strict adherence to recommended administration routes, strengthened verification systems, and active integration of clinical pharmacists into paediatric care teams to enhance medication safety and prevent avoidable harm

Prescription patterns and factors influencing antidiabetic medication selection among type 2 diabetes mellitus patients in a tertiary hospital in Ghana

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Background: Type 2 diabetes mellitus (T2DM) represents a growing public health challenge in sub-Saharan Africa, with medication selection influenced by multiple clinical and socioeconomic factors. Understanding prescription patterns and determinants of medication choice is essential for optimising diabetes care in resource-limited settings. T2DM is a chronic metabolic disease characterised by persistent hyperglycaemia resulting from the body's inability to effectively use or produce sufficient insulin (World Health Organization). Among the various tests used for diagnosis, glycated haemoglobin (HbA1c) is particularly valuable, serving not only as a diagnostic tool but also as a reliable marker for long-term monitoring of glycaemic control

Objective: This study examined antidiabetic prescription patterns, clinical characteristics, and patient-perceived

factors influencing medication selection among T2DM patients attending an outpatient clinic in Ghana.

Method: A cross-sectional descriptive study was conducted among 124 adults with T2DM attending the clinic at the National Diabetes Management and Research Center. Data on sociodemographic characteristics, clinical parameters, prescribed medications, comorbidities, and perceived factors influencing medication choice were collected using structured questionnaires and medical record review. Descriptive statistics were used to analyse the data.

Results: The majority of participants were female (78.2%), aged 65 years or older (52.4%), with a mean age of 64.2 ± 10.8 years. Most patients (68.6%) had been diagnosed with T2DM for over 10 years, and 93.6% were covered by the National Health Insurance Scheme. The mean HbA1c was $7.3 \pm 1.9\%$, with 34.7% of participants having uncontrolled diabetes ($\text{HbA1c} \geq 7\%$). Hypertension (81.5%) and dyslipidemia (65.3%) were the most prevalent comorbidities. Biguanides (metformin) were the most frequently prescribed medication class (94.4%), followed by insulin (47.6%) and sulfonylureas (21.0%). Newer agents, including SGLT2 inhibitors (8.9%) and GLP-1 receptor agonists (0.8%), were minimally utilised. Dual therapy was the most common regimen (34.1%), followed by monotherapy (30.1%) and insulin combinations (28.5%). Regarding patient perceptions, the convenience of medication (preferred medicines taken once daily) was considered important by 50.8% of participants, whereas cost (26.8%), availability (13.0%), and side effects (18.6%) were less frequently perceived as influential factors.

Conclusion: Metformin remains the cornerstone of T2DM pharmacotherapy in this Ghanaian population, consistent with international guidelines. However, the limited utilisation of newer cardioprotective agents (SGLT2 inhibitors and GLP-1 receptor agonists) despite high cardiovascular comorbidity burden suggests potential gaps in optimal diabetes management. The high insurance coverage may explain why cost and availability were not major concerns for most patients. Future interventions should focus on improving glycaemic control and expanding access to evidence-based newer therapies with proven cardiovascular benefits.

Double win: One scan, zero waste, accelerated workflow

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Background: Discharge medication collection from KK Women's and Children's Hospital paediatric inpatient pharmacy traditionally relies on paper-based memos prepared by nurses and provided to caregivers to guide the collection process. This practice requires considerable nursing administrative time and generates substantial paper waste. Preparation of each memo requires an average of 3.5 minutes of nursing time, totalling to approximately 280 nursing hours annually. Nursing feedback identified manual memo preparation was time-consuming due to irregular memo replenishment and the need for reprint. On average, 4800 patients from 2 wards collect discharge medications from the pharmacy annually, resulting in an equivalent number of paper memos discarded each year. Digitalisation of this process presents an opportunity to improve operational efficiency while supporting environmental sustainability in clinical practice.

Objective: This quality improvement initiative aimed to reduce nursing administrative time through digitalisation of the discharge medication collection memo while reducing paper waste and associated environmental impact.

Method: Paper memos were replaced with QR code-enabled digital memos using For.sg, Singapore's official secure link platform for public healthcare institutions developed by GovTech's Open Government Products team. Self-administered surveys were conducted to evaluate nurses' and caregivers' perceptions of digital memo utility and their level of satisfaction towards the digitalised process.

Results: The transition from paper-based to digital information for discharge medication collection achieved a significant 75% reduction in median nursing administrative time for memo preparation, allowing reallocation of these valuable man-hours to patient-care clinical activities. As a secondary benefit, this digitalisation successfully eliminated approximately 4,800 paper memos annually, corresponding to an estimated reduction of 36 kg of CO₂ emissions associated with residual waste disposal. This reduction is comparable to the environmental impact of driving approximately 180 km in an average petrol car. These estimates do not account for upstream emissions associated with paper printing, suggesting that the total environmental benefit may be even greater. Among 56 nurses who completed the survey, 94.7% (n = 53) strongly agreed or

agreed that the digital memo improved overall efficiency when discharging patients, whilst 100% (n = 56) agreed that it was easy to guide caregivers on the retrieval process. Of 33 caregivers surveyed, 87.9% (n = 29) found it easy to scan the QR code using a mobile device to retrieve the digital memo, and 100% (n = 33) reported that the digital memo launched smoothly on their device without technical issues. Overall, 92.9% (n = 52) of nurses and 90.9% (n = 30) of caregivers were satisfied with the transition from paper to digital memo.

Conclusion: The successful implementation of the digital memo system has achieved dual objectives of operational efficiency and environmental sustainability, with high satisfaction rates among both nurses and caregivers. Environmental sustainability in healthcare is increasingly important, as the healthcare sector is among the largest contributors to carbon emissions. Digitalisation offers an effective means to reduce hospitals' carbon footprint and minimise environmental impact. This digital transformation demonstrates the potential for similar process improvements across healthcare administrative functions, contributing to enhanced workflow efficiency, cost savings and environmental sustainability.

Medication use evaluation of statin prescribing in patients with HIV based on ASCVD risk

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Background: Patients living with human immunodeficiency virus (PLWH, HIV) have an increased risk of cardiovascular disease due to HIV-associated chronic inflammation and immune activation, metabolic effects of antiretroviral therapy, and an over-representation of traditional cardiovascular risk factors. Based on evidence from the REPRIEVE trial that was published July 2023, the Clinical HIV Guidelines recommend moderate-intensity statin therapy for people aged 40-75 living with HIV and a 10-year atherosclerotic cardiovascular disease (ASCVD) risk of 5% to <20%. For risk <5% they continue to favor statin therapy, using HIV-related risk factors to guide decisions. Research Question or Hypothesis: Does statin prescribing in PLWH at a single Southern large academic medical center align with updated guideline recommendations based on calculated ASCVD risk scores? Study Design: Retrospective medication use evaluation of adult HIV patients at the Medical University of South Carolina (MUSC) from October 2024 to October 2025.

Method: PLWH with documented lipid panels and sufficient data for ASCVD risk score calculation were included. Data collected: demographics, height, weight, diabetes status, A1C, hypertension, smoking status, lipid values, calculated ASCVD risk score, and current statin therapy.

Results: Of 1202 patients included in this retrospective chart review, 705 (58.6%) had a 10-year ASCVD risk score >5%, meeting guideline-based indications for statin initiation. Among these high-risk patients, only 84 (11.9%) were receiving statin therapy at the time of assessment. Of the statin users, 69 (82.1%) were within the guideline-relevant age range of 40–75 years. Just 7.0% (84/1202) of the total cohort received statins despite over half qualifying based on ASCVD risk thresholds.

Conclusion: Statin prescribing was suboptimal in PLWH with elevated ASCVD risk, with only 11.9% receiving guideline-recommended therapy despite 58.6% meeting indications. This prescribing pattern represents a notable quality gap and targeted interventions are needed to optimize cardiovascular risk reduction in this high-risk population.

A French-language educational podcast in pediatric pharmacotherapy: Example of the “mg par kilo” podcast

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Background: Podcasting has become an increasingly valuable educational tool in healthcare, offering flexible, asynchronous learning opportunities. Despite this growth, French-language educational resources remain limited, particularly in pharmacotherapy. Most existing podcasts focus on adult medicine or discuss pediatrics from a medical point of view. For health sciences students and frontline healthcare workers, exposure to pediatrics can be limited, resulting in a lack of foundational knowledge in pediatric health problems and pharmacotherapy. To address this gap and to fulfill the mission to share knowledge, the largest mother and child centre in Canada, the Centre hospitalier universitaire (CHU) Sainte-Justine, affiliated with the Université de Montréal, launched a podcast.

Purpose: “mg par kilo” is an educational podcast, conceived by a hospital pharmacist and intended for pharmacists and other healthcare professionals. It aims to democratize access to specialized pediatric expertise, raise awareness among healthcare workers about the specificities of pediatric pharmacotherapy, and highlight interdisciplinarity.

Method: The podcast consists of episodes of 30-45 minutes published once or twice per month in both audio and video formats. They are distributed free of charge on major podcasting platforms. The idea originated with Émilie Roy-St-Pierre, a general pediatric pharmacist, in 2023 and the Department of Pharmacy allowed her to dedicate part of her

clinical free time to developing the concept. The Department of Education provided a large and multi-purpose studio, which hosts the recordings.

Over the past two years, she has gathered a growing team. The audiovisual specialist and audiovisual technician handle the video editing, the communications advisor helps with the internal distribution within CHU Sainte-Justine, and a pharmacy student helps her with the subtitling of the episodes. She coordinates the entire project: recruiting guests, reviewing content, hosting the podcast, overseeing post-production, managing social media, and handling finances and continuing education accreditations.

Results: The podcast has a very positive impact on the health sciences community. This evidence-based and high-quality podcast can be useful on a daily basis for frontline workers or trainees in pediatrics. Highly specialized professionals generously share their knowledge and their clinical experiences. From a pedagogical perspective, it stands out for its flexibility, originality, and accessibility. The podcast is accredited by the Ordre des pharmaciens du Québec, demonstrating that it meets standards of quality and rigor.

The podcast has reached a growing community worldwide, with the majority located in Québec, Canada: over 20,000 listens and 1,500 subscribers (Apple Podcasts and Spotify combined), over 100,000 video views on YouTube, more than 1,200 Instagram followers and nearly 1,100 Facebook followers (@mg par kilo).

Conclusion: This pediatric podcast represents an innovative educational initiative that addresses a clear gap in French-language pediatric resources. Departments from several other hospitals have already contacted Émilie to learn from her experience in order to launch podcasts within their own areas of expertise. High-quality and evidence-based podcasts could become a core part of academic learning for all levels of training, as this format can lead to increased engagement.

From invisible to indispensable: An executive-relevant KPI toolkit for benchmarking hospital pharmacy performance

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Background: Hospital pharmacy services significantly contribute to patient safety, timely access to therapy, stewardship, and operational reliability. However, these contributions are often undervalued in executive decisions because they are not consistently reflected in performance metrics that leadership can utilize. Many departments struggle with indicator overload, inconsistent definitions, and limited capacity to sustain reporting, leading to dashboards that lack credibility or fail to influence decisions.

Benchmarking and productivity analysis provide a practical way to demonstrate value by linking what the pharmacy delivers (outputs) to the resources used (inputs) and supporting trend-based management. Internal benchmarking is especially helpful as an initial step because it allows tracking improvements within the same service model. This educational presentation offers a practical approach to initiating pharmacy key performance indicator (KPI) reporting that is feasible across diverse health systems, including low- and middle-income countries, while remaining relevant to executive audiences.

Method: The session uses a framework-based teaching approach rooted in benchmarking and productivity principles. It starts by explaining external benchmarking and internal benchmarking, emphasizing internal benchmarking as an accessible starting point for consistent monitoring and improvement, especially when service models and data maturity vary across organizations. It then presents productivity as output divided by input, using practical denominators such as units of service (UOS) and full-time equivalents (FTE) where available. The framework guides participants to develop a core KPI dataset organized into four key areas relevant to executives: safety and reliability of the medication-use process; service delivery and access to therapy; operational performance; and financial stewardship. Finally, the approach standardizes each KPI with a data guide that details its purpose, numerator/denominator, inclusion/exclusion rules, data source, reporting frequency, responsible owner, and action trigger thresholds.

Results: Participants will leave with a starter KPI framework and practical templates that allow immediate use without advanced informatics. The framework helps select a focused set of KPIs that matter to executives, usually including workload metrics, turnaround time (TAT) for key workflows, reliability indicators that show safe system performance, and stewardship measures that summarize resource optimization. By using internal benchmarking and baseline indexing, pharmacy leaders can show whether performance is improving over time and identify where variation occurs, enabling more open discussions about capacity, recruitment, automation, and targeted quality improvements. The session also provides an executive-level narrative structure to translate KPIs into decisions: what changed, why it changed, the impact, actions being taken, and support needed. This encourages clearer, evidence-based conversations about resources and service sustainability.

Conclusion: Consistent KPI reporting is an effective way to improve hospital pharmacy visibility, credibility, and influence. A benchmarking- and productivity-focused framework helps pharmacy leaders start with a manageable minimum dataset, standardize definitions, and communicate trends in ways that align with executive priorities. The approach is designed to scale from basic reporting to more advanced analytics while keeping clarity and comparability. Future efforts should focus on shared templates and cross-setting learning to accelerate adoption and enhance

performance discussions across hospital pharmacy services worldwide.

Real-world efficacy and safety of maribavir compared with conventional therapy in CMV infection after ganciclovir failure following hematopoietic stem cell transplantation

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Background: Ganciclovir (GCV) remains the standard first-line therapy for cytomegalovirus (CMV) infection in haematopoietic stem cell transplantation (HSCT) recipients. However, its clinical use is frequently limited by treatment failure related to antiviral resistance and dose-limiting toxicities, particularly myelosuppression. Maribavir (MBV) is a novel antiviral agent that selectively inhibits the CMV UL97 kinase through a mechanism distinct from that of GCV and has emerged as an alternative option for refractory or GCV-intolerant CMV infection. Following reimbursement approval in April 2024, MBV has been increasingly adopted in routine clinical practice in South Korea; however, real-world data regarding its effectiveness and safety remain limited. This study aimed to evaluate the real-world efficacy and safety of MBV compared with conventional antiviral therapy in patients with CMV infection who experienced GCV treatment failure after HSCT.

Method: A retrospective, single-centre study was conducted among adult HSCT recipients diagnosed with GCV-resistant, refractory, or GCV-intolerant CMV infection at Asan Medical Center between January 2023 and July 2025. Patients were categorised into two groups according to subsequent antiviral management. The conventional therapy group included patients who continued GCV therapy or were switched to foscarnet (FOS) (n = 17), while the MBV group comprised patients who were switched from GCV to MBV (n = 12). The primary outcome was the CMV clearance rate. Secondary outcomes included the virologic response at week 2, time to CMV clearance, and the incidence of adverse drug reactions. Statistical analyses were performed using Fisher's exact test for categorical variables, Kaplan–Meier survival analysis for time-to-event outcomes, and the log-rank test.

Results: The CMV clearance rate was significantly higher in the MBV group than in the conventional therapy group (66.7% [8/12] vs. 23.5% [4/17]; odds ratio [OR], 6.50; 95% confidence interval [CI], 1.26–33.58; p = 0.029). The virologic response rate at week 2 was numerically higher in the MBV group compared with the conventional therapy group (91.7% [11/12] vs. 58.8% [10/17]), although this difference did not reach statistical significance (OR, 7.70; 95% CI, 0.80–74.10; p = 0.093). The median time to CMV clearance was 33.0 days (95% CI, 9.2–56.8) in the MBV group, whereas the median

could not be estimated in the conventional therapy group because more than half of the patients did not achieve CMV clearance (log-rank test, $p = 0.013$). Treatment discontinuation due to grade ≥ 4 haematologic toxicity occurred in 29.4% of patients receiving conventional therapy, while no such events were observed in the MBV group.

Conclusion: In HSCT recipients with CMV infection and GCV treatment failure, MBV demonstrated higher CMV clearance rates, faster virologic responses, and a lower incidence of severe haematologic toxicity compared with conventional antiviral therapy. Despite the limitations inherent to its retrospective design, single-centre setting, and small sample size, this study provides meaningful real-world evidence supporting MBV as an effective and safer salvage treatment option for CMV infection following HSCT.

Increasing pharmacist support in psychiatric outpatient clinics: Medication reconciliation as the Trojan Horse

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Background: Medication reconciliation is a patient safety initiative that reduces the risk of medication errors, and is an Accreditation Canada Required Organizational Practice. The activities related to medication reconciliation can be performed by physicians, nurse practitioners, pharmacists, pharmacy technicians and registered nurses. At the Centre for Addiction and Mental Health (CAMH) in Toronto, Ontario, Canada, outpatient clinics are required to complete medication reconciliation at the time of admission for patients prescribed high-risk medications, as defined by the institution. Approximately 25 CAMH outpatient clinics prescribe these high-risk medications regularly. Most of these clinics do not have dedicated pharmacist support, and thus, medication reconciliation is generally not completed in these clinics.

Objective: The objective of this pilot project was to determine if dedicated clinical pharmacist support would improve the outpatient admission medication reconciliation completion rates at CAMH and provide other valuable medication-related support to clinic staff and patients.

Method: During this pilot project, one clinical pharmacist was integrated into five multidisciplinary psychiatric outpatient clinics at CAMH in a step-wise fashion between September 2022 and August 2023. Admission outpatient medication reconciliation completion rates were generated for the five selected clinics. Completion rates were collected for the pilot project period and the year prior to the pilot project, when

there was no dedicated pharmacist in the targeted clinics (September 2021 to August 2022). Completion rates were compared between the pre-pilot phase and the pilot phase. The non-medication reconciliation services provided by the pharmacist during the pilot project period were summarized.

Results: The outpatient admission medication reconciliation completion rates increased significantly ($p < 0.001$) between the pre-pilot phase (27.9%) and pilot phase (76.8%). The nature of non-medication reconciliation activities conducted by the pharmacist during the pilot included: responding to drug information questions, providing pharmacological recommendations for psychiatrists and other clinicians, providing medication education to patients and clinicians, conducting thorough medication histories, ensuring the safe injection of long-acting injectable antipsychotics by confirming the most recent injection date, assisting in triaging non-psychiatric health concerns, contributing to multidisciplinary case conferences, facilitating drug coverage and compassionate medication supply, and troubleshooting medication procurement issues.

Conclusion: Dedicated pharmacist support for outpatient psychiatric clinics at CAMH led to an increase in admission medication reconciliation completion rates. This pilot project resulted in the hiring of 2.0 FTE pharmacists to support these five clinics. Once integrated into a clinic, the pharmacist became available to the multidisciplinary team for other important patient care and continuity of care practices.

AI-empowered pharmacy management: Breaking system barriers through deep pharmacist-AI collaboration in developing an electronic controlled substance management system

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Background: The inventory management of controlled substances involves stringent regulations and cumbersome audit procedures. In practice, legacy Hospital Information Systems (HIS) are often too rigid to precisely track multi-batch First-In-First-Out (FIFO) logic and fail to generate dynamic logbooks formatted for regulatory audits. Confronted with nearly 60 routinely stocked controlled substance items and a massive daily dispensing volume, pharmacists must manually

query individual patient orders in the HIS and transcribe usage data and balance calculations across multiple item-specific paper logbooks. This process entails high operational complexity, is extremely time-consuming, and is highly susceptible to human transcription or arithmetic errors. This study aims to demonstrate a novel digital transformation paradigm: empowering clinical pharmacists with domain knowledge to collaboratively build a highly customizable "Electronic Management and Audit System" using Generative AI from scratch, addressing the shortfalls of HIS at a minimal cost.

Method: This project utilized Agile Development to build a Single Page Application (SPA) using HTML5, CSS3, and JavaScript, leveraging LocalStorage to ensure endpoint data privacy without requiring IT infrastructure deployment. The pharmacist translated clinical pain points into prompts to guide the AI's coding. In pursuit of practical perfection, the system underwent 29 major version evolutions, 7 critical Service Packs (culminating in v29.0 SP7), and hundreds of micro-adjustments. Core breakthroughs include: 1. High-Efficiency Batch & Precision FIFO Engine: Developed a "detailed prescription import" feature to parse HIS dispensing arrays, enabling one-click multi-transaction precise deductions and data logging with a forced automated expiry-based batch splitting algorithm. 2. Visual Alerts & Smart Sorting: Pioneered a color-coded "Expiration Alert Dashboard" (categorizing items expiring in < 6 months, < 3 months, < 1 month, and already expired) for proactive risk interception. Implemented a dual-sorting logic (Control Schedule Level -> Code/Dosage Form) to streamline management. 3. Flawless Audit Views & Disaster Recovery: Utilized CSS page-break controls to generate compact, signature-protected A4 regulatory forms. Built-in JSON backups and a "Time Machine" deep scanner ensure safe data migration and security.

Results: Refined through hundreds of operational optimizations, the deployed system successfully revolutionized the traditional controlled substance registration workflow. Post-implementation, even when handling complex transaction data across nearly 60 controlled drug items, features like "Universal Import" and automated dynamic balances reduced pharmacists' daily data entry and reconciliation time by over 80%, achieving an outstanding 0% arithmetic error rate. The visual dashboard enabled proactive interception of near-expiry drugs, minimizing the risk of expired inventory accumulation. Furthermore, the smart sorting combined with optimized "Stocktake and Audit Sheets" slashed the preparation time for inventory and audit data from hours to mere minutes.

Conclusion: The success of this project profoundly validates the immense potential of combining clinical persistence with "AI Empowerment." By utilizing Generative AI to overcome coding barriers and investing in iterative optimization, clinical pharmacists with deep domain knowledge can create low-cost, perfectly tailored digital solutions that resolve high-complexity manual tasks. This not only establishes a new paradigm for grassroots digital transformation in hospital

pharmacies but also tangibly and effectively alleviates the heavy clinical workload and stress on pharmacists.

Descriptive analysis of anticancer and supportive care drug shortages in a hemato-oncology department

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Background: During August and September 2025, several anticancer and supportive care medicines were temporarily unavailable in our hemato-oncology department. These shortages led to treatment delays, patient purchases outside the hospital, and difficulties maintaining chemotherapy protocols. This local observation prompted us to analyse the affected drugs, their causes, and their impact on patient care. This study aimed to describe and analyse anticancer and supportive care drug shortages observed in the hemato-oncology department between August and September 2025. The objectives were to identify the most affected therapeutic classes, determine the main causes of shortages, and assess their impact on patient management and treatment continuity.

Method: A descriptive, observational study was conducted in the hemato-oncology pharmacy, 20 about Hospital Casablanca, Morocco from 25 August to 30 September 2025. All anticancer and supportive care medicines that experienced unavailability during this period were recorded using a standardized Excel form. For each drug, data collected included name, dosage form, therapeutic category, date of shortage, duration, stockout type, root cause, and actions taken. The data were analysed descriptively to identify the most affected drugs and common causes of shortages.

Results: Between August 25th and September 30th, 2025, a total of 17 drug shortages were recorded in the hemato-oncology department, including 9 anticancer (53%) and 8 supportive care medicines (47%). Full stockouts accounted for 76.47% of cases, primarily due to supplier delays (38.46%) and national unavailability (7.70%). Approximately 148 patients experienced treatment disruption or had to purchase medicines externally. The most affected anticancer drugs were imatinib, methotrexate, daunorubicin, and cisplatin, while the main supportive drugs affected included vancomycin, meropenem, metronidazole, and morphine. Cycle delays and treatment modifications were most frequent with anti cancer drugs, whereas external purchase was common for supportive care.

Conclusion: Drug shortages in the hemato-oncology department mainly affected chemotherapy and supportive care medicines, causing treatment delays and external patient purchases. Better coordination between the pharmacy and clinical teams, and stronger national supply management, are essential to ensure treatment continuity and patient safety.

Case reports of suspected Imipenem/Cilastatin-induced epilepsy

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Background: Imipenem/Cilastatin belongs to the Carbapenem class of antibiotics. Because of its broad-spectrum efficacy against Gram-negative, Gram-positive, and anaerobic bacteria, it is widely used to treat hospitalized patients with multidrug resistance and severe infections. Among antibiotics associated with neurotoxicity that may cause seizures include penicillins, carbapenems, cephalosporins, and quinolones. Seizures induced by Carbapenems are relatively uncommon. Here, we report a case of seizure induced by the use of Imipenem/Cilastatin, and we also discuss the populations at high risk of seizure development and review relevant literatures to raise awareness of possible adverse effects and precautions when using this class of antibiotics.

Method: An 80-year-old woman was admitted to the hospital with bilateral pneumonia, an acute exacerbation of asthma, and depressive symptoms accompanied by insomnia. During hospitalization, she developed bacteremia, and blood cultures identified *Acinetobacter baumannii*, *Klebsiella pneumoniae*-CR, and *Pseudomonas aeruginosa*. Based on antibiotic sensitivity, she was treated with imipenem/cilastatin and polymyxin B sulfate. Simultaneously, *Enterococcus faecium* was cultured from her urine, for which linezolid was administered based on antibiotic sensitivity. After six doses, the patient experienced focal twitching and seizures. Symptoms resolved after discontinuation of imipenem/cilastatin, administration of lorazepam, and continuous treatment with the antiepileptic drug levetiracetam. Electroencephalography (EEG) revealed occasional epileptiform discharges of 1-2 episodes without continuous activity. After adjusting the antiepileptic drug dosage, the EEG showed no abnormal discharges. According to the Naranjo score for adverse drug reactions, this case was classified as "probably" related to Imipenem/Cilastatin-induced seizures.

Results: The adverse drug reaction prolonged the patient's hospital stay and necessitated continued antiepileptic therapy, thereby increasing the risk of drug-drug interactions and additional adverse effects.

Conclusion: Previous literature has reported seizure cases associated with carbapenem therapy. When prescribing Imipenem/Cilastatin, clinicians should carefully consider the patient's body weight and renal function, adjust the dosage appropriately, and monitor for seizure-related symptoms. Early intervention is essential to reduce complications, particularly in patients with pre-existing central nervous system disorders who are more susceptible.

Case study of patient discharge in clinical setting in Sweden

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Background: A previous quality improvement project in Kristianstad and Hässleholm hospitals indicated that only 75% and 79% of patients received written discharge information at hospital discharge. The primary objective in this study was to identify whether patients had received verbal and written discharge information, based on the patient's perception and information in the medical record. The secondary objective was to analyze whether there were any discrepancies between the drugs the patients said they were taking at home and the information contained in the medical record, and to classify any drug discrepancies.

Method: Interview study where telephone interview was used. Clinical pharmacists (CP) performed medication reconciliation and medication review at the hospital wards and recruited patients to the study. One CP interviewed patients between 2-7 days after discharge to check with the patients on how they perceived that they had received verbal and written information regarding medications at discharge and if there were any drug discrepancies. Chi2-test was used to analyze if there were any difference between separate demographic data in the patients and discharge information. Setting: Internal medicine wards at the hospitals in Kristianstad and Hässleholm in southern Sweden. Main outcome measures: Patients' perception of receiving discharge information, verbal and written, and if there existed any drug discrepancies between physicians written instruction and what the patients were taking.

Results: According to the patients 88% had received both verbal and written discharge information and the remaining 12% had only received written discharge information. The

written medication report at discharge was not always complete. For eight patients 13 drug discrepancies were identified. The most frequent discrepancies belonged to the main Anatomical Therapeutic Chemical groups heart and circulation and respiratory system. The difference between demographic data and discharge information was not significant.

Conclusion: Most patients discharged from internal medicine wards at the hospitals in Kristianstad and Hässleholm received both written and verbal information at discharge. Medication reconciliation and medication review performed by a CP during the hospital stay probably resulted in fewer medication discrepancies after discharge. Further studies are needed, preferably an intervention study with a larger population, to test these hypotheses.

Establishment of hospital pharmacy medication procurement and inventory management section and its impact in a comprehensive cancer center

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Background: In a VUCA environment where black swans' events are becoming more frequent, risks in medication supply chains are increasing with direct impact on health care system and patients, rather than being a typical chain, they are continuously evolving into webs of interconnected tiers, limiting visibility and further increasing risks, as such the role of pharmacists as clinical leaders has become essential in managing medication supply chains. In King Hussein Cancer Center, pharmaceutical procurement has always been under pharmacy, but after participating in FIP Basel 2008, and starting to apply the elements under the theme of the procurement, pharmacists working in medication supply chains started receiving specialized training. The authors' purpose is to describe the establishment of pharmacy supply chain management services in a comprehensive cancer center, and assess the impact of specialized pharmacists' training in medication supply chain management to ensure that pharmacists are well equipped to assume their role in medication procurement and inventory management, a role they have always participated in, within a heavily regulated sector, but without structured specialized training during their clinical education.

Method: A descriptive study of the establishment of Pharmacy procurement and inventory management section

and an assessment of the impact of enabling pharmacists to assume their role in medication supply chains as part of the medication management cycle in both patients' safety and the financial sustainability of hospital healthcare systems.

Results: Pharmacists with training in supply chain management played a role in enhancing patients' safety and reducing medication errors through leading the procurement and inventory management tasks, ensuring that standard concentrations are available, mitigating risks of shortages, improving accessibility to critical medications while managing cost barriers, in addition to managing risks associated with sound-alike look alike inventory specially in high alert medications. Pharmacists managing medication supply chains in hospitals also improved compliance with the national and international regulations and good storage and distribution practices, especially in such a heavily regulated section and highly sensitive commodities, in addition to reducing risks of counterfeit and misused medications. Enabling pharmacists with proper training and empowering them with specialized skills, also improved contract negotiations and contract management in medication procurement, while focusing on sustainable partnerships with key suppliers. Their direct interaction with pharmacy HTA section and health care providers, in addition to patients and regulatory authorities, improved cost management, ensured better compliance with regulations including good disposal practices, reduced waste and ensured better financial outcomes while maintaining a high level of patient centered care.

Conclusion: Establishing pharmacy procurement and inventory management section under control of pharmacy and ensuring structured training for pharmacists to equip them to assume their role as clinical leaders in medication supply chain, improved patient safety and sustained pharmacy financial outcomes.

Analysis of antineoplastic prescribing errors and clinical pharmacist interventions in a medical center

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Background: Antineoplastic agents, including chemotherapy and other anticancer therapies, are high-alert medications with potential for serious toxicity and complex dosing requirements. Most of these agents, particularly cytotoxic chemotherapy, exhibit a narrow therapeutic index, rendering prescribing accuracy critical. Prescribing errors can lead to significant patient harm, and clinical pharmacists serve as a critical safety barrier by intercepting and preventing such errors through structured prospective verification.

Objective: To analyze the types and frequency of antineoplastic prescribing errors and describe the role of clinical pharmacist interventions in ensuring patient safety at a medical center.

Method: A retrospective observational study was conducted to evaluate antineoplastic prescribing errors occurring from January 2023 to December 2025. Errors were defined as deviations from institutional protocols and categorized by type. All identified errors were documented at the time of interception and subsequently reviewed by clinical pharmacists to analyze error patterns and contributing factors.

Results: During the three-year study period, 43,660 antineoplastic prescriptions (22,225 outpatient; 21,435 inpatient) were reviewed. A total of 65 prescribing errors were identified, yielding an overall prescribing error rate of 0.15% (0.17% outpatient vs. 0.13% inpatient). The primary error types included incorrect administration sequence (27.7%, n=18), dosing errors (20.0%, n=13), incorrect administration date (12.3%, n=8), omission of required medications (12.3%, n=8), incorrect route (9.2%, n=6), and other errors (18.5%, n=12). All errors were successfully intercepted and corrected by pharmacists prior to administration. Root cause analysis identified multiple contributing factors, including system inconsistencies, insufficient clinical decision support (CDS) functionality within the computerized physician order entry (CPOE) system, and prescriber oversight. Corrective actions included workflow optimization and collaboration with the information technology department to implement targeted CDS alerts within the CPOE system.

Conclusion: Although the prescribing error rate was low, the potential severity of harm associated with antineoplastic agents necessitates multilayered safety mechanisms. The successful interception of all identified errors underscores the role of pharmacist-led verification as an essential safety barrier. Continued enhancement of clinical decision support within CPOE systems remains vital to further strengthen medication safety.

Redesigning a digital documentation workflow for medication consultation services using Google Forms and Power BI

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Background: Medication consultation is a core service provided by pharmacists. Traditionally, documentation of

consultation services relied on paper-based records, which limited data completeness, accessibility, and analysis. In addition, existing hospital information systems primarily capture consultation records related to specific outpatient records, leaving other types of medication inquiries insufficiently documented. The lack of integrated and visualized data restricts comprehensive evaluation of service workload and performance. This study addresses these gaps by integrating digital data collection tools with existing hospital systems to enhance data usability and real-time feedback.

The objective of this study was to establish a redesigned workflow for medication consultation documentation by integrating Google Forms for data collection and Power BI for data visualization. This workflow aimed to evaluate consultation workload and service characteristics, compare the efficiency of digital and paper-based documentation processes, and explore the feasibility of using visualized data to support individual pharmacist performance assessment.

Method: Pharmacists documented consultation details using Google Forms, replacing the previous paper-based recording process. Data from Google Forms included consultations provided to all healthcare professionals and the general public, while existing hospital information systems captured medication consultations related to specific patient visits. All records were integrated into Power BI for data analysis and visualization, including consultation volume, topics, service recipients, time distribution, and pharmacist workload.

Results: Compared with paper-based documentation, the use of Google Forms significantly improved data completeness, timeliness, and standardization.

Power BI enabled the integration of multiple data sources, including Google Forms and records from information systems, eliminating manual data consolidation and allowing near-real-time analysis through automated dashboards. Differentiation between patient-specific consultations and general inquiries provided a more comprehensive overview of the service scope.

Interactive dashboards allowed users to dynamically filter and explore data, including individual pharmacist consultation workload, average time spent across different consultation categories, and major inquiry topics by different recipients. These visualized outputs improved data interpretation efficiency, supported workload balancing, and facilitated managerial decision-making related to staffing and service planning. Overall, the implementation successfully transitioned the consultation documentation process from a paper-based workflow to a paperless, data-driven practice model.

Conclusion: The integration of Google Forms and Power BI provides an effective and scalable approach for documenting and analyzing medication consultation services in hospital pharmacy. Digital documentation demonstrated clear advantages over traditional paper-based methods and complemented existing information systems by capturing a broader range of consultation activities.

This workflow supports workload monitoring through automated, near-real-time analysis and provides a data-driven foundation for pharmacist service evaluation, with future integration of service quality indicators and clinical outcomes to further optimize pharmacy services and inform strategic planning.

Enhancing chemotherapy medication safety through an intelligent closed loop system

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Background: Although the average annual incidence of reported medication errors related to chemotherapy medications is relatively low, undetected compounding and administration errors may still occur and lead to serious patient harm. Chemotherapy drugs are considered high-alert medications due to their narrow therapeutic index, complex dosing regimens, and potential for severe adverse effects if errors occur. Traditional chemotherapy preparation workflows often rely on multiple manual verification steps, which may still be vulnerable to human error. To address these risks, our institution implemented an intelligent closed-loop chemotherapy medication management system. This system integrates modular prescription generation, barcode verification, and standardized compounding processes to enhance medication safety throughout the entire chemotherapy workflow, from prescription to administration.

Method: The intelligent closed-loop system was designed to prevent common chemotherapy-related errors, including missing premedication, incorrect drug selection, and dosage inaccuracies. At the prescription stage, chemotherapy orders are generated using a modular prescription system, ensuring standardized regimens and reducing prescribing variability. A pharmacist initially reviews each prescription to verify treatment protocols, dosage accuracy, and patient suitability for chemotherapy. During the compounding process, medications and diluents are selected and confirmed using a barcode recognition system to minimize selection errors. All chemotherapy drugs are prepared in an independent negative pressure sterile compounding room, which is regularly monitored and maintained to prevent contamination. Vertical laminar flow sterile workbenches are used to protect both pharmacists and the environment from hazardous drug exposure. A two-person compounding system is implemented, in which a second pharmacist independently rechecks medication accuracy using barcode verification before and during preparation, ensuring compliance with aseptic techniques. After preparation, chemotherapy medications are delivered

by designated delivery personnel to the nursing station or chemotherapy infusion room. At the administration stage, a barcode medication administration system verifies the correct patient, drug, dose, route, and administration rate, ensuring timely and accurate delivery of chemotherapy.

Results: Following implementation of the intelligent closed-loop system, barcode verification was successfully applied at each critical step of the chemotherapy workflow. This approach effectively prevented compounding and administration errors, including omissions of premedication and incorrect dosages. Through systematic barcode verification and dual pharmacist checks, 100% of identified potential errors were intercepted before reaching patients, significantly enhancing chemotherapy medication safety.

Conclusion: The intelligent closed-loop chemotherapy medication management system substantially improves patient safety by integrating modular prescription generation, barcode verification, and standardized compounding workflows. The combination of a two-person compounding process, controlled sterile environments, and barcode-assisted verification minimizes human error and ensures accurate and timely chemotherapy administration. This system demonstrates a practical and effective strategy for reducing chemotherapy-related medication errors and may serve as a model for improving safety in high-risk medication processes in hospital pharmacy practice.

Improving medication inventory management through HFMEA-based process redesign

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Background: Medication inventory management plays a critical role in hospital pharmacy operations, directly affecting medication safety, service efficiency, and quality of patient care. In emergency departments, pharmacies are required to provide 24-hour medication services and maintain a full range of hospital formulary medications. However, inventory levels and storage allocation are often determined based on individual pharmacists' judgment, which may lead to medication shortages, overstocking, and increased operational risks. With the introduction of automated vertical storage systems and intelligent dispensing counters, pharmacies face new workflow challenges that require systematic evaluation and redesign.

Purpose: This project aimed to reduce human judgment errors in medication replenishment, improve accuracy, and optimize medication expiration date management in an emergency pharmacy through a quality improvement

initiative. The hypothesis was that applying Healthcare Failure Mode and Effects Analysis (HFMEA) combined with system-based interventions would significantly reduce replenishment errors and medication shortages.

Method: A quality control circle project was conducted in an emergency pharmacy. The medication inventory management workflow was mapped into 7 main processes, 12 sub-processes, and 34 detailed steps. HFMEA was applied using hazard scoring and decision tree analysis to identify high-risk steps and failure causes. A total of 21 failure causes were identified for correction. Through multidisciplinary team brainstorming, 27 improvement actions were developed and categorized into six strategic intervention groups: (1) establishment of a replenishment planning system and standardized lists, (2) enhancement of pharmacist education and training, (3) strengthening medication picking procedures, (4) implementation of a medication bin location reminder system, (5) redesign of the system interface, and (6) execution of storage cabinet accuracy audits. Outcome indicators included replenishment error rates, medication shortage rates, and pharmacist satisfaction.

Results: Following implementation, the replenishment error rate of storage cabinets decreased from 56.2% to 14.2%, achieving an improvement rate of 295.4%. Medication shortages were reduced from 27.3% to 0%, with an achievement rate of 366.3%. Additionally, 86.1% of pharmacists reported satisfaction with the improved workflow (Likert scale ≥ 4), indicating enhanced usability and acceptance of the redesigned processes. These outcomes demonstrate improved operational stability, reduced reliance on individual judgment, and greater consistency in inventory control across shifts, contributing to a safer and more reliable medication management.

Conclusion: The application of HFMEA enabled comprehensive and systematic identification of risks within emergency pharmacy inventory management. Combined with intelligent system support and workflow redesign, the intervention significantly reduced replenishment errors and medication shortages while improving pharmacist satisfaction. Although the post-intervention evaluation period was limited, the results demonstrate that structured risk analysis is an effective strategy for optimizing emergency pharmacy operations. Ongoing monitoring and long-term evaluation are recommended to sustain improvements and further refine the system.

Assessing predictors of diabetic kidney disease and medication use in a diabetic population attending selected tertiary teaching hospitals in Lagos Nigeria: A retrospective study

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Background: Diabetic kidney disease (DKD) is one of the most frequent and severe long-term complication of diabetes, causing significant morbidity and mortality in patients with diabetes. The prevalence of DKD is rising continuously and under-recognized in low and middle-income countries. There is a dearth of knowledge regarding the medication use and effect on antidiabetics of Management of Diabetes Kidney Diseases in the tertiary institutions of low and middle income countries

Method: A retrospective study was conducted using the medical records of diabetic patients over a period of 24 months at the diabetes clinic of two selected tertiary healthcare institutions. Descriptive data on patients sociodemographic, clinical, biochemical, and prescription pattern of medications were retrieved, collated. The Kidney Disease Initiative: Global outcome (KDIGO) and American Diabetes Association (ADA) recommendations were used to assess adherence to medications guidelines at different stages of the disease. The results was analyzed using IBM SPSS (v.31.0).

Results: Among the 222 patient case notes reviewed, 55.4% were male and over half of the patients were > 60 years of age. Advanced age, a higher number of comorbidities, longer duration of DM, and poor glycemic control were independent predictors of DKD. Dipeptidyl peptidase-4 (DPP-4) inhibitors (>53%) and biguanides (50%) were the most commonly used classes of oral antidiabetics. Renin-Angiotensin System Inhibitors (RASi) were the most prescribed antihypertensives while SGLT2 inhibitors were the least prescribed across DKD stages. Non-adherence to KDIGO and ADA guidelines was confirmed for antidiabetic medications used in patients in stages 3-5.

Conclusion: The management of diabetic kidney disease is suboptimal in the tertiary-care outpatient clinics studied, which may reflect similar shortcomings nationwide. Strategies to ensure guideline adherence need to be developed or adopted.

Pharmacist-led antimicrobial telestewardship in small rural hospitals: A descriptive analysis of pharmacist interventions and prescriber acceptance

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Background: Antimicrobial resistance is a major global public health threat driven by inappropriate and excessive antimicrobial use, emphasising the need for effective antimicrobial stewardship programmes (ASPs). Small rural hospitals often lack formal ASPs due to barriers such as limited staffing, information technology infrastructure, funding and infectious diseases expertise, hindering implementation and sustainability. Technology, including remote and telepharmacy platforms, has been used to bridge care gaps and provide support in resource-limited settings. Pharmacists are ideally positioned to lead stewardship efforts, offering expertise to optimise antimicrobial therapy and support prescriber decision-making. Pharmacist interventions and prescriber acceptance rates following implementation of a pharmacist-led telestewardship model in small rural Canadian hospitals have not been described.

Objective: To characterise types of telepharmacist-led ASP interventions and assess prescriber acceptance.

Method: This prospective observational study was conducted across two small rural hospitals participating in a remote pharmacist-led ASP. The study characterised interventions performed by ASP pharmacists and prescriber responses to these recommendations. ASP telepharmacists conducted prospective reviews of antimicrobial therapy for hospitalised patients using electronic health records. Telepharmacist reviews followed standardised stewardship criteria, and their recommendations were communicated to prescribers by telephone. All adult inpatients (≥ 18 years) for whom pharmacists conducted stewardship assessments during the study period were eligible. Data collected included types of pharmacist ASP interventions (ASP classification categories) and prescriber acceptance of each intervention. Reasons for interventions declined by prescribers were also categorised. Categorical variables were summarised as counts. Descriptive statistics, including counts and percentages, were used to summarise intervention types and prescriber acceptance overall and by intervention type. Ethics approval was not sought as this project was undertaken as a quality improvement initiative.

Results: From November 2024 to December 2025 ASP telepharmacists conducted 1,795 patient assessments and made 1,101 recommendations of which 993 (90%) were accepted. When those interventions categorized as not accepted due to patient status changes (e.g., palliative care, discharge, alternate level of care) or inability to contact the

prescriber by telephone were excluded, the intervention acceptance rate increased to 95%. The most common documented reasons for prescriber intervention non-acceptance (9.8%) included disagreement (42.6%) and inability to contact the prescriber (40%). The most frequent telepharmacist recommendations were antimicrobial therapy discontinuation (222 [20.2%]) and targeting or de-escalation of therapy (197 [17.9%]). Acceptance rates varied significantly by intervention type. Compared with recommendations for antimicrobial discontinuation, recommendations defining duration of therapy (OR 2.45, $p = 0.018$), therapeutic drug monitoring/laboratory testing (OR 13.63, $p = 0.011$), and other recommendation types (OR 4.63, $p = 0.005$) had significantly higher odds of acceptance. Intravenous to oral formulation and escalation of therapy recommendations showed lower but non-significant acceptance differences.

Conclusion: Pharmacist-led antimicrobial telestewardship interventions in small hospitals without prior ASPs were diverse, and most involved therapy discontinuation and optimisation. Prescriber acceptance was high and varied by intervention type, indicating areas of strong prescriber support and opportunities to optimise intervention uptake. These findings suggest telestewardship can support antimicrobial use when on-site resources are limited. Future research could explore factors influencing prescriber acceptance and measure intervention clinical and economic outcomes.

Development and evaluation of an AI-driven virtual pharmacist consultation module in a clinical setting: A pilot study

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Background: Demographic shifts toward an aging population and the rising prevalence of chronic conditions have significantly escalated the demand for accessible and accurate medication consultation. Traditional pharmacist-led models, primarily conducted through face-to-face or telephone-based interactions, are increasingly constrained by personnel shortages, time limitations, and the rapid evolution of pharmacological knowledge. Advances in artificial intelligence, particularly large language models (LLMs), present novel opportunities for the digital transformation of clinical pharmacy services. This study aimed to develop and evaluate a virtual pharmacist consultation module that meets real-world clinical requirements.

Method: A systematic development and evaluative design were adopted. A pharmacist-vetted knowledge base

comprising 195 question-and-answer pairs was established, covering general medication use, antibiotics, lipid-lowering agents, and antihypertensive therapies. This knowledge base was integrated into a virtual interaction module utilising natural language processing (NLP) and conversational AI. A pilot study was conducted in January 2026 at a regional hospital in Taiwan. User experience was assessed via post-interaction questionnaires evaluating comprehensibility of responses, effectiveness in addressing inquiries, interface usability, and overall satisfaction.

Results: Forty participants completed the evaluation of the AI pharmacist interaction. Feedback was overwhelmingly positive, with 86% of respondents indicating that the provided medication information was a valuable reference. Furthermore, 83% of users found the responses easy to comprehend, and 79% agreed that the system effectively addressed their primary medication concerns. Approximately 79% of participants reported increased confidence in their medication management after the interaction. Regarding usability, 79% to 83% of users expressed satisfaction with the interface and indicated a willingness to continue using or recommend the system.

Conclusion: The virtual pharmacist consultation module demonstrates high acceptability and feasibility as a supplementary tool for clinical pharmacy services. By automating routine and repetitive medication inquiries, the system has the potential to alleviate pharmacist workload while enhancing medication safety. Future development should prioritize expanding the knowledge domain, strengthening risk detection and referral protocols, and fostering interdisciplinary collaboration within healthcare teams.

Cultural transformation: Successfully transitioning toward autonomous pharmacist prescribing in long-term care

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Background: In long-term care, pharmacy practice has traditionally been rooted in a culture centered on medical prescribing, limiting pharmacists to a primarily consultative role. This model often leads to clinical delays and underutilization of pharmacists' expertise. A Quebec project aims to fundamentally shift this dynamic by positioning pharmacists as autonomous prescribers, marking a significant cultural transformation within care teams and the profession. Despite challenges related to heavy workloads, staffing shortages, and limited time, a pilot project was launched to demonstrate that such a transition is achievable. Through mobilizing leadership, a supportive and collaborative environment, and communication strategies that reinforce

trust and innovation, the initiative successfully catalyzed change in less than two years.

Objective: The objective of the project was to transform the clinical culture of a team of 10 pharmacists working across five long-term care centers, serving 672 residents in the Outaouais region in the Quebec province. The goal was to shift from a consultative practice model to full autonomous decision-making for patient's pharmacotherapy.

Method: The approach involved conducting an initial assessment of the existing organizational culture, clarifying the project vision, and ensuring strong leadership engagement. Continuous communication, structured training, and professional mobilization were implemented to support the pharmacists throughout the transition. Progress was monitored through ongoing evaluation and iterative adjustments, enabling the initiative to reach its current stage of consolidation and long-term sustainability.

Results: Results show a significant and sustained improvement: the average number of autonomous prescriptions increased from 2 to 98 per week, achieved without additional staffing. Admission prescriptions, previously completed exclusively by physicians, now include an average of four pharmacist-completed admissions per week. Survey results indicate that 27% of pharmacists now issue autonomous prescriptions more than ten times per week, and their prescriber identity score is rated at 4 out of 5 on a Likert scale, demonstrating a strong sense of professional empowerment.

Conclusion: This project has proven to be a powerful cultural lever, repositioning pharmacists at the center of clinical decision-making and strengthening their professional identity as prescribers. This initiative offers a scalable and reproducible model for other long-term care settings seeking to modernize pharmacy practice and optimize patient care.

Generative AI-driven digital transformation of a clinical pharmacology course: Construction and evaluation of a teaching model based on the ADDIE framework

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Background: Clinical pharmacology serves as a critical bridge between basic science and clinical practice. However, traditional teaching often faces a "theory-practice gap," where students lack confidence in applying pharmacokinetic and pharmacodynamic principles to real-world clinical decision-making. With the advent of the "New Medical Science" era, Generative Artificial Intelligence (GenAI) offers

transformative potential for medical education. This study aimed to develop and evaluate a systematic digital teaching model to enhance students' clinical reasoning and digital literacy within a highly compressed 10-hour curriculum for eight-year medical students.

Method: Based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) framework, we constructed a "1-Center, 3-Collaboration, 5-Linkage" model. The "1-Center" focused on the "Pharm-E" (Purpose, Healthcare context, Abstract, Role, Methodology, Evidence) structured prompt framework. The "3-Collaboration" involved aligning scenarios, tasks, and roles, while the "5-Linkage" implemented a "Check-Act-Learn-Practice-Reflect" pedagogical path. Participants were 117 eight-year medical students from Peking University, divided into a trial group (n=58, Class 2022) receiving the GenAI-integrated model and a control group (n=59, Class 2021) receiving traditional teaching. Evaluation included academic scores, the Academic Self-Efficacy Scale, satisfaction surveys, and qualitative analysis of AI dialogue logs to observe students' corrective responses to pre-set "AI hallucination traps."

Results: The total score of the trial group (88.79 ± 6.27) was comparable to the control group (87.35 ± 12.28) with no significant difference ($p=0.422$). Notably, the trial group showed significantly higher stability with a 29.4% reduction in score standard deviation, and the proportion of students in the "pass and below" category (<70) dropped to 0% compared to 10.2% in the control group ($p=0.027$). In the trial group, the practice application efficacy score rose significantly from 3.12 ± 0.85 (pre-test) to 4.38 ± 0.62 (post-test) ($p<0.001$). Overall satisfaction reached 90.38%, with the highest rating for "Teacher-GenAI integration" (4.67 ± 0.52). Qualitative analysis of 52 dialogue logs revealed that 78.8% of students effectively identified AI "traps" (e.g., incorrect dosing suggestions in acute kidney injury) and performed "human-in-the-loop" corrections by invoking pharmacological evidence.

Conclusion: The GenAI-assisted model based on the ADDIE framework successfully integrated theory with clinical practice. It proved superior in ensuring the homogeneity of teaching quality and eliminating bottom-tier performance. By mastering the Pharm-E framework, students established a "GenAI-preliminary judgment, human-review, evidence-based decision" critical thinking pattern. This study provides a scalable digital transformation strategy for pharmacy education, shifting students from passive tool users to competent human-AI collaborative decision-makers.

Antimicrobial stewardship in a hospital intensive care unit: A comparative analysis of intervention strategies and clinician adherence (2024–2025).

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Background: Surveillance is a core component of antimicrobial stewardship (AMS), providing evidence to guide rational antimicrobial use, improve patient outcomes, and curb antimicrobial resistance. Routine AMS surveillance in the ICU includes ward rounds, monitoring antimicrobial prescribing patterns, microbiological culture and sensitivity testing, and evaluation of stewardship interventions. Comparing surveillance outcomes across consecutive years enables assessment of the growth of the AMS program and prescriber responsiveness. This study sought to compare antimicrobial prescribing practices, diagnostic investigations, and clinician adherence to AMS interventions in the ICU over two consecutive years.

Method: A retrospective comparative review of AMS surveillance data was conducted in the ICU of a quaternary hospital for 1st January to 31st December 2024 and 1st January to 31st December 2025. All patients reviewed during routine pharmacist-led AMS ward rounds were included (n=98 patients in 2024; n=51 in 2025). Data collected included demographics, infectious diagnoses, biomarker and microbiological investigations, antimicrobial prescribing patterns, and AMS interventions with clinician acceptance. Data were analyzed using STATA 18 descriptively using frequencies and percentages.

Results: In 2024, patients were predominantly female (56.1%) with most aged 31–60 years, while 2025 showed a male predominance (60.4%) and a wider age range (2–89 years). Sepsis was the most common diagnosis in 2024 (29.2%), whereas pneumonia predominated in 2025 (35.3%). Biomarker testing increased from 85.7% in 2024 to 100% in 2025, while culture and sensitivity testing increased slightly from 73.5% to 76.6%, with *Pseudomonas aeruginosa* remaining the most frequently isolated organism from culture & sensitivity tests. Antibiotic use remained high in both years (95.9% vs 96%), with empiric therapy being most frequent. Meropenem use increased from 40.8% in 2024 to 57.7% in 2025. AMS interventions focusing on optimizing antibiotic use, adjusting therapies based on cultures, and monitoring for toxicity increased from 64.3% of patients in 2024 to 71.1% in 2025, with clinician acceptance improving markedly from 26.5% to 75.5%.

Conclusion: This comparative analysis demonstrates strengthening of ICU antimicrobial stewardship practices between 2024 and 2025, reflected by improved diagnostic consistency and substantially higher clinician acceptance of

AMS interventions. Persistently high antibiotic use and increased reliance on meropenem highlight the need for ongoing surveillance and targeted stewardship strategies to address evolving infection patterns in the ICU.

Lean-guided reduction of medicine expiry in a multi-site hospital pharmacy network: A prospective quality improvement study in Ghana

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Background: Medicine expiry represents a significant and avoidable financial loss in hospital pharmacy settings in Ghana. Contributing factors include fluctuating demand due to public health events, unpredictable prescriber behaviour, non-adherence to hospital formularies, poor consumption-based stock allocation, and inadequate expiry date monitoring across dispensary units.

Objective: To implement and evaluate a structured, multi-component intervention to reduce medicine expiry losses across dispensary units within a private hospital network in Ghana.

Method: A prospective quality improvement study was conducted across eight dispensary units from October 2023 to June 2025, guided by Lean principles to reduce medication waste and optimize inventory management. Interventions incorporated Lean tools including 5S and visual management (systematic expiry tracking of over 370 stock-keeping units), standardized work and Gemba practices (routine physical stock counts and reconciliation), Kanban-based pull systems (consumption-driven stock allocation), Kaizen (ongoing prescriber engagement), and value stream optimizations (inter-facility redistribution of near-expiry medicines). Data was collected from the pharmacy inventory management system and validated through periodic physical counts. The primary outcome was the quarterly value of expired medicines (GHC). Secondary outcomes included stock discrepancies, reconciliation accuracy, and volume of near-expiry medicines redistributed. Data were analyzed descriptively to assess trends over time.

Results: The Lean-guided interventions across eight dispensary units resulted in a sustained reduction in expired medicine losses of 67%. Losses fell from GHC 29,236 in Q4 2023 to consistently below GHC 10,000 per quarter during the intervention period: GHC 9,667 in Q1 2024, GHC 9,527 in Q2 2024, GHC 9,778 in Q4 2024, and GHC 9,694 in Q2 2025. Stock reconciliation improved markedly, with routine counts and

Gemba walks identifying and correcting discrepancies, achieving >90% accuracy and near-complete compliance over 18 months. Consumption-based allocation and inter-facility redistribution optimised near-expiry medicine use: 376 items (>55,500 units) were flagged, and a single redistribution recovered 39,524 units (GHC 321,581). Kaizen-driven prescriber engagement contributed to improved ordering patterns, with a total of 62 structured prescriber engagement actions documented over the intervention period. Overall, 88 actions were undertaken to optimise inventory: 17 transfers, and 9 supplier returns and 62 prescriber engagements.

Conclusion: A structured, low-cost expiry management programme combining real-time monitoring, prescriber engagement, and inter-unit stock sharing achieved and sustained a marked reduction in medicine wastage. This replicable model offers practical lessons for hospital pharmacy teams across sub-Saharan Africa seeking to protect limited pharmaceutical budgets.

Prevalence of nosocomial infections in South African paediatric wards: A review study

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Background: Healthcare-associated infections (HAIs) increasingly endanger South African pediatric hospital wards. They occur after 48 hours of admission or soon after discharge and result in complications, prolonged hospital stays, and higher healthcare costs. They affect the bloodstream, urinary and respiratory tracts, and the skin and soft tissues. Low treatment response and increased mortality risk come with high fatality risk pathogens like *Klebsiella pneumoniae*. Multidrug - resistant, such as methicillin resistant *Staphylococcus aureus* (MRSA) also increase the complexity of management. The research aims to fill this void by conducting research to quantify the prevalence of NIs and assess the impact on pediatric healthcare in South Africa. Determining the primary causes and key bacteria involved are critical.

Method: The reviews used articles that were retrieved from different sources such as PubMed, google scholar, EBSCOhost and Cinahl and we focused on published articles between the year 2014 to 2024 across the South African paediatric wards. Endnote was used to reference the articles. Abstracts were screened to fully screen the inclusion and exclusion. The study was focused on identifying the prevalence and causes of nosocomial infections.

Results: A Total of 23 systematic reviews articles were identified and included in the study, the articles focused on prevalence of HAIs in South African paediatric wards. The studies reported a prevalence of 7% in non- ICU wards and the

PICU settings documented a rate of 29.1%, whereas pooled rate throughout the whole studies reported an average prevalence of 30.6 %, which indicated a higher risk burden of these nosocomial infections.

Conclusion: Overall the present evidence suggests that, regardless some improvements nosocomial infections continue to be a key cause of preventable morbidity and mortality among hospitalized children in South Africa. These findings have significant clinical implications: lowering HAI rates can directly reduce hospital stays, treatment costs, and antimicrobial resistance, ultimately improving paediatric survival outcomes. Policy recommendations include HAI indicators into hospital performance criteria, increasing investment in infection control infrastructure, and developing national surveillance systems for paediatric care. Strengthening these measures will be critical to achieve long-term gains in patient safety and healthcare quality across South African paediatric hospitals

Recognising and managing life-threatening osimertinib-associated pneumonitis during sepsis treatment: A medication-safety case emphasising diagnostic stewardship and EGFR-TKI switching

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Background: Osimertinib is a third-generation epidermal growth factor receptor tyrosine kinase inhibitor (EGFR-TKI) recommended as first-line therapy for metastatic non-small cell lung cancer (NSCLC) with sensitising EGFR mutations. Although generally well tolerated, osimertinib may cause rare but potentially life-threatening drug-induced interstitial lung disease (DI-ILD), including pneumonitis. In critically ill patients, overlapping clinical conditions such as sepsis, hospital-acquired pneumonia and tumour progression can obscure diagnosis, delaying appropriate medication-safety interventions. This case highlights diagnostic stewardship and medication management strategies in severe osimertinib-associated pneumonitis.

Method: A structured retrospective clinical review was conducted for an elderly woman with advanced EGFR-mutant NSCLC treated in Taiwan in 2025. Data were obtained from electronic medical records, including serial clinical assessments, laboratory parameters, microbiological investigations, bronchoscopy and bronchoalveolar lavage findings, radiological imaging, pleural fluid cytology with immunohistochemistry, medication exposure timelines and clinical outcomes. Adverse drug reaction causality was assessed using the Naranjo probability scale. Severity of pneumonitis was graded according to the Common Terminology Criteria for Adverse Events (CTCAE), version 5.0.

Results: A 79-year-old non-smoking woman with stage IVB lung adenocarcinoma harbouring an EGFR L858R mutation initiated osimertinib 80 mg once daily. Approximately four weeks later, she developed acute mixed respiratory failure with septic shock, requiring mechanical ventilation and renal replacement therapy. Legionella urinary antigen was positive, and multidrug-resistant *Pseudomonas aeruginosa* was subsequently isolated. Osimertinib was initially withheld while broad-spectrum antimicrobials and supportive treatment were administered. Despite extensive antimicrobial therapy and repeated diagnostic evaluations, respiratory failure persisted. Chest computed tomography performed in August demonstrated a dissociated radiological response, with reduction of the primary right upper-lobe tumour from 3.0 cm to 2.6 cm alongside worsening bilateral ground-glass opacities and consolidation. Pleural fluid immunohistochemistry was negative for thyroid transcription factor-1 and Ber-EP4, reducing the likelihood of malignant pulmonary spread. The combination of temporal association with osimertinib exposure, dissociated imaging findings, exclusion of disease progression and subsequent corticosteroid responsiveness supported a diagnosis of severe osimertinib-associated pneumonitis. Osimertinib was permanently discontinued, and high-dose systemic corticosteroids were initiated, leading to marked clinical improvement and successful ventilator weaning. For ongoing oncological management, afatinib was introduced under close monitoring during steroid taper. Follow-up imaging showed resolving inflammatory lung changes and stable disease. The event fulfilled CTCAE grade 4 criteria, with a Naranjo score of 5, indicating a probable adverse drug reaction.

Conclusion: Severe osimertinib-associated pneumonitis may be masked by sepsis and multidrug-resistant infection in critically ill patients. Diagnostic stewardship, including recognition of dissociated radiological response and exclusion of tumour progression, is essential for timely medication-safety decisions. Early permanent discontinuation of osimertinib and appropriate corticosteroid therapy enabled respiratory recovery. Switching to an alternative EGFR-TKI may allow continued cancer control following recovery from severe DI-ILD.

Preventing medication errors at hospital discharge: Pharmacist-led medication reconciliation for detecting and managing discrepancies

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Background: Hospital discharge is a critical transition point where medication errors frequently occur. Discrepancies may arise between medications taken prior to admission, those administered during hospitalisation, and the medications prescribed at discharge. Previous studies report that approximately 30–70% of patients experience medication discrepancies at discharge, with up to 60% considered unintentional and therefore representing potential medication errors. If these discrepancies remain unidentified, they may lead to adverse drug events (ADEs), reduced adherence to therapy, and a higher risk of hospital readmission within 30 days. Medication reconciliation is a structured process designed to ensure the accuracy and appropriateness of a patient's medication list during transitions of care. Pharmacists have been shown to play a key role in identifying and resolving medication discrepancies at discharge. However, evidence describing the scale and clinical relevance of pharmacist interventions at this stage remains limited in many healthcare settings. This study evaluates medication discrepancies detected during discharge medication reconciliation and assesses their potential clinical consequences. The objective of this study was to assess the contribution of hospital pharmacists in preventing medication errors through discharge medication reconciliation. Specifically, the study aimed to identify medication discrepancies occurring at discharge, categorise unintentional discrepancies according to medication error type, and estimate the potential severity of their clinical impact if they had not been detected.

Method: A retrospective descriptive study was conducted to evaluate near-miss medication errors identified during discharge medication reconciliation. The study took place in the inpatient wards of Cipto Mangunkusumo Hospital, Indonesia, from January to December 2025. Data were obtained from medication error reports and hospital discharge records. The study population included all patients discharged during the study period, while the sample consisted of patients in whom pharmacists detected near-miss medication errors during discharge medication reconciliation. Pharmacists compared three medication lists: pre-admission medications, medications administered within the last 24 hours before discharge, and discharge prescriptions. Identified discrepancies were categorised into types of medication errors, including omission, duplication, incorrect medication, wrong dose, wrong dosage form, and incorrect quantity. For each unintentional discrepancy, pharmacists also estimated the potential clinical impact if the

discrepancy had not been detected, classifying it as minor, moderate, or major.

Results: A total of 767 unintentional medication discrepancies were identified, representing a discrepancy rate of 1.6%. Omission was the most frequently identified error (72.5%), followed by wrong dose (14.5%), wrong dosage form (4.7%), duplication (3.7%), incorrect quantity (1.8%), medication without indication (1.3%), wrong medication (0.9%), and contraindicated medication (0.7%). Regarding potential clinical impact, 14% of discrepancies were classified as minor, 72.6% as moderate, and 13.4% as major. These findings indicate that many discrepancies could have led to clinically meaningful harm if not detected before discharge.

Conclusion: Pharmacist-led medication reconciliation at hospital discharge plays an important role in identifying and preventing medication errors during care transitions. The findings demonstrate that pharmacists are able to detect clinically significant discrepancies, many of which carry the potential for moderate to major clinical consequences if left unaddressed.

A multidimensional collaborative management model to improve study start-up efficiency: Retrospective analysis of 922 registrational drug clinical trials

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Background: Efficient study start-up is critical to the timely initiation of registrational drug clinical trials and to the overall research performance of hospital-based clinical trial institutions. However, prolonged start-up timelines remain a common operational challenge, particularly under increasing project workload. In response, integrated management strategies involving organisational reform, digital infrastructure development, process optimisation and cross-departmental collaboration have been introduced in many institutions. Although these approaches are widely considered beneficial, evidence remains limited regarding their measurable impact on study start-up efficiency across different categories of registrational drug clinical trials. This study examined whether a multidimensional collaborative management model was associated with improved study start-up efficiency and whether the magnitude of improvement differed across trial subgroups.

Method: A retrospective analysis was conducted of 922 registrational drug clinical trial projects with signed agreements at a national clinical trial institution between 2021 and 2025. Trials were classified into a pre-improvement

phase (2021–2022, n=289) and a post-improvement phase (2023–2025, n=633) according to the year of agreement signing. The interval from trial registration to agreement signing was defined as the study start-up cycle. Key stages included registration to initial review, initial review to ethics approval, and ethics approval to agreement signing. Group comparisons were performed using the Mann–Whitney U test. To account for workload, an approval intensity index was introduced and defined as the annual number of projects divided by the median duration of the corresponding stage. Negative binomial regression was used to analyse the association between calendar year and approval timelines and to assess interaction effects between year and subgroup characteristics, including innovative drugs, international versus domestic trials, and oncology trials.

Results: The median study start-up cycle decreased from 128 days in the pre-improvement phase to 87 days in the post-improvement phase, representing a 38.3% reduction ($P<0.05$). Stage-specific analysis showed that the median registration-to-initial-review interval decreased from 15 to 3 days ($P<0.05$), while the median ethics-approval-to-agreement-signing interval decreased from 52 to 27 days ($P<0.05$). The approval intensity index for the initial-review-to-ethics stage increased from 2.58 to 4.06, indicating improved processing capacity despite increased workload. Negative binomial regression showed a significant year-on-year reduction in approval timelines across all subgroups. No statistically significant interaction effects were observed between year and subgroup dimensions ($P>0.05$), suggesting that efficiency gains were broadly comparable across different trial types.

Conclusion: The multidimensional collaborative management model was associated with substantial improvements in study start-up efficiency for registrational drug clinical trials. Strengthened internal governance, digital infrastructure, cross-departmental collaboration and continuous workflow optimisation were associated with shorter timelines and enhanced processing capacity under increasing workload. The findings suggest that this management approach can deliver balanced efficiency gains across multiple trial categories and may provide a practical reference for research-oriented hospitals and clinical trial institutions seeking to strengthen trial management performance.

What matters to you? Three years of wellbeing conversations with a large pharmacy department

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Background: Practitioner wellbeing has long been a concern in healthcare, with burnout recognised since the 1980s.

Recent workforce strategies emphasise employee experience as essential to sustaining safe, high-quality care. Rising mental health–related workplace injury claims in Australia reinforce the need for approaches that improve engagement, psychological safety and staff wellbeing. The Institute for Healthcare Improvement (IHI) Framework for Improving Joy in Work provides a structured method to understand staff experience through What Matters to You (WMTY) conversations and supports teams to address workplace challenges using improvement science. The organisational Strategic Plan (2026–2031) places “Joy in Work” as a priority, aligning with regulatory requirements for psychological safety. There is a clear need for access to timely, local, candid feedback mechanisms to generate actionable insights.

Objective: This work describes three years of using the IHI framework within the Pharmacy Department of a large metropolitan public hospital in Melbourne. The aim was to understand what matters most to pharmacy staff, identify barriers to wellbeing and translate findings into practical actions that support an engaged workforce.

Method: Two rounds of WMTY conversations were undertaken across a three-year period with the pharmacists and pharmacy technicians across Monash Health sites. The department experienced significant growth during this period, with headcount increasing from 464 (2022) to 566 (2024). Round 1 (2022–2023) used two week listening periods at each site. 338 staff (72.8%) participated via group discussions, surveys and individual conversations. Round 2 (2024) engaged all sites in a single two week period through existing team meetings, involving 219 staff (38.7%). Across both rounds, 2060 responses were collected. Responses were mapped to IHI domains and local themes, with feasible actions developed in collaboration with site leaders. Each two-week period concluded with a “You Said, We Did” session providing real time feedback. All comments were coded for sentiment, domain and keywords to assess trends, differences across sites and emerging priorities.

Results: Daily Improvement was the most frequently cited domain and showed high negative sentiment in both rounds (82.0% and 83.9%). Staff described frustration with digital system reliability, device access, workflow duplication and other operational inefficiencies. In Round 2, Real Time Measurement also showed high negative sentiment (80 %), reflecting concerns about documentation burden and inconsistent data processes. Conversely, staff expressed consistently positive sentiment about Camaraderie and Teamwork, Recognition and Rewards and Meaning and Purpose, indicating strong interpersonal culture and shared professional values. Keyword patterns shifted over time: Round 1 focused on teamwork, workload, rosters and respect, while Round 2 emphasised workspace adequacy, electronic medical record challenges, leadership and wellbeing. The proportion of responses linked to actionable items increased from 61.3 % to 79.3 %.

Conclusion: This work demonstrates that recurring, structured qualitative feedback provides timely insights into

workforce experience. A strong team culture coexists with operational challenges related to rostering, digital systems, device availability and workflow duplication. Future work will integrate findings from a psychological safety study and undertake a third cycle of WMTY conversations in 2026 with an expanded focus on communication preferences, belonging and psychological safety.

Ceftaroline-induced agranulocytosis during prolonged therapy for MRSA endocarditis: A case report

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Background: Ceftaroline is a fifth-generation cephalosporin with activity against methicillin-resistant *Staphylococcus aureus* (MRSA) and is commonly reserved for complicated infections requiring prolonged antimicrobial therapy, including infective endocarditis. Although generally well tolerated, hematologic adverse effects such as neutropenia and agranulocytosis have been reported, particularly with extended treatment courses. Patients with renal impairment or multiple comorbidities may be at increased risk of drug-related adverse events. We report a case of severe but reversible agranulocytosis in a patient with renal impairment receiving prolonged ceftaroline therapy, highlighting the importance of close laboratory monitoring during extended antimicrobial treatment.

Case Presentation A 70-year-old woman with sick sinus syndrome status post cardiac implantable electronic device (CIED) implantation, hypertension, type 2 diabetes mellitus, and chronic kidney disease stage 3B was admitted on 8 May for recurrent pacemaker-related MRSA infective endocarditis. Following surgical removal of the infected leads, ceftaroline therapy was administered from 19 May to 17 June (30 days). Baseline laboratory values on Day 1 of ceftaroline therapy showed WBC 11,620/ μ L and ANC 9,296/ μ L. ANC decline began on Day 16 of therapy (7,008/ μ L) and progressively decreased despite renal dose adjustment (Day 21: 4,251/ μ L; Day 23: 2,982/ μ L; Day 26: 549/ μ L). On Day 30, ANC reached a nadir of 9/ μ L, consistent with agranulocytosis, and ceftaroline was discontinued immediately. Antibiotics were switched to teicoplanin with protective isolation. Granulocyte colony-stimulating factor (G-CSF; filgrastim 250 mcg daily) was administered from Day 32 to Day 40. ANC remained critically low on Day 33 (26/ μ L) but subsequently recovered to 6,474/ μ L within 10 days after ceftaroline discontinuation. During recovery, transient reactive immunologic changes, including atypical lymphocytes and large granular lymphocytes, were observed. The patient stabilized with negative follow-up blood cultures and was discharged with outpatient follow-up.

Discussion Previous reports have described neutropenia and agranulocytosis associated with prolonged ceftaroline

therapy, particularly beyond 14 days of treatment. In this case, ANC decline occurred during ceftaroline exposure with recovery after drug discontinuation. Alternative causes of agranulocytosis were excluded. Concomitant medications with potential hematologic toxicity, including vancomycin, cefepime, and teicoplanin were temporally inconsistent with the onset of neutropenia; notably, subsequent treatment with teicoplanin did not reproduce the hematologic abnormality. The Naranjo Adverse Drug Reaction Probability Scale score was 6, indicating a probable association. The abrupt decline in ANC, together with transient reactive lymphocyte changes during recovery, is compatible with a peripheral immune-mediated process, supporting a probable causal association with prolonged ceftaroline exposure.

Conclusion: Prolonged ceftaroline therapy may be associated with sudden and severe agranulocytosis, particularly in patients with renal impairment. The rapid hematologic decline observed within a few days underscores the importance of close complete blood count monitoring during extended therapy and prompt drug discontinuation at early signs of neutropenia to prevent life-threatening complications.

Entecavir: Continuous self-paid therapy in patients with chronic hepatitis B at a regional hospital in Taiwan

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Background: Chronic hepatitis B virus (HBV) infection has long been a major contributor to chronic liver disease and liver cancer in Taiwan. Following the nationwide newborn hepatitis B immunization program implemented in 1984 and the introduction of oral antiviral treatment allowance under the National Health Insurance (NHI) system since 2003, HBV prevalence in younger generations and liver-related mortality have markedly declined. Nevertheless, many adults with chronic hepatitis B still require long-term antiviral therapy to maintain viral suppression. Under current NHI policies, some patients are required to discontinue treatment or switch to self-paid therapy before achieving long-term treatment goals, such as functional cure indicated by hepatitis B surface antigen (HBsAg) loss. Relapse after nucleotide analogue (NA) discontinuation is common and may be followed by hepatitis flares. A recent meta-analysis reported pooled 12-month cumulative incidences of 63% for virological relapse and 35% for clinical relapse among HBeAg-negative patients after NA discontinuation. International guidance reflects these risks. The Asian-Pacific Association for the Study of the Liver (APASL) permits NA cessation only under strict criteria with close monitoring and generally favors treatment until HBsAg loss because of high relapse risk. World Health Organization (WHO) guidelines further emphasize restarting antiviral therapy when consistent signs of HBV reactivation are

present. In real-world practice, concern over relapse may lead both physicians and patients to favor continuous therapy, even through self-paid regimens.

Method: We conducted a retrospective study at a regional hospital in Tainan, Taiwan, including patients with chronic hepatitis B managed by the gastroenterology department who received self-paid entecavir 1 mg therapy in 2025. Medical records were reviewed to determine prior antiviral treatment history, focusing on patients who used entecavir 1 mg throughout their treatment course. Patients were categorized as either never having discontinued therapy or having previously discontinued NHI-covered therapy. For patients who discontinued treatment, therapy was restarted based on clinically meaningful reappearance of viral activity or liver enzyme abnormalities. Eligibility for NHI retreatment at the time of treatment reinitiation was assessed.

Results: A total of 115 patients receiving self-paid entecavir 1 mg therapy were analyzed. The majority (92/115, 80.0%) had never discontinued antiviral therapy, indicating that continuous treatment was the predominant pattern of care. Thirteen patients (11.3%) had previously discontinued therapy, and 12 (10.4%) restarted antiviral treatment after cessation. None of the patients who restarted therapy met NHI retreatment criteria at the time of treatment reinitiation and therefore required self-paid therapy. During routine clinical encounters, several patients reported alanine aminotransferase elevation shortly after treatment cessation, which may have reinforced a preference for ongoing therapy.

Conclusion: In this cohort, continuous self-paid entecavir therapy was the predominant real-world practice. This pattern appears to reflect concern regarding the high risk of relapse after treatment discontinuation and a cautious clinical approach favoring early treatment reinitiation. Antiviral therapy was frequently restarted at early biochemical or virological changes, consistent with international guidance emphasizing vigilance for hepatic dysfunction after NA cessation.

Determining the use and reasons for non-de-escalation of empiric carbapenem therapy in a private hospital in South Africa

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Background: Due to the rising incidence of Extended-spectrum -lactamases (ESBLs) -producing bacterial infections the use of carbapenems has increased over recent decades. Carbapenems are part of the group of last-resort antimicrobials and are used widely as empirical therapy, which is contributing to the growing rate of antimicrobial resistance (AMR). De-escalation has been proven to be a

successful tool in antimicrobial stewardship programmes (ASPs) in minimising the occurrence of AMR and decreasing the use of antimicrobials. It is defined as the timely narrowing or discontinuation of broad-spectrum empiric antimicrobial therapy once pathogen data or clinical improvement is observed. It is a cornerstone of antimicrobial stewardship. By reducing unnecessary exposure to potent agents, de-escalation helps preserve antibiotic effectiveness, minimize adverse effects, and slow the emergence of antimicrobial resistance, thereby safeguarding future treatment options. The purpose of the study was to find the reasons why prescribers do not de-escalate from empiric carbapenem therapy.

Method: This retrospective quantitative study was conducted in a private hospital in South Africa. A retrospective approach was conducted by following all the patients that were prescribed carbapenems during this period. Patient demographics, diagnosis on admission, infection markers, culture results, carbapenem used as empiric therapy and whether therapy was de-escalated within 72 hours were obtained. Reasons for not de-escalating therapy were compiled and this data was analysed. The infection markers and cultures of these patients were considered.

Results: Approximately 1 754 patients were admitted to the wards, with a total of 197 (11.2%) patients started empirically on carbapenems. The most prescribed carbapenem was ertapenem (62.4%) followed by meropenem (25.4%). If resistance to carbapenems were seen, polymyxins (18.2%) were the drug of choice. Cultures were available in 71.1% of the study population with *E. coli* being the most cultured organism (37.3%), followed by *K. pneumoniae* (26.7%). Culture availability led to de-escalation ($p=0.003$) and positive cultures also guided de-escalation ($p<0.001$). However, de-escalation was practiced in 17% of the patients. De-escalation was not performed in 83% of patients, because their infection markers decreased with carbapenem therapy (45.9%) or because of culture unavailability (28.9%).

Conclusion: The study came to the conclusion that prescribers do not want to de-escalate once their patients are improving on current treatment or if there are no cultures available.

Opioid prescription audit at time of discharge in post-surgical patients

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Background: The Canadian Institute for Health Information has documented a rise in opioid-related harms across Canada, reporting a 16% increase in hospital admissions for opioid-related harms between 2022 and 2023. Postoperative opioid prescriptions frequently exceed actual patient needs, leaving large quantities of unused tablets that may be diverted for non-medical purposes. Furthermore, receiving an opioid prescription at hospital discharge is associated with an increased risk of long-term opioid use. Despite these concerns, evidence remains limited regarding the optimal quantity of opioids to prescribe at discharge for patients requiring more than 24 hours of hospitalisation after surgery.

This audit builds on a 2021 project conducted at the Jewish General Hospital (JGH) as part of the pharmacy residency programme at the University of Montreal. That study showed that more than half of dispensed opioid tablets remained unused. Findings were presented to the surgical team and informed early efforts to promote safer prescribing. As part of ongoing quality-improvement initiatives at the JGH, this follow-up audit was undertaken to evaluate current prescribing practices and further increase prescriber awareness of appropriate postoperative opioid prescribing.

Purpose. The audit had two objectives: (1) to describe opioid-prescribing practices at discharge for post-surgical patients between January and April 2025; and (2) to evaluate the conformity of these practices with local, evidence-based recommendations developed to promote safe opioid stewardship.

Method: A retrospective chart review (n = 201) was conducted on patients admitted for more than 24 hours following elective general, colorectal, vascular, ear-nose-throat, urological, or gynaecologic oncology surgery. Extracted data included demographic characteristics, relevant medical history (e.g., chronic pain, substance misuse), surgical details, use of postoperative co-analgesia, opioid administration in the 24 hours prior to discharge, and discharge prescription information, including opioid type, dose, and quantity. Data collection occurred exclusively on site and was stored in a secure, access-restricted folder on the centre's protected network. The project received formal approval from the Quality Department.

Results: The median number of opioid tablets prescribed at discharge was 10 for oxycodone and hydromorphone and 15 for morphine. These values were comparable to those reported in the 2021 study yet remained lower than figures described in the wider literature. The median morphine milligram equivalent (MME) was also lower (50 mg vs 75 mg), and the interquartile range was narrower (37.5-75.0 vs 48.8-100.0), indicating a trend towards reduced prescribed doses. Co-analgesia was prescribed for 161 patients (96%). Notably, 86 patients (43%) were discharged with an opioid prescription despite having received no opioids in the preceding 24 hours; this practice was most common among colorectal, gynaecological, and vascular surgery patients.

Conclusion: When prescribing opioids at discharge, clinicians should assess whether the patient required opioids in the prior 24 hours. If no opioid doses were needed, an opioid prescription may be unnecessary, or a small quantity (1 to 5 tablets) may suffice. Tailoring discharge prescriptions to actual postoperative use can reduce unnecessary dispensing, improve patient safety, and support community pharmacists in appropriate dispensing practices.

Argatroban: An audit of the Jewish General Hospital's nomogram after a decade of use

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Background: Argatroban is an anticoagulant used primarily in patients with heparin-induced thrombocytopenia (HIT) who have severe renal impairment or in whom rapid reversibility is required. As with unfractionated heparin, the drug produces a highly variable response despite weight-based dosing. At the centre, a nomogram was developed in 2012 to guide dose adjustments based on activated partial thromboplastin time (aPTT); however, it has not been reviewed since its implementation. There is also a paucity of scientific literature regarding Argatroban nomogram dosing. To support continuous quality improvement for patients admitted to the Jewish General Hospital, an audit was conducted of all patients who had received this drug over the past 10 years, with the aim of improving the quality of care by ensuring treatment appropriateness and minimising adverse effects.

Purpose. This project had three objectives: (1) to describe how the current Argatroban protocol was followed; (2) to evaluate whether the nomogram enabled appropriate levels of anticoagulation to be achieved for the maximum amount

of time; and (3) to propose adjustments to the nomogram if required.

Method: A PharmD student, supervised by two pharmacists, conducted a retrospective chart review of patients who had received Argatroban within the past 10 years ($n = 50$). One pharmacist (RK) is a recognised expert in thrombosis. Data collected included demographic information (e.g., age, sex, weight), protocol-related details (e.g., baseline aPTT, starting dose, timing of subsequent aPTTs), and prescribing information (e.g., initiation date/time, indication, HIT assay). Data were collected exclusively on site and stored in a protected folder within the centre's secure network, with access restricted to authorised audit personnel. The project received formal approval from the Quality Department.

Results: The review showed that 21% of patients had confirmed HIT. Argatroban was prescribed for an appropriate indication in 85% of cases. The nomogram was followed correctly in 95% of patients who were not critically ill, and in 80% of patients with hepatic impairment or critical illness; in several of these cases, the incorrect starting dose had been prescribed, or the patient was not, in fact, critically ill. Seventy per cent of patients had a subtherapeutic aPTT before Argatroban initiation, and the median time to achieving a therapeutic aPTT was 6.5 hours. For the majority of patients ($n = 22$), dosing adjustments were performed in accordance with the protocol. Treatment was interrupted in two cases (5%) due to bleeding. Only one patient experienced a new thrombotic event during therapy.

Conclusion: Overall, the nomogram was applied correctly and for appropriate indications in most cases. Although dosing rates were correctly adjusted for the majority of patients, the requirement to measure aPTT every 1 to 3 hours can be labour-intensive for nursing and medical teams. The small number of patients who experienced significant bleeding or thrombotic complications had comorbidities that independently increased their risk. Based on these findings, no modifications to the current nomogram are anticipated. Future work may involve validating the protocol with a larger sample.

Cost minimising economic analysis on daptomycin replacement to IV vancomycin at Montreal University's hospital

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Background: In Infectious Diseases, vancomycin is often considered the gold standard for resistant Gram-positive

infections, or as a broad coverage empirical therapy. However, nephrotoxicity, rigorous timely therapeutic drug monitoring and frequent IV administration makes this treatment complicated and resource intensive. This generates costs related to frequent administration and hospital time (physicians, nurses, pharmacists and laboratorians) for dose adjustments. Daptomycin is a similar antibiotic used in Gram-positive infections, including methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE). It is considered a reasonable alternative to vancomycin, but cannot be used in lung infections, because it is inactivated by pulmonary surfactants. Currently, Quebec's provincial drug plan does not cover daptomycin because of its high listing price, much more expansive than vancomycin, especially for outpatient therapy. However, given its recent price drop and simpler follow-up, daptomycin could hypothetically be less expensive when analysed from a larger perspective.. This economic evaluation aims to verify, based on a hospital perspective, if daptomycin is cheaper than vancomycin for the treatment of bacterial infections.

Method: Patients treated with at least 72-hour of IV vancomycin between April 1st, 2024, and March 31st, 2025 were randomly selected and analysed. Any treatment referring to pneumonia, sepsis with no source identified or CNS infections were excluded from the analysis, since daptomycin is not indicated for these clinical situations. Resources tallied were, among others, blood draws for creatinine surveillance and vancomycin therapeutic monitoring, antimicrobial susceptibility testing and clinical dosage adjustment consultations. This data was then exported to Microsoft Excel, and with the individual price of lab analyses, pharmacist and nurse hourly rate and price of both drugs, the total average cost of both treatments was calculated for the same duration.

Results: With this analysis using a Quebec hospital's perspective, the average cost per patient for an IV vancomycin treatment of at most 40 days was estimated at 314.47\$, while the hypothetical daptomycin replacement treatment amounted to 275.47\$ for the same time interval. These costs included the acquisition price for both drugs as well as the perfusion bags needed for the whole treatment duration, blood draws for dosing creatinine, vancomycin and CPK, as well as pharmacist and nursing time needed for the surveillance of both therapies. The cost difference was mainly affected by therapeutic drug monitoring and serious adverse drug reaction treatment, such as dialysis.

Conclusion: It becomes apparent how the added costs from vancomycin follow-ups render the overall treatment more expensive, making daptomycin a more cost-efficient treatment plan for resistant infections targeted by both antibiotics. With this real-world data analysis, daptomycin could be considered as an alternative to IV vancomycin when clinically appropriate. Future studies should address indirect costs of daptomycin replacement, like outpatient's time-consuming follow-ups and the overall safety of daptomycin use at a larger scale.

Rethinking ambulatory care clinic utilization: identifying opportunities to optimize medication administration in a tertiary/quaternary hospital

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Background: Ambulatory Care Clinics (ACC) enable the delivery of treatments, diagnostic procedures, and medical care without hospital admission. In tertiary and quaternary care settings, optimal use of ACC requires prioritizing interventions that truly depend on hospital resources. Evaluating the appropriateness of medication administration in ACC is therefore essential to optimize resource allocation and support higher-acuity care activities.

Objective: To develop recommendations to improve medication administration processes in ACC by integrating clinical and organizational relevance criteria.

Method: A process mapping of ACC planning and medication administration was conducted through document review (forms and procedures) and interviews with key stakeholders. A logical framework model was used to assess alignment between resources, activities, and expected outcomes. All medications administered in ACC between September 1, 2024, and August 31, 2025, were identified using institutional databases. A retrospective analysis was performed on the 20 most frequently administered medications to assess the context and justification of use. Additionally, selected complex or contentious cases were reviewed in collaboration with ACC and pharmacy teams.

Results: The medication administration process includes medical prescription, nursing validation, appointment scheduling, and pharmacy preparation in accordance with regulatory requirements. Analysis revealed substantial variability in the reasons for ACC use, which were categorized as clinical, organizational, or administrative. While some cases clearly required a hospital setting (e.g., need for monitoring or concomitant therapies), many appeared driven by limited access to community services or insurance constraints. Several cases lacked documented justification, limiting assessment of appropriateness. The mean patient travel distance to ACC was 20.7 km, suggesting that some care could be safely delivered closer to home.

Conclusion: Defining clear relevance criteria and strengthening coordination with community and institutional partners could support a safer and more efficient redistribution of certain medication administrations outside the hospital setting.

Description of the usage of last line antibiotics against multidrug resistant gram-negative bacteria in two teaching hospitals of Montreal

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Background: Over the past decade, antimicrobial resistance has increased in Canada and Quebec, particularly among Gram-negative pathogens such as *Escherichia coli* and *Klebsiella pneumoniae*. The prevalence of extended-spectrum beta-lactamase (ESBL)-producing *E. coli* rose from 3.6% in 2007–2008 to 11.8% in 2021–2023, while ESBL-producing *K. pneumoniae* increased from 2.2% to 8.0% over the same period. In Quebec, the incidence of nosocomial infections caused by carbapenemase-producing Gram-negative bacteria (CP-GNB) reached 0.16 per 10,000 patient-days in 2023–2024, while colonization rates increased to 2.92 per 10,000 patient-days in university-affiliated hospitals—nearly doubling compared to the previous year. In response to rising resistance, the use of newer broad-spectrum antimicrobials targeting multidrug-resistant Gram-negative organisms has increased, including drugs accessed through special access programs (SAP). This analysis aims to describe trends in the use and costs of broad-spectrum antimicrobials targeting multidrug-resistant Gram-negative bacteria in two teaching hospitals in Montreal.

Method: This descriptive analysis used retrospective data from two teaching hospitals in Quebec. Consumption of selected broad-spectrum antimicrobials (e.g., ceftazidime/avibactam, ceftolozane/tazobactam, meropenem/vaborbactam, imipenem/relebactam, and cefiderocol) was measured using defined daily doses (DDD) and days of therapy (DOT). Direct acquisition costs were also calculated.

Results: In both hospital settings, there has been increased reliance on broad-spectrum agents including newer β -lactam/ β -lactamase inhibitor combinations (ceftazidime/avibactam, ceftolozane/tazobactam, meropenem/vaborbactam, imipenem/relebactam) and cefiderocol for severe infections. Combined consumption rose from 4.38 DDD per patient-day in 2022 to 6.7 in 2025. Similarly, DOT increased from 1.6 to 2.9 per 1,000 patient-days. Total acquisition costs reached \$1.4 million in 2025, with one hospital peaking at \$2.1 million in 2024.

Conclusion: Use and costs of newer broad-spectrum antimicrobials targeting multidrug-resistant Gram-negative bacteria are increasing. Coordinated national strategies are needed to optimize access to these agents while mitigating further antimicrobial resistance.

Pharmacovigilance point prevalence survey of adverse drug reactions at the centre hospitalier de L'Université De Montréal (CHUM)

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Background: Adverse drug reactions (ADRs) are very common in hospital settings. They can even be the reason for hospitalisation, prolong a hospital stay, cause a disability or lead to death. Serious ADRs must be reported to Health Canada under Vanessa's Law. At the Centre hospitalier de l'Université de Montréal (CHUM), despite a well-established procedure to facilitate reporting and transmission of serious ADRs, reports remain very infrequent. Many ADRs are also preventable due to well-known high-risk drugs.

Objective: The objective is to estimate the rate of ADRs among patients admitted to the CHUM at a specific point in time (point prevalence). Reactions will be described by type, severity, reporting requirement under Vanessa's Law, and the drug involved. The utility and performance of trigger tools in guiding research will also be assessed.

Method: A retrospective observational study is conducted by reviewing files of patients admitted on 4 November 2025. Data from a sample of 350 files will be collected to estimate the annual ADR rate. Trigger tools from the Institute for Healthcare Improvement are used to identify records requiring further investigation and to improve ADR detection; the list was adapted to CHUM's clinical context. Data collection is performed by research assistants and pharmacists, with the pharmacist reviewing selected records.

Results: Among the 350 case files reviewed, a total of 56 ADR (16%) was detected, comprising 32 serious and 24 non-serious reactions. Of the serious ADRs meeting Vanessa's Law criteria, only four were officially reported. The adapted trigger tools successfully identified 23 of the 56 ADRs. Frequently implicated medication classes included central nervous system agents, hormones, anti-infectives, antineoplastics, cardiovascular agents, and electrolytes/diuretics. Serious ADRs requiring reporting included, among others, bradycardia, delirium, hypotension, paroxysmal supraventricular tachycardia, sinus tachycardia, diplopia, renal toxicity, electrolyte imbalance, thrombocytopenia and febrile neutropenia.

Conclusion: This assessment confirms that ADRs are common among hospitalised patients and that reporting of serious

ADRs is suboptimal at the CHUM. Most of the drugs involved are known for their risks, suggesting that some ADRs could have been prevented. Trigger tools are therefore useful for identifying ADRs, although the process remains laborious and imperfect. An awareness campaign targeting relevant healthcare professionals will be launched to reinforce the importance of documenting and reporting serious ADRs. An annual prevalence survey is being considered, with a research strategy to be refined. The aim is to enhance documentation, better quantify associated risks, prevent avoidable ADRs and improve patient safety. These findings support the importance of conducting regular ADR prevalence assessments using trigger tools.

Clinical activities and implication of hospital pharmacists in solid organ transplant programs: A province-wide survey

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Background: Pharmacists are an essential part of any multidisciplinary healthcare team treating solid organ transplant (SOT) patients. Guidelines published in 2019 by the American Society of Health-System Pharmacists (ASHP) provide recommendations on optimal services and best practices for hospital pharmacists involved in SOT patients care. Detailed and contemporary information on pharmacy services currently dispensed in SOT programs in Quebec is lacking.

Objective: The aim of this study was to describe the current state of clinical pharmacy services in SOT programs across the Canadian province of Quebec.

Method: An online survey was designed and sent to all pharmacy departments of hospitals with at least one SOT

program in the province of Quebec, Canada. The survey comprised 39 questions spanning across five domains of pharmacy practice – clinical care, services, research, education and management – and explored topics in accordance with the previously mentioned ASHP guidelines. Surveys were distributed to and filled by one clinical pharmacist per SOT program.

Results: Every hospital centre (8/8, 100%) responded, yielding 16 surveys, representing 16 different SOT programs including heart (n = 4), kidney (n = 6), liver (n = 3), lung (n = 1) and pancreatic (n = 2) transplantation. A total of 7/8 (88%) hospital centres and 15/16 (94%) SOT programs reported having clinical pharmacy services dispensed for SOT patients. Most SOT programs (11/16, 69%) have collaborative practice agreements in place for clinical pharmacy services. Most SOT programs (11/16, 69%) reported having regular medical rounds; of these, 7/11 (64%) include pharmacists all or most of the time. A minority of SOT outpatient clinics (6/16, 38%) have pharmacists dispensing clinical care on a regular basis, while the same proportion (6/16, 38%) have pharmacists dispensing clinical care on a on-demand basis only. Most hospital centres (7/8, 88%) reported publishing at least one SOT-related article with pharmacist authorship in a peer-reviewed journal in the past five years. Only 1/16 (6%) SOT program reported pharmacists validating prescriptions directly from the ward. No hospital centre reported having pharmacists with specialized clinical pharmacy SOT certification.

Conclusion: This survey provides a comprehensive overview of clinical pharmacy services currently dispensed in SOT programs in Quebec, Canada. The extent of pharmacists' involvement in these programs varies across different hospital centres.

Description of a pharmacy-led team to improve prescribing practices and ensure optimal drug use at capitale-nationale integrated university health and social services centre

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Background: Ensuring safe, consistent, and evidence-based medication use across complex healthcare systems remains a significant challenge. The Capitale-Nationale Integrated University Health and Social Services Centre (CIUSSSCN) is a large healthcare organisation delivering care across a broad continuum, including community-based primary care clinics, acute-care hospitals, rehabilitation services, and long-term

care facilities. In 2022, the Department of Pharmacy established a pharmacy-led team dedicated to optimal drug use, named Usage Optimal du Médicament (UsOpMed), to support prescribing practices across CIUSSSCN diverse clinical settings. This team ultimately comprises five hospital pharmacists who dedicate part of their professional time to optimal drug use initiatives.

Method: A descriptive analysis was performed using a prospectively maintained Excel database documenting all completed UsOpMed initiatives from January 2024 to February 2026 were used. Initiatives were categorised as standardised order sets, collective prescriptions, formulary drug evaluations or other medication-use support activities, which could include the development of clinical guidance documents. All initiatives were based on pharmacotherapeutic evaluations using standard drug information databases and drug monographs. When relevant, structured literature searches were undertaken, complemented by the judicious integration of artificial intelligence tools specialised in literature retrieval. Descriptive statistics were used to summarise the number and nature of initiatives completed during the study period.

Results: Over the study period, a total of 123 initiatives were completed. This included the development or revision of 29 standardized order sets, such as status epilepticus management and thromboprophylaxis, and the review of 14 collective prescriptions, notably a nurse-initiated order for salbutamol inhaler in patients presenting with bronchospasm. In addition, 18 medications or medication classes underwent formulary drug evaluations, for instance the revision of inhaler use with automatic substitution favouring options with lower environmental impact. A total of 62 medication-use support initiatives were completed, including the development of 24 clinical guidance documents, 8 of which are maintained and regularly updated. These initiatives addressed diverse clinical needs, such as the development of evidence-based guidance on renal function estimation methods, comparative evaluation of drug–drug interaction software, and assessment of the feasibility of administering specific parenteral medications in community-based ambulatory care settings without on-site physician supervision. Collectively, these initiatives promoted greater consistency, safety and standardisation of prescribing practices across the organisation. Beyond internal implementation, several clinical documents have been shared outside the organisation, including the Geriatric Medication Review Tool, an interactive web-based resource that was translated into English to support broader accessibility.

Conclusion: A dedicated pharmacy-led optimal drug use team can generate a substantial volume of structured, evidence-based initiatives that support safe prescribing and rational medication use across a large, integrated healthcare organisation.

Development of a five-resource toolkit to improve medicines management for patients with Parkinson's disease in hospital and long-term care settings

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Background: Current gaps in knowledge regarding the management of patients with Parkinson's disease undermine the safe and effective treatment of these particularly vulnerable patients, resulting in avoidable harm. To address these gaps, members of the Regroupement de pharmaciens experts en gériatrie of the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), a professional group of clinical pharmacists experts in geriatrics, developed a toolkit aimed at improving medicines management for patients with Parkinson's disease in hospital and long-term care settings in Quebec.

Method: In 2023, a literature review was conducted searching grey literature sources and PubMed database combining MeSH and free-text terms on available resources to educate Parkinson's disease patients and healthcare workers on the management of their medicines in healthcare settings. A notable lack of educational resources for Quebec hospital health workers was observed. In comparison, various initiatives, such as Aware in Care, Get it on Time and ACT on Time, were developed in other jurisdictions in recent years but are not adapted to the reality of the Quebec healthcare system. Examples of interventions that could be undertaken to ensure that Parkinson's disease patients receive the "right medicine at the right time" were also identified. Informational resources were developed and aimed to inform and recommend strategies to improve medicines management for these patients.

Results: A total of five resources were produced by members of the group of clinical geriatric pharmacists and published in 2026. First, a one-pager document intended for patients with Parkinson's disease visiting the hospital, whether planned or unplanned, was developed. Reviewed by a patient partner, the document provides concise recommendations on key items to bring during their hospital visit, such as an up-to-date, comprehensive medicines list, and includes recommendations for the healthcare team regarding, for

example, which medicines to avoid and the importance of administering medication on time. A second resource, tailored to the nursing team, emphasises the importance in minimising delays in administering time-sensitive medicines. Third, an assessment grid was designed to assist nursing staff in evaluating motor symptoms in patients with Parkinson's disease. A fourth resource focusing on medicines management in the perioperative setting was produced. Finally, a tool summarising ten recommendations on the safe and timely distribution of medicines within health facilities was developed. The five resources in the toolkit were revised by pharmacists, a neurologist, a nurse practitioner, and a clinical nurse educator.

Conclusion: This toolkit summarises currently available evidence and draws on multidisciplinary expertise to provide guidance in improving medicines management for patients with Parkinson's disease. The resources are expected to be consulted numerous times considering how the clinical tools previously published by the Regroupement de pharmaciens experts en gériatrie were viewed more than 1,100 times in Canada and globally in 2025. The development of the toolkit not only supports pharmacists as their scope of practice continues to expand to include broader prescribing authority, but it also serves as a valuable resource for members of the healthcare team for providing safe and effective care.

Development of a clinical tool on the management of high ileostomy output for hospitalised patients

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Background: According to the Ostomy Canada Society, over 150,000 Canadians live with an ostomy. Of these patients, many will likely be admitted to hospitals where very few clinicians possess the necessary tools and knowledge to provide adequate care to these patients. Patients with an ileostomy in particular bear an increased risk of high output stomas, which can lead to serious complications, such as dehydration and acute kidney injury. To support healthcare professionals in providing safer and more effective care for patients with an ileostomy, members of the Regroupement de pharmaciens experts en chirurgie of the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), a professional group of clinical pharmacist experts in surgery, developed a clinical tool on the management of ileostomy output for hospitalised patients.

Method: A literature review was conducted on ileostomy output management by five clinical pharmacists specialised in surgery and members of the professional group. A preliminary version of the tool was developed, then reviewed by a registered dietitian and gastroenterologist with expertise in ostomy care. The revised version of the clinical tool was presented to the other members of the Regroupement de pharmaciens experts en chirurgie to gather expert opinion and consensus.

Results: Data from peer-reviewed references and clinical guidelines were included in the development of the clinical tool. The tool summarises available evidence and practical clinical experience and is divided into five sections. The tool begins with a short introduction to the different types of gastrointestinal stomas and their main characteristics. Additional sections include causes and complications of high ileostomy output as well as recommended investigations and monitoring parameters. Non-pharmacological interventions, including recommendations regarding hydration and nutrition, are presented. The final section focuses on pharmacological treatments of high ileostomy output and short bowel syndrome. More specifically, treatments are categorised according to their place in therapy into therapeutic classes and notably include antitomotility and antisecretory medicines. Details on initial and maximum dosing regimens, effectiveness on stoma output, and adverse effects as well as practical clinical considerations are also provided for each of the recommended treatments.

Conclusion: The management of high output ileostomy requires knowledge of the characteristics of gastrointestinal stomas in addition to a thorough understanding of its causes, complications, monitoring, and treatment. This tool combines evidence-based recommendations and clinical experience, with an emphasis on practical considerations in the use of pharmacological treatments, to support pharmacists and other healthcare professionals in providing safer and more effective care for hospitalised patients with an ileostomy.

Development of a clinical tool on the use of continuous subcutaneous fentanyl infusions in palliative care

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Background: In recent years, the use of continuous subcutaneous fentanyl infusions has increased in Quebec, though prescribing practices remain variable. Despite the

growing adoption of this treatment approach, important uncertainties persist, notably regarding equianalgesic dosing and titration strategies. To address these knowledge gaps and support safer, more standardised practices, members of the Regroupement de pharmaciens experts en soins palliatifs of the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), a professional group of clinical pharmacists experts in palliative care, developed a tool on the use of continuous subcutaneous fentanyl infusions in palliative care.

Method: A comprehensive literature review was conducted in MEDLINE and Embase in addition to manual reference screening and review of grey literature sources. The clinical tool was developed by three pharmacists specialised in palliative care and was subsequently reviewed by a palliative care physician and validated by the pharmacists members of the Regroupement de pharmaciens experts en soins palliatifs. Divergent recommendations were resolved through consensus.

Results: Data from 34 references were included in the development of the tool. After review and validation, the tool was published in 2026 and integrates pharmacological principles, pharmacokinetic evidence, and clinically relevant considerations to improve the prescribing of continuous fentanyl infusions in palliative care. A series of recommendations are provided in the tool. For example, the use of continuous subcutaneous fentanyl infusions should be considered in several patient populations. Fentanyl is preferred in patients experiencing opioid-induced neurotoxicity, as it lacks known active metabolites and demonstrates minimal intrinsic psychomimetic effects. Opioid rotation to fentanyl may therefore be beneficial in cases of suspected opioid-induced delirium. In addition, current evidence does not support routine dose adjustments solely for renal dysfunction. Despite theoretical concerns of accumulation, population pharmacokinetic studies have not demonstrated clinically meaningful alterations in fentanyl elimination, even in severe renal impairment. Continuous subcutaneous infusions also provide greater titration flexibility. In end-of-life care, transdermal fentanyl may be suboptimal due to delayed steady-state achievement, reduced flexibility for prompt dose adjustments, and potential variability in absorption related to poor peripheral perfusion or fever. Fentanyl use may also be advantageous in patients with suspected opioid allergy or histamine-mediated intolerance. Additional recommendations address equianalgesic dosing and dose titration intervals. Opioid conversion ratios vary across the literature. A commonly used and clinically validated approach suggests approximately 15 micrograms of subcutaneous fentanyl per 1 milligram of subcutaneous morphine. Dose reductions to account for incomplete cross-tolerance may also be considered. Furthermore, optimal dose titration intervals are uncertain. According to pharmacokinetic data, steady-state achievement may require more than 36 hours; however, in most contexts, reassessment and dose adjustments every 24 hours appear reasonable, with earlier dose reductions in cases of toxicity or excessive sedation. Factors found to

influence fentanyl exposure include hepatic insufficiency, advanced age, and drug-drug interactions.

Conclusion: Continuous subcutaneous fentanyl infusions represent a valuable and versatile strategy in palliative care. This clinical tool synthesizes available evidence and practical guidance to reduce prescribing variability and enhance medication safety. Further studies are warranted to refine dosing strategies and pharmacokinetic understanding.

Development critical care pharmacotherapy toolkits^p

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Background: Patients admitted to the Intensive Care Unit (ICU) require complex, coordinated care. As integral part of interdisciplinary critical care teams, pharmacists play an essential role in ensuring safe and effective pharmaceutical care for these vulnerable patients. Pharmacists with little to no prior exposure to the critical care setting, including newly trained pharmacists as well as interns and residents, frequently experience a steep learning curve at the start of their practice in the ICU, most notably due to characteristics unique to the health conditions, monitoring parameters, and treatments associated with critically ill patients. To facilitate knowledge acquisition and promote standardised practices among ICU pharmacists, a clinical toolkit on key components of critical care pharmacotherapy was developed by the Regroupement de pharmaciens experts en soins intensifs de l'Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), a professional group of clinical pharmacists experts in critical care.

Method: Topics for inclusion in the toolkit were determined by members of the professional group of clinical pharmacists. For each tool, a comprehensive literature review was conducted by groups of two to three clinical pharmacists. Initial versions of the tools underwent peer review by clinical pharmacists with expertise in critical care and by other members of the interdisciplinary team, including critical care physicians and respiratory therapists. Revised versions of the clinical tools were presented to the other members of the Regroupement de pharmaciens experts en soins intensifs to gather expert opinion and consensus.

Results: A total of four topics were selected for inclusion in the clinical toolkit: mechanical ventilation, system-based approaches to patient assessment, shock and vasoactive medicines, and pharmacokinetics in the critically ill. Data from peer-reviewed literature and clinical guidelines were taken

into account in the development of the toolkit. In 2026, the first two clinical tools on mechanical ventilation and system-based approaches to patient assessment were shared with hospital pharmacists in Quebec. The first tool includes definitions of commonly used modes of invasive and non-invasive mechanical ventilation, ventilation settings, and associated complications. Recommendations regarding the optimisation of medication therapy for mechanically ventilated patients were also laid out. The second tool describes the main clinical parameters included in the assessment of critically ill patients, organised by organ system. For example, for the cardiovascular system, parameters include haemodynamic stability, heart rate and rhythm, and other cardiovascular conditions. Furthermore, the tool addresses practical considerations on medicines reconciliation in the ICU. The remainder of the clinical tools are under development and review for future publication.

Conclusion: The clinical tools draw on evidence-based content and practical clinical experience to serve as accessible, practice-ready resources for pharmacists, especially those who are unfamiliar with critical care pharmacotherapy. The publication of these tools will support training endeavours and help pharmacy practice in critical care among the pharmacy workforce, ultimately contributing to ensuring safe and effective pharmaceutical care for critically ill patients.

Exclusive breastfeeding of a premature infant after prenatal exposure to Lithium: A case report

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Background: Some sources still suggest that breastfeeding is contraindicated for mothers treated with lithium, even when the neonate has been exposed in utero and maternal and neonatal serum concentrations are similar at birth. However, pregnancy, delivery, and breastfeeding form a continuum. Lithium transfer via breast milk is lower than placental transfer; therefore, a breastfed infant will never be exposed to the same extent as during fetal life. A few case reports describe infants exposed in utero and subsequently breastfed, but none involved a premature infant exposed to polytherapy at the time of this case.

Method: Data were collected prospectively through parental consent and interviews, alongside a review of maternal and infant medical records.

Results: Delivered at 36 weeks, the infant initially presented with hypotonia and required transient respiratory support with CPAP, discontinued on day 1. Adaptation difficulties were likely multifactorial: caesarean delivery, prematurity, and maternal medications, which included bupropion 400 mg, lurasidone 40 mg, lithium 750 mg daily, and trazodone 50 mg as needed. On day 2, parents were informed of the lack of data regarding breastfeeding in premature infants exposed to polytherapy including lithium. As postnatal exposure would be lower than in utero, a gradual introduction of breast milk was agreed upon, aiming for exclusive breastfeeding while minimising adverse effects. A “slow but steady” approach was adopted. Maternal lithium level at delivery (day 0) was 0.9 mmol/L; neonatal level at 67 hours (day 3) was 0.5 mmol/L, with serum creatinine at 44 µmol/L and TSH at 5.07 mIU/L. Breast milk intake began at 10% of total nutrition. At discharge (day 8), neonatal lithium level was under 0.2 mmol/L, serum creatinine at 34 µmol/L, and breast milk intake increased to 20%. By day 22, lithium level remained under 0.2 mmol/L with breast milk intake already at 33% for several days; paediatric assessment deemed development normal and allowed ad lib breastfeeding. At day 51, lithium level was still under 0.2 mmol/L, serum creatinine at 15 µmol/L, and TSH normalised at 1.49 mIU/L. The infant was exclusively breastfed, with normal development. Maternal lithium level at day 66 remained at 0.9 mmol/L.

Conclusion: Caution was essential to achieve the mother’s goal of exclusive breastfeeding, given the absence of similar reported cases involving premature infants exposed to polytherapy including lithium. Initially fed mainly with formula, the infant transitioned to exclusive breastfeeding by three weeks of life without adverse effects. This case highlights the feasibility of breastfeeding under lithium and polytherapy in a premature infant with close monitoring. Given the benefits of breast milk for preterm infants, such as reducing the risk of necrotising enterocolitis and providing protective antibodies against infections, additional reports are essential to guide clinicians and parents in decision-making.

AI-generated medication education songs as an auditory counseling tool: A pilot study

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Background: Currently, patient medication education may be delivered through three main approaches: direct instruction by healthcare professionals, patient education leaflets, and educational videos. To assist patients with visual impairment in accessing medication education by listening and to enhance their retention of educational information, artificial intelligence (AI) tools may be used to develop audio-based patient education materials. This approach may potentially offer a dual benefit by reducing the manpower of healthcare

professionals required for patient education while improving medication safety.

Method: Online drug education leaflets were first processed into spoken dialogues using an AI tool (NotebookLM). Due to the inability to control the generated wording, the method was modified: the leaflets were converted into song lyrics with an AI tool (ChatGPT) and then transformed into educational songs using AI music software (SUNO). A questionnaire based on the leaflet content was administered to adults and geriatric participants without hearing impairments, medical backgrounds, or previous use of the study medication. Participants listened to the educational song and completed the four-question assessment.

Results: A total of 19 questionnaires were collected. All participants had a university-level education or higher. The age distribution was as follows: 6 participants aged 20–39 years, 3 aged 40–49 years, 2 aged 50–59 years, 6 aged 60–69 years, and 2 aged 70–79 years. No statistically significant differences were observed in responses among different age groups for any of the questions ($p > 0.05$), suggesting that comprehension of the educational song did not differ significantly by age group. The overall probability of answering all four questions correctly was 42.1%. Most incorrect responses occurred on the same question, which had an accuracy of 47.4%. After the test, several participants reported not noticing that this question required selecting the incorrect option, unlike the other questions, leading to incorrect responses. When this question was excluded, the overall accuracy increased to 89.5%.

Conclusion: During this trial, multiple adjustments were required before finalizing the educational song. The prompts had to be modified to ensure clear articulation and appropriate rhythm, and to match the local language and accent. In addition, because the lyrics were not in English, it was necessary to verify that each word could be correctly recognized and pronounced by the AI. Some lyrics also needed to be adjusted to sound more conversational during the song generation process. Since the accuracy did not reach 100%, patients' understanding would still need to be further confirmed when using this educational approach. Moreover, generating educational songs required considerable manual oversight, and the efficiency was lower than expected. These findings suggest that this approach cannot currently replace conventional patient education provided by healthcare professionals, but it may serve as a supplementary tool for reviewing information after standard education when needed.

Retrospective analysis of pharmaceutical care prescriptions at a regional teaching hospital in 2025

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Background: Pharmacists play a vital role in medication safety by evaluating prescription appropriateness across all hospital departments. These judgmental services are routinely recorded in the HIS (Hospital Information System), providing essential data for improving pharmaceutical care quality and refining information system functionality.

Method: Using a retrospective approach, we gathered pharmacy service records from the HIS between January and December 2025. To ensure data integrity, we excluded test entries from trainee examinations and blank/invalid records. The data were then statistically analyzed based on the prescription source (department of inpatient, outpatient or emergency), a three-level hierarchical classification of service reasons, and the level of physician acceptance

Results: A total of 764 valid pharmacist intervention records were identified for the 2025 fiscal year. The distribution by setting was: inpatient (543 cases, 71.1%), outpatient (174 cases, 22.8%), and emergency department (47 cases, 6.2%). Following pharmacist recommendations, 747 interventions (97.8%) resulted in prescription adjustments by physicians, while 17 cases (2.2%) maintained the original prescription. Post-consultation adjustments were primarily categorized into two major groups: prescription errors (519 cases, 67.9%) and physician entry errors (126 cases, 16.5%). Among prescription errors, the top three types were drug-drug interactions (204 cases, 39.3%), dosage errors (203 cases, 39.1%), and medication selection errors (102 cases, 19.7%). Within drug-drug interactions, similar pharmacological mechanisms accounted for the majority (156 cases, 76.5%). Regarding dosage errors, impaired renal function was the leading cause (129 cases, 63.5%). For medication errors, incorrect dosage forms were most frequent (40 cases, 39.2%). Lastly, the most common reason for physician entry errors was medication selection errors (66 cases, 52.4%), with duplicate prescriptions (48 cases, 72.7%) being the most prevalent subtype.

Conclusion: The data from pharmacist intervention records confirms that pharmacists play a vital role in ensuring patient safety. To continuously improve our team's competency, these records are compiled monthly as educational resources to strengthen clinical judgment and cross-functional teamwork. Our analysis highlights that similar pharmacological mechanisms and renal dosage adjustments

are the two most common areas requiring intervention. While our current HIS provides basic alerts for these issues, we plan to conduct a detailed review of the specific medications involved. This will allow us to further refine and optimize our information systems to better meet clinical demands.

A climate resilient acute care clinical operations framework for hospital pharmacy - an initiative by the Canadian Association of Pharmacy for the Environment (CAPHE)

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Background: Climate change increasingly threatens healthcare delivery through extreme weather events, infrastructure disruptions, supply chain instability, and rising temperatures. Hospitals are also significant contributors to healthcare-related greenhouse gas emissions, with medication production, procurement, and use contributing to the sector's environmental footprint. Within acute-care systems, hospital pharmacy departments play a central role in maintaining medication continuity, ensuring safe and effective therapy, and supporting emergency response during disasters. Due to this critical role, pharmacy operations require significant climate-resilience planning within broader health-system frameworks. The Climate Resilient Acute Care Clinical Operations Framework (CRACCO) provides high-level guidance for embedding climate resilience and low-carbon strategies across hospital clinical operations. A structured pharmacy-specific approach is required to operationalise these strategies within medication management systems.

Objective: This project introduces the Climate-Resilient Hospital Pharmacy Framework, an adaptation of the CRACCO model designed to guide hospital pharmacy departments in integrating climate adaptation, mitigation, and resilience into clinical and operational practice. The framework translates high-level institutional climate strategies into actionable pharmacy-specific domains, enabling departments to systematically evaluate vulnerabilities, implement sustainable practices, and strengthen medication continuity during climate-related disruptions.

Method: The framework was developed through a collaboration between pharmacists at the Canadian Association of Pharmacy for the Environment (CAPhE) within hospital pharmacy settings across Canada. The development process involved adapting the CRACCO framework's core pillars—Leadership and Governance, Health System Strengthening, Healthcare Service Delivery, Climate

Research, and Quality Improvement and Education—to the operational context of hospital pharmacy. Pharmacy-specific strategies and indicators were identified through literature review, practice-based expertise, and consultation with stakeholders involved in hospital pharmacy practice, sustainability initiatives, and emergency preparedness. Key domains include workforce training, governance and strategic planning, supply chain resilience, technological integration, sustainable procurement, waste reduction, medication continuity planning, and climate-informed patient care.

Results: The resulting framework provides a structured model that aligns hospital pharmacy activities with broader institutional climate resilience goals. Within Leadership and Governance, the framework emphasises workforce education, designated sustainability champions, and executive-level accountability. Health System Strengthening includes strategies for digital monitoring systems, supply chain preparedness, and vulnerability assessments related to medication stability and shortages. Healthcare Service Delivery focuses on climate-informed medication management, low-carbon prescribing practices, and equitable care models for vulnerable populations. Quality Improvement and Research promote pharmacy-led sustainability projects, emissions monitoring, and research on medication-related climate impacts, such as inhaler emissions or heat-related drug toxicity. Together, these components support measurable indicators that allow hospital pharmacies to track progress toward resilience and environmental sustainability.

Conclusion: The Climate-Resilient Hospital Pharmacy Framework offers a practical approach for embedding climate adaptation and mitigation strategies into acute-care pharmacy operations. By aligning pharmacy leadership, clinical services, supply chain management, and sustainability initiatives, the framework positions hospital pharmacy as a key driver of resilient and low-carbon healthcare systems. Its adaptable structure allows implementation across diverse healthcare settings and provides a foundation for ongoing research, evaluation, and international collaboration to strengthen climate-resilient pharmacy practice.

Acute kidney injury following initiation of SGLT2 inhibitors and loop diuretics in heart failure: A case report

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Background: Heart failure (HF) is a major cause of morbidity and hospitalisation worldwide and is often complicated by fluid overload due to impaired ventricular systolic function and activation of neurohormonal compensatory mechanisms.

This leads to sodium and water retention, peripheral oedema, and congestion. Diuretics remain the cornerstone of therapy for managing fluid retention in HF. Among these agents, loop diuretics are considered first-line treatment because of their potent natriuretic effects and preserved efficacy in patients with renal insufficiency. Recent randomised controlled trials have demonstrated that SGLT2 inhibitors significantly reduce hospitalisation in patients with heart failure. Consequently, SGLT2 inhibitors have been incorporated into heart failure treatment guidelines by major societies, including the European Society of Cardiology and the American Heart Association. As SGLT2 inhibitors are increasingly used in clinical practice, concomitant therapy with loop diuretics has become more common. However, evidence regarding the renal safety of combined SGLT2 inhibitor and loop diuretic therapy remains limited, particularly in elderly patients.

Method: We report an elderly patient with heart failure who developed acute kidney injury shortly after initiation of combined SGLT2 inhibitor and loop diuretic therapy. Clinical data were retrospectively obtained from the patient's medical records.

Results: An 81-year-old woman with a history of paroxysmal atrial fibrillation, hypertension, and diabetes mellitus was admitted with a three-day history of worsening dyspnoea and suspected acute decompensated heart failure. Echocardiography showed a left ventricular ejection fraction of 23%, consistent with heart failure with reduced ejection fraction. After clinical stabilisation, she was discharged and scheduled for outpatient follow-up. At a follow-up visit on 26 August, torsemide and dapagliflozin were initiated for HF management. Five days later, the patient was readmitted because of generalised weakness and limb numbness. Laboratory evaluation revealed a serum creatinine level of 1.35 mg/dL, increased from 0.85 mg/dL on 20 August and 0.90 mg/dL on 30 June, consistent with acute kidney injury. During hospitalisation, torsemide and dapagliflozin were discontinued and supportive care was provided. Renal function gradually improved, with serum creatinine decreasing to 0.92 mg/dL by 3 September. She was discharged in stable condition and scheduled for outpatient follow-up.

Conclusion: Concomitant use of SGLT2 inhibitors and loop diuretics may increase the risk of excessive volume depletion because of their combined natriuretic and osmotic diuretic effects, which may subsequently contribute to acute kidney injury. Observational studies have reported a higher incidence of volume depletion-related adverse events with this combination, including symptomatic hypotension, acute kidney injury, postural dizziness, and syncope. Previous studies also suggest that initiation of SGLT2 inhibitor therapy may reduce diuretic requirements in patients with heart failure, indicating that loop diuretic dose adjustment may be necessary after treatment initiation. Therefore, renal function and volume status should be carefully monitored when SGLT2 inhibitors are initiated in patients receiving loop diuretics, and loop diuretic dose adjustment should be

considered to reduce the risk of volume depletion and acute kidney injury, particularly in elderly individuals.

Analysis of DOACs dosage in the Asian population: An observational study in a university hospital in Taiwan

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Background: As the population ages and cardiovascular comorbidities increase, the prevalence of Atrial Fibrillation (AF) is growing exponentially. The core of AF management lies in ischemic stroke prevention. While Direct Oral Anticoagulants (DOACs) are safer than warfarin, the "Asian Paradox"—characterized by a simultaneous high risk of both stroke and intracranial hemorrhage (ICH)—often leads clinicians to prescribe lower doses. This study investigates whether DOAC dosages at a case hospital in Taiwan are lower than global recommendations and evaluates the clinical rationality of these adjustments.

Method: This study analyzed electronic medical records from hospital claims databases for AF patients prescribed Apixaban, Dabigatran, Edoxaban, or Rivaroxaban between January 1, 2025, and December 31, 2025. The Average Daily Dose (ADD) per patient for each DOAC was calculated and compared against the WHO Defined Daily Dose (DDD) to determine if local dosages align with or fall below standard global recommendations.

Results: A total of 981 AF patients were analyzed: Apixaban (n=273), Dabigatran (n=92), Edoxaban (n=286), and Rivaroxaban (n=360). Patients aged ≥ 75 years accounted for 55% (n=542) of the cohort. The ADD for all DOACs was lower than the WHO DDD: Apixaban 7.8 mg (DDD: 10 mg), Dabigatran 245.0 mg (DDD: 300 mg), Edoxaban 29.0 mg (DDD: 60 mg), and Rivaroxaban 13.6 mg (DDD: 20 mg). In the elderly subgroups (≥ 75 and ≥ 80 years), dose reductions were even more pronounced (e.g., Apixaban at 8.3 mg and 6.0 mg, respectively). Most patients over 75 had already received dosage adjustments prior to the study period.

Conclusion: At the case hospital, DOAC dosages for elderly Asian patients generally align with APSC (Asian Pacific Society of Cardiology) dose-reduction criteria after considering individual bleeding risks. While standard doses are recommended for most eligible patients to ensure stroke prevention, reduced dosages remain appropriate for specific high-risk sub-populations (e.g., extreme old age, low body weight, or renal impairment) to balance efficacy with the prevention of major bleeding.

Nephroprotective effects of Sodium-Glucose Cotransporter 2 (SGLT2) Inhibitors in patients receiving platinum-based chemotherapy: A retrospective cohort study

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Background: Cisplatin and carboplatin are widely used platinum-based chemotherapies, yet their use is often limited by nephrotoxicity, including acute kidney injury (AKI), progression to chronic kidney disease, and hypomagnesemia. Sodium-glucose cotransporter-2 (SGLT2) inhibitors have demonstrated nephroprotective effects in preclinical models, potentially through reduction of oxidative stress and improvement in magnesium homeostasis. However, clinical data evaluating their role in patients receiving platinum-based chemotherapy remain limited. This study aimed to assess the association between baseline use of SGLT2 inhibitors and changes in serum creatinine (SCr) and serum magnesium levels.

Method: A retrospective cohort study was conducted using electronic health records from the University Health Network (UHN) between January 1, 2022, and December 31, 2024. Adult patients (≥ 18 years) who received at least one cycle of cisplatin or carboplatin for an oncology-related indication and those on baseline SGLT2 inhibitor or dipeptidyl peptidase-4 (DPP4) inhibitor (control group) were included. Patients receiving kidney replacement therapy, enrolled in clinical trials, or with incomplete SCr, magnesium, and chemotherapy data were excluded. Primary endpoints included change in SCr during chemotherapy (Δ SCr; post-minus pre-treatment), incidence of AKI (defined as a $\geq 50\%$ increase in SCr from baseline), and incidence of hypomagnesemia (<0.7 mmol/L) during treatment.

Results: A total of 21 patients in the cisplatin cohort and 39 in the carboplatin cohort were included. Among patients receiving cisplatin, a significant difference in Δ SCr was observed between SGLT2 inhibitor and DPP4 inhibitor groups ($p<0.05$). Patients with baseline use of an SGLT2 inhibitor demonstrated a median improvement in SCr (Δ SCr = -4.0 μ mol/L), while the DPP4 inhibitor group showed a median worsening in SCr (Δ SCr = 6.5 μ mol/L). No significant differences were observed in the proportion of AKI events between the two groups. There was a trend toward reduced hypomagnesemia events in the SGLT2 inhibitor group compared to the control group during cisplatin treatment (44.4% vs. 70.0%), but this was not statistically significant. No significant differences in renal or magnesium outcomes during treatment were observed in the carboplatin cohort.

Conclusion: Baseline SGLT2 inhibitor use was associated with improved renal outcomes in patients receiving cisplatin, but not carboplatin. This suggests a potential context-specific nephroprotective effect, with SGLT2 inhibitors providing possible benefit in patients receiving more nephrotoxic platinum agents. No significant differences in hypomagnesemia outcomes were detected, but this may be due to small sample sizes. Future studies with larger sample sizes are warranted to confirm these findings and further elucidate the underlying mechanisms of SGLT2 inhibitor-mediated nephroprotection.

Implementation of an electronic real-time inventory management system for chemotherapy and TPN medications

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Background: In our hospital pharmacy, the daily inventory management of Chemotherapy (CT) and Total Parenteral Nutrition (TPN) was previously conducted manually. This routine workflow included drug receiving, daily dispensing, inventory deduction, and stock-taking. However, relying on these manual processes was highly time-consuming, prone to human error, and resulted in delayed data updates. These challenges potentially compromised medication safety and operational efficiency within our institution.

Objective: To develop and implement an electronic system for CT and TPN medications, aiming to achieve accurate and real-time inventory management.

Method: We changed our traditional manual workflow into a real-time digital system: 1)System Workflow: The Computerized Provider Order Entry (CPOE) system connects directly to the pharmacy receiving system to automatically generate medication labels. 2)Smart Dispensing & Deduction: The inventory management system then extracts key data from these labels, including the drug name, dosage, batch number, and expiration date. Guided by Electronic Paper Displays (EPD) showing real-time drug locations, pharmacists use PDAs to scan barcodes. This process simultaneously verifies the picked drugs and automatically deducts the exact stock. 3)Receiving & Inventory Tracking: We also introduced barcode scanning for drug receiving to reduce initial stocking errors. By enforcing First-In-First-Out (FIFO) rules through batch tracking, the workflow shifted from manual end-of-day counts to dynamic, zero-time-lag inventory tracking.

Results: The new system significantly reduced daily average errors in all operational steps for both CT and TPN: 1)Deduction Errors: Dropped by 57.8% in CT (from 0.64 to

0.27 errors/day) and by 50.9% in TPN (from 0.53 to 0.26 errors/day). 2)Inventory Errors: Dropped by 36.3% in CT (from 1.57 to 1.00 errors/day) and by 45.8% in TPN (from 0.48 to 0.26 errors/day). 3)Receiving Errors: Thanks to barcode scanning, receiving errors dropped by 25.3% in CT (from 1.42 to 1.06 errors/day) and by 3.8% in TPN (from 1.04 to 1.00 errors/day). 4)Transfer Errors: The system greatly reduced unrecorded drug transfers. The error rate dropped from 53.3% to 16.7% for CT, and from 34.7% to 20.0% for TPN.

Conclusion: Integrating EPD, PDA, and barcode technologies with the CPOE system successfully solved the data delay problems of manual inventory. Real-time location tracking and barcode scanning significantly reduced errors in receiving, deduction, and stock-taking. Overall, this real-time electronic system improves drug expiration management, work efficiency, and patient safety for critical medications like CT and TPN.

Prescribing patterns of antifungal agents in the intensive care unit of a tertiary medical center in Taiwan

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Background: Invasive fungal infections are associated with high morbidity and mortality in critically ill ICU patients, often prompting empirical antifungal therapy. Inappropriate antifungal use may contribute to unnecessary costs, adverse events, and antifungal resistance, highlighting the importance of antimicrobial stewardship programs (ASPs). However, data on antifungal prescribing patterns in ICUs of tertiary medical centers are limited. This study analyzes antifungal prescribing patterns in the ICU to assess current practice and identify targets for ASP optimization.

Objective: To analyze ICU antifungal prescribing patterns in a tertiary hospital and identify opportunities to optimize antifungal stewardship.

Method: Patients admitted to the medical intensive care unit (MICU) or surgical intensive care unit (SICU) and received at least one systemic antifungal agent between January 1, 2024, and April 30, 2025 were retrospectively included. Prescription data were collected and analyzed, including the number of antifungal agents, the proportion of each antifungal agent, duration of therapy, and whether de-escalation strategy in patients receiving echinocandins was applied. De-escalation was defined as switching from echinocandins to fluconazole, whereas escalation was defined as switching from

echinocandins to voriconazole, isavuconazole, or liposomal amphotericin B for broader antifungal coverage. Data was processed and analyzed using SAS version 9.4.

Results: Between January 1, 2024, and April 30, 2025, a total of 904 patients in the MICU and 575 patients in the SICU were included. The mean length of ICU stay was 16 days in the MICU and 15 days in the SICU. Among these patients, 374 MICU patients (41.4%) and 240 SICU patients (41.7%) received at least one systemic antifungal agent. Antifungal prescribing patterns were comparable between the two units. Of the 513 antifungal prescriptions in the MICU and 301 in the SICU, echinocandins were the most frequently prescribed agents (55.9% vs. 73.8%), followed by azoles (37.8% vs. 22.3%). Among patients treated with echinocandins, the majority continued echinocandin therapy (77.7% in the MICU and 81.5% in the SICU), whereas de-escalation strategies were applied in only a small proportion of patients (3.5% in the MICU and 5.9% in the SICU).

Conclusion: In this ICU cohort, systemic antifungal use was common, with similar prescribing patterns observed between the MICU and SICU. Echinocandins were the predominant antifungal agents in both units. The high use of echinocandins likely reflects the guideline-recommended first-line role in critically ill patients, favorable safety profile in the presence of hepatic and renal dysfunction, and clinician preference for empirical broad-spectrum coverage. Most patients remained on echinocandin therapy throughout treatment. De-escalation strategies were infrequently implemented, highlighting a potential opportunity to optimize antifungal stewardship through earlier reassessment and microbiology-guided therapy.

Cardiovascular outcomes associated with sacubitril/valsartan use in patients with hypertension without heart failure: A real-world cohort study

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Background: Although Sacubitril/valsartan is primarily indicated for the treatment of heart failure, its use has increasingly expanded to hypertensive patients without heart failure in routine clinical practice, despite limited evidence regarding cardiovascular outcomes in this population. In real-

world settings, treatment decisions for antihypertensive therapy may be influenced by patients' baseline cardiovascular risk, which may affect observed clinical outcomes. However, evidence describing cardiovascular outcomes associated with sacubitril/valsartan use in hypertensive patients without heart failure remains limited. This study aimed to evaluate the association between sacubitril/valsartan initiation and major adverse cardiovascular events (MACE) in a real-world cohort of hypertensive patients without documented heart failure.

Method: We conducted a retrospective cohort study using electronic medical records from a tertiary hospital in China. Adult patients with a diagnosis of hypertension who initiated treatment with sacubitril/valsartan or angiotensin-converting enzyme inhibitors/angiotensin receptor blockers (ACEI/ARB) between July 2023 and December 2023 were included. To identify new users of study medications, a six-month washout period prior to cohort entry was applied to exclude patients with prior prescriptions of sacubitril/valsartan. The index date was defined as the first recorded prescription of the study medication during the study period. Patients with documented heart failure before the index date were excluded. Participants were followed from the index date until the occurrence of MACE, or 31 December 2025, whichever occurred first. The primary outcome was MACE, defined as a composite of cardiovascular death, myocardial infarction, stroke, or coronary revascularisation. Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs). Univariable and multivariable Cox regression analyses were performed to evaluate the association between sacubitril/valsartan initiation and cardiovascular outcomes. Model discrimination was assessed using the concordance index (C-index).

Results: A total of 9,714 patients were included in the analysis, among whom 65 (0.67%) experienced the composite outcome during follow-up. In univariable Cox regression analysis, initiation of sacubitril/valsartan was associated with a higher risk of MACE compared with ACEI/ARB therapy (HR 2.00, 95% CI 1.11–3.62; $p=0.02$), although the model demonstrated limited discriminative ability (C-index=0.55). In multivariable Cox regression analysis, coronary heart disease (HR 3.84, 95% CI 2.23–6.60; $p<0.001$) and age (HR 1.03 per year increase, 95% CI 1.01–1.05; $p=0.002$) were identified as independent predictors of MACE. After adjustment for these factors, the association between sacubitril/valsartan use and MACE was attenuated and no longer statistically significant (HR 1.59, 95% CI 0.87–2.89; $p=0.13$). The multivariable model demonstrated improved predictive performance (C-index=0.75).

Conclusion: In this real-world cohort of hypertensive patients without documented heart failure, sacubitril/valsartan initiation was associated with a higher observed incidence of cardiovascular events in unadjusted analyses; however, this association was attenuated after adjustment for baseline risk factors. These findings suggest that differences in underlying cardiovascular risk, particularly age and pre-existing coronary heart disease, may partly explain the observed associations.

The results highlight the importance of accounting for treatment selection when evaluating real-world cardiovascular outcomes associated with sacubitril/valsartan use in hypertensive populations.

Vedolizumab versus Infliximab in biologic-naïve moderate-to-severe ulcerative colitis: A real-world comparative analysis of efficacy, safety and pharmacoeconomics

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Background: Ulcerative Colitis (UC) is a chronic inflammatory bowel disease significantly impairing patients' quality of life. For patients with moderate-to-severe UC, conventional treatments are often inadequate, thus requiring the use of biological therapies. Infliximab (IFX), an anti-TNF- α agent, effectively promotes mucosal healing but is linked to primary non-response, secondary loss of response, and systemic immunosuppression-related adverse events. Vedolizumab (VDZ), a gut-selective integrin antibody, offers targeted intestinal inflammation control with minimal systemic immune impact. Although both are first-line biologics for moderate-to-severe UC, direct real-world comparisons in biologic-naïve patients remain limited. This research evaluates efficacy, safety, and pharmacoeconomics of VDZ and IFX in biologic-naïve UC, providing evidence for Chinese clinical practice.

Method: The clinical data of biologic-naïve UC patients who received treatment in Shanxi Provincial People's Hospital from January 2023 to December 2025 were retrospectively collected. The patients were divided into IFX and VDZ groups according to the treatment plan. The clinical/endoscopic response rates and remission rates of the two groups at 14-week and 54-week were compared; the adverse events and drug treatment costs during the treatment period were recorded. Logistic regression analysis were used to identify factors influencing 14-week clinical remission and 54-week endoscopic remission. Cost-effectiveness analysis were used to compare the economic superiority of the two treatment regimens.

Results: A total of 157 patients with moderate-to-severe UC were included. After 1:1 propensity score matching, 49 patients were matched in each group for analysis and comparison. No significant differences were observed in clinical/endoscopic response rates and remission rates between the two groups at 14 weeks and 54 weeks ($P > 0.05$). At week 14, the proportion of patients combination with hormones in VDZ group was significantly higher than that in IFX group (26.67% vs. 7.5%, $P = 0.011$), and significant differences were showed in C-reactive protein levels ($4.496 \pm$

7.313 vs. 1.823 ± 2.208 , $P = 0.014$) and erythrocyte sedimentation rate (13.865 ± 9.024 vs. 10.453 ± 5.314 , $P = 0.022$). Adverse reaction incidence was significantly higher in IFX group (10.2% vs. 0%, $P = 0.022$). Multivariate analysis showed that baseline UCEIS score [OR = 0.24, 95% CI (0.11 - 0.47), $P < 0.001$] and lesion range [OR = 0.22, 95% CI (0.04 - 0.87), $P = 0.048$] were independent risk factors for 14-week clinical remission, and no independent factors related to 54-week endoscopic remission were found. Cost-effectiveness ratio of the IFX group was lower (303.90 vs. 836.66, $P < 0.001$).

Conclusion: In biologic-naïve moderate-to-severe UC patients, VDZ and IFX demonstrate comparable efficacy in inducing and maintaining clinical remission, and promoting mucosal healing. IFX is associated with greater short-term improvements in systemic inflammatory markers (C-reactive protein and erythrocyte sedimentation rate) and a more favorable cost-effectiveness ratio, whereas VDZ exhibits a superior safety profile. Baseline UCEIS score and lesion range are key predictors of short-term clinical remission. Treatment selection should integrate disease characteristics, efficacy, safety, and pharmacoeconomic: IFX may be preferred for rapid systemic inflammation control or cost constraints, while VDZ benefits those with higher infection risk or prioritizing long-term safety.

Patients undergoing surgery benefit significantly from the physician-pharmacist collaborative management pattern

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Background: Physician–pharmacist co-management has increasingly been recognized as an important model within surgical care systems. However, pharmacists' participation in postoperative acute pain services (APS), chemotherapy-induced nausea and vomiting (CINV) management, and antimicrobial stewardship remains limited. Moreover, there is still scarce evidence regarding their attitudes, current practices, and clinical impact in these domains.

Method: A series of studies were conducted at our center using surgical pharmacy services initiated by clinical pharmacists and led by surgeons, involving multidisciplinary collaboration among pharmacists, surgeons, anesthesiologists, and nurses. Key interventions included the establishment of an Acute Pain Service (APS) team, development of standardized perioperative pain management protocols, implementation of an informatized pharmacy platform for chemotherapy-induced nausea and vomiting (CINV) management, and antimicrobial stewardship in elective surgeries. Prospective and retrospective studies were conducted to comprehensively analyze the

effectiveness of pharmacist interventions in APS, inpatient days, hospitalization costs, medication adherence, CINV control, and postoperative infections.

Results: In hepatobiliary surgery, pharmacist participation in APS significantly improved pain control in procedures associated with moderate to severe pain ($P < 0.05$) and reduced the incidence of breakthrough pain (8.99% vs. 26.82%, $P < 0.05$). In orthopedic surgery, the intervention group demonstrated lower pain scores at 24 hours postoperatively both at rest (2.4 vs. 3.2, $P < 0.001$) and during movement (3.1 vs. 4.5, $P < 0.001$), along with a reduction in length of stay by 2.3 days ($P < 0.001$). Among colorectal cancer surgery patients, the use of an informatized pharmacy platform led to improved acute vomiting control (97.73% vs. 80.49%, $P = 0.009$), delayed vomiting control (88.63% vs. 70.73%, $P = 0.039$), and significantly higher medication adherence (97.73% vs. 60.98%, $P < 0.001$). In laparoscopic cholecystectomy, the omission of prophylactic antibiotics did not result in increased infection rates, while significantly reducing medication costs ($P < 0.01$), suggesting that pharmacist intervention can not only reduce the occurrence of drug side effects but also reduce the waste of medical resources. Furthermore, a comprehensive survey involving 133 centers revealed that although 95.93% of pharmacists believed they should participate in postoperative pain services, only 62.60% reported substantial involvement in such roles, and 98.38% expressed a need for systematic training to enhance their competencies.

Conclusion: Surgical pharmacy services interventions were associated with positive effects on economic, clinical, and humanistic outcomes (ECHO). Importantly, while pharmacists have a positive attitude towards being on the front lines of clinical practice, but standardized pharmacist services need improvement urgently.

Reducing outpatient medication waiting time through lean management: A scalable quality improvement model

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Background: Medication waiting time is a critical determinant of patient-centred care and overall healthcare quality. Following a Computerized Physician Order Entry (CPOE) system upgrade at our hospital, the average outpatient medication waiting time increased from 10 to 14 minutes. Peak-hour congestion led to workflow instability, queue disorder, increased pharmacist cognitive load, and declining service evaluations. Prolonged waiting time not only affected patient satisfaction but also reflected systemic inefficiencies and workforce strain. To address these operational and professional challenges, our team implemented a structured

Lean management framework to redesign the outpatient dispensing process and eliminate non-value-added activities.

Objective: This project aimed to systematically identify workflow bottlenecks, reduce process waste, and establish a sustainable and standardized dispensing model that enhances operational efficiency, improves patient experience, and strengthens pharmacist workplace well-being.

Method: From March to October 2025, we analyzed the complete outpatient dispensing pathway—from electronic prescription receipt in the CPOE system to medication collection by patients. Lean tools applied included: Value Stream Mapping (VSM) Spaghetti Diagrams (movement analysis) Affinity Diagrams (root cause identification) ECRS framework (Eliminate, Combine, Rearrange, Simplify) Five primary inefficiencies were identified: Inadequate medication stock preparation Suboptimal physical layout System latency Manual documentation processes Queue disorder during peak hours Interventions included implementation of 5S principles, digital workflow optimization, real-time inventory stabilization, spatial redesign, and cross-departmental coordination. Standard operating procedures were established to ensure long-term sustainability of improvements.

Results: By September 2025, measurable and sustained improvements were achieved: Waiting Time: Reduced from 12.3 to 10.2 minutes (17.1% reduction). Digital Optimization: System latency and manual documentation-related non-value-added time were nearly eliminated. Workflow Efficiency: Pharmacists' movement-related non-value-added time decreased from 2,009 to 168 minutes (91.6% improvement). Inventory Stability: Non-value-added time for urgent and inter-departmental drug transfers decreased from 1,385 to 472 minutes (65.9% improvement). Service Stability: Dispensing system-related non-value-added time was reduced to zero; queue disorder was resolved, and no further complaints were recorded. Workforce Impact: Pharmacist stress index decreased by 60% (75.6 to 30.5), demonstrating substantial improvement in workplace sustainability. Overall, the redesigned workflow enhanced operational stability, reduced patient anxiety, and improved professional practice conditions.

Conclusion: The integration of Lean management principles and digital optimization effectively transformed the outpatient dispensing process into a standardized, high-efficiency model. Beyond reducing waiting time, this initiative strengthened workforce resilience, enhanced patient-centred service delivery, and demonstrated quantifiable system-level impact. This scalable model has since been successfully extended to emergency and inpatient pharmacy services, offering a transferable framework for healthcare institutions seeking to improve medication-use systems through structured quality improvement methodologies.

Publication of a journal on hospital pharmacy activities to improve professional visibility

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Background: In France, hospital pharmacy activities are little known to the general public and health decision makers, even though they are numerous and diverse. The demographics of pharmacists in the country are encouraging, but vigilance must be constant and communication about the attractiveness of the profession must be dynamic.

Objective: With the aim of communicating on a large scale, the Hospital Pharmacy Council of the French Chamber of Pharmacists had created a magazine aimed at students who are still deciding on their career path, students who are discovering the different facets of pharmacy, pharmacists who are already working in the field, and even experts in these specialties who wish to perfect their knowledge on the subject. Institutions and agencies are also recipients.

Method: An editorial committee was formed with three elected pharmacist advisors, a coordinator, and a publication director who is the president of the Hospital Pharmacy Council of the French Chamber as permanent members. For each issue and each topic, pharmacists who are experts in their field are asked to contribute to articles.

Results: The themes of the first issues are as follows: - Sterilization - The pharmacist at the heart of oncology - Preparation of doses to be administered - Radiopharmacy Two digital versions are published for each issue: one in article format (PDF) and a “dynamic” version with hyperlinks and videos. The magazine is freely accessible on the website of the French NChamber of Pharmacists, and the release of each issue is promoted on social media and via email to hospital pharmacists. It is also used at various events such as conferences and information days for students. Hospital pharmacists who receive students or residents also use it as a training aid to introduce them to the specialty at the beginning of their internship. This form of communication has been very well received within the profession. It is actually difficult to quantify how much students looking for their career path appreciate the tool at this stage, as its distribution is still in its infancy.

Conclusion: The challenge in writing this review lies in adapting the writing style to a wide audience, including both novices and experts. There are still many topics to cover in order to explore all the specialties of hospital pharmacy, such as the preparation of innovative therapy drugs and clinical research, for example. Consultation and impact statistics will

need to be studied further as publications continue to improve relevance.

Hematologic response after switching to sucrosomial iron in patients with inadequate response to conventional oral iron: A real-world retrospective study

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Background: Iron deficiency anemia (IDA) is the most common form of anemia worldwide. Although conventional oral iron therapy remains the first-line treatment, a substantial proportion of patients demonstrate inadequate hematologic response due to poor gastrointestinal tolerance or impaired intestinal absorption. Sucrosomial iron (Sideral®) is a novel oral iron formulation designed to enhance bioavailability and improve tolerability. However, evidence regarding its effectiveness after failure of conventional oral iron therapy remains limited in real-world clinical settings. The aim of this study is to evaluate hematologic outcomes after switching from conventional oral iron (Ferrian®) to sucrosomial iron in patients with suspected inadequate response to prior oral iron therapy.

Method: This retrospective observational study analyzed electronic medical records from a tertiary medical center between 2023 and 2025. Adult patients who received sequential oral iron therapy consisting of Ferrian® followed by Sideral® were identified from prescription records. Baseline hemoglobin (Hb) was defined as the closest value within 30 days prior to initiation of Sideral®, and follow-up Hb was defined as the first value between 30 and 90 days after switching therapy. The primary outcome was change in hemoglobin after switching therapy. Treatment response was defined as an increase in Hb ≥ 1 g/dL. Sensitivity analyses were performed after excluding patients with potential confounding factors including blood transfusion, perioperative transfusion, pregnancy, and insufficient drug exposure.

Results: A total of 169 patients received sequential Ferrian® and Sideral® therapy, of whom 62 patients had available baseline and follow-up hemoglobin measurements. Mean baseline hemoglobin was 8.57 g/dL and increased to 9.46 g/dL after switching therapy, corresponding to a mean increase of 0.89 g/dL (95% CI 0.46–1.32; $p < 0.001$). Overall, 41.9% of patients achieved a hemoglobin increase ≥ 1 g/dL. After excluding patients with potential confounding factors, the primary analysis cohort consisted of 33 patients, in whom hemoglobin increased from 8.39 g/dL to 9.37 g/dL (mean change 0.98 g/dL; $p < 0.001$). Subgroup analysis showed greater hemoglobin improvement in patients with baseline Hb < 8 g/dL.

Conclusion: Switching from conventional oral iron to sucrosomial iron was associated with significant improvement in hemoglobin levels in patients with suspected inadequate response to prior oral iron therapy. These findings suggest that sucrosomial iron may represent an effective alternative oral iron strategy in routine clinical practice.

Audit of French hospital pharmacies by elected advisors of the French Chamber of Pharmacists

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Background: Elected advisors from the Hospital Pharmacy Council of the French Chamber of Pharmacists audit hospital pharmacies in order to provide an opinion to regional health agencies (ARS) on any requests for authorization to create, transfer, modify, or close hospital pharmacies. Between 2020 and 2025, 2,589 opinions were issued, providing an exceptional source of information on the activities of hospital pharmacies in France, their strengths, and areas for improvement.

Method: When a hospital pharmacy applies for or renews its authorization, it sends its file to the Regional Health Authority (RHA). The RHA forwards the entire file to the French Chamber of Pharmacists for review. The president of Hospital Pharmacy Council appoints one of the 28 elected advisors (spread across France) to review the file. The council advisor visits the hospital pharmacy and audits it using a specific audit grid. This grid covers all the elements of a reference framework drawn up by the Hospital Pharmacy Council of the French Chamber, based on the regulations in force. The areas audited are: quality management, organization, processes, human resources, premises, and equipment. At the end of this “collegial” visit, the council advisor writes an “opinion” (for each activity requested) which is sent to the RHA. There are three possible types of explained opinion: favorable, favorable with recommendations, or unfavorable.

Results: Between 2020 and 2025, 2,589 opinions were issued, with an increasing number of opinions each year. Of these requests, 2,005 (77%) received a favorable opinion (with or without recommendations), 168 (6%) received an

unfavorable opinion, and 331 (13%) received a partially favorable and partially unfavorable opinion depending on the activities involved. For so-called “high-risk” activities such as sterile and non-sterile preparations, whether dangerous or not (for staff and the environment), it was the topic of “equipment” that required the most recommendations. For the activity of preparing innovative therapy drugs, it was the premises that presented the most non-conformities. The activity with the most “unfavorable” opinions was sterilization. In this last example, these audits enabled establishments to prioritize the renovation of sterilization units in order to bring them into compliance with the latest recommendations in force.

Conclusion: Beyond the figures, the first positive aspect of these audits is the collegial approach, with constructive dialogue between the elected advisor and their fellow pharmacist. This support is expected and appreciated by our colleagues. Examples of good practices can be shared between hospital pharmacies. Finally, visits by the French Chamber of Pharmacists to healthcare facilities raise the profile of our colleagues' work, particularly among facility management, which often leads to the release of funds for improving premises and practices.

From screening to outcomes: Automated clinical decision support reduces viral hepatitis reactivation during immunosuppressive therapy

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Background: Reactivation of hepatitis B virus (HBV) or hepatitis C virus (HCV) may occur in patients receiving immunosuppressive therapies such as biologics, chemotherapy, and Janus kinase inhibitors, potentially leading to severe hepatitis, liver failure, and increased mortality. Although international guidelines recommend hepatitis screening before initiating high-risk medications, adherence in routine clinical practice remains inconsistent. Clinical decision support integrated into electronic prescribing systems may improve screening compliance and help prevent viral reactivation.

Method: An automated hepatitis reactivation alert system was implemented in July 2022 at a tertiary medical center in Taiwan. The system identifies high-risk medications and reviews patients' hepatitis screening records (HBsAg, anti-HBc, and anti-HCV) within the previous two years. If screening or follow-up evaluation (e.g., HBV DNA testing) is incomplete, real-time alerts are generated during prescribing. Outcomes before and after implementation were compared in a retrospective study (August 2020–June 2025).

Results: After implementation, screening rates for hepatitis B and C markers improved across multiple high-risk medication groups, including rituximab, JAK inhibitors, and anti-TNF agents. Among rituximab users, screening remained high (HBsAg 94.2% to 95.4%; anti-HBc 91.0% vs 89.8%; HBV DNA 42.7% to 52.9%). Among anti-TNF users, HBsAg screening increased from 32.8% to 46.3% and anti-HBc screening from 19.0% to 29.8%, while HBV DNA testing remained limited (2.3% vs 2.2%). Over three years, 118,728 hepatitis-related tests were performed (mean 3,298/month). HBV reactivation decreased from 0.88% to 0.14%, and HBV reactivation with hepatitis decreased from 0.32% to 0.07%.

Conclusion: Automated clinical decision support improved hepatitis screening and reduced HBV reactivation among patients receiving high-risk medications, highlighting its value in improving medication safety.

The role of pharmacists in managing climate-sensitive health risks through the lens of one health approach: A review

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Background: Background information: The One Health Approach encompasses strategies for addressing the complex and interrelated health issues of the twenty-first century. It encourages interdisciplinary cooperation, systems thinking, and sustainable practices in recognition of the interconnectedness of human, animal, and environmental health. Climate change keeps impacting animal, human and environmental health. There is a surge in the prevalence of diseases transmitted between animals and humans. There is an ongoing rise in Climate-sensitive health risks due to changing weather patterns such as droughts, floods and extreme heat. These include: heatstroke, respiratory illnesses, vector borne diseases (malaria, dengue), malnutrition (from food insecurity), mental health illness, food and water borne diseases.

Objective: Independent sectoral approaches to address health of humans, animals and protect the environment from the devastation caused by climate change has not yielded the desired outcome and it is a costly option. The way out is to explore integrated approaches, such as the One Health Approach, in handling human, animal and environmental health. This multisectoral synergy is effective and cost-saving. This review paper seeks to present the roles pharmacists can play in managing Climate-Sensitive Health Risks through the lens of One Health Approach.

Method: Using the title presented above, a scoping search was run through Google Scholar database and relevant

articles were retrieved and synthesized. A total of 404 articles were sighted at first search. By varying the search words developed from the title, top relevant articles to the title were retrieved, synthesised, analysed and emerging themes were collated. Out of these, only 9 articles were referenced in this paper.

Results: The findings from the study revealed that pharmacists can leverage on their position in healthcare as frontline healthcare advisors as an opportunity to contribute maximally to one health approach. Pharmacists in developed countries are ahead of those in low- and middle-income countries in the education and practice of one health approach. Roles of pharmacists in managing Climate-Sensitive Health Risks Through the Lens of One Health Approach include: Health Education/Promotion and Patient Counselling: educate communities on preventive measures like vector control through use of insecticide treated nets, vaccination and responsible medication disposal to prevent environmental contamination. Strengthening Transdisciplinary, Multisectoral Collaboration in Training and Practice: develop integrated strategies to address antimicrobial resistance and food security through collaboration with other health professionals and sectors. Environmentally Sustainable Practices: by minimising ecological footprints of medications.

Conclusion: Pharmacists can play significant roles in managing climate-sensitive health risks. However, challenges such as limited resources and the need for interdisciplinary collaboration remain. Addressing these challenges through enhanced training and policy support can further empower pharmacists in their critical role within the One Health framework. Country regulatory bodies for Pharmacy training and practice are encouraged to review curricula by integrating sustainable pharmacy practice and the intersection of climate change and health.

Antipsychotic polypharmacy in Japanese outpatients with schizophrenia: Prevalence and sex- and age-related patterns

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Background: Schizophrenia is a chronic psychiatric disorder often requiring long-term pharmacological treatment. Antipsychotic monotherapy (APM) is widely regarded as the gold standard because of its efficacy and lower risk of adverse effects compared with polypharmacy. However, in real-world clinical practice, monotherapy is often insufficient for

achieving adequate symptom control, leading to the frequent use of antipsychotic polypharmacy (APP), defined as the concurrent prescription of two or more antipsychotic agents. Previous studies have described the prevalence and clinical implications of APP, but findings regarding the influence of sex and age on APP remain inconsistent. We conducted a nationwide survey of outpatients with schizophrenia in Japan to clarify the clinical characteristics associated with APP and its relationship with concomitant psychotropic medications. We focused particularly on the influence of sex and age on APP to generate insights that could support strategies for optimizing antipsychotic treatment in clinical practice.

Method: This cross-sectional survey included patients diagnosed with schizophrenia who attended outpatient clinics at 36 medical institutions across Japan between October 21 and October 25, 2024. Data were extracted from medical records regarding age, sex, frequency of medication administration, and prescribed psychotropic medications. Antipsychotic doses were standardized to chlorpromazine (CP) equivalents. Patients were categorized into APM and APP groups, and comparisons were made regarding demographic and clinical variables, including the use of clozapine, long-acting injectables (LAIs), and concomitant antiparkinsonian agents, anxiolytics/hypnotics, and mood stabilizers. Multivariable logistic regression analyses were performed to examine factors independently associated with APP, and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.

Results: Among 3,657 patients, APP was prescribed in 40.8%. CP equivalent doses increased with the number of antipsychotic agents prescribed. Multivariable analyses showed that APP was significantly associated with male sex (OR 1.25, 95% CI 1.08–1.45); older age (per 10-year increment: OR 1.07, 95% CI 1.01–1.13); and use of LAIs (OR 1.86, 95% CI 1.49–2.32), antiparkinsonian agents (OR 2.65, 95% CI 2.25–3.11), anxiolytics/hypnotics (OR 2.53, 95% CI 2.14–3.00), and mood stabilizers (OR 1.73, 95% CI 1.46–2.05), whereas clozapine use was inversely associated with APP (OR 0.13, 95% CI 0.08–0.21). Age- and sex-stratified analyses showed that females received higher CP equivalent doses up to their twenties, whereas males received higher doses from their thirties onward, with significant differences in the 40–69 years. Peak doses were observed in the 40–59 years, followed by a gradual decline with advancing age. Second-generation antipsychotics predominated in APM, whereas first-generation antipsychotic use increased with the number of antipsychotics prescribed.

Conclusion: APP remains common in real-world outpatient practice in Japan and is associated with male sex, older age, and frequent concomitant psychotropic use. These findings underscore the importance of careful management of APP, taking sex- and age-related prescribing patterns into consideration.

Stakeholder experiences and expectations of transition of care services to reduce medication-related hospital readmission for cardiology patients

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Background: Transition of care (ToC) for patients with post-acute myocardial infarction (AMI) or coronary revascularization is a complex, high-risk period often leading to medication-related harm (MRH) and hospital readmissions. While specialised programs exist for other cardiac conditions and cohorts, a gap in tailored medication management services exists for this specific patient population. Pharmacist-led, interdisciplinary ToC services have demonstrated a positive impact on patient outcomes. The REDucing hospital re-admission for high-risk CARDiology patients (RECARD) program aims to address this by co-designing, implementing, and evaluating a new pharmacist-led ToC service. The current study focuses on understanding the experiences and expectations of patients and clinicians to inform the development of this service.

Method: This qualitative study utilised semi-structured interviews and focus groups to gather data from patients and hospital and community clinicians aligned with three Queensland hospitals. Patients who had experienced an AMI or coronary revascularization procedure in the past three months were interviewed via telephone or Microsoft TEAMS. Clinicians participated in focus groups or individual interviews. Data were audio-recorded, transcribed, and analysed using the six-phase thematic analysis method by Braun and Clarke, guided by Bradshaw's model of need to understand stakeholders' expressed and comparative needs.

Results: Data were obtained from 13 patient interviews and 40 clinicians, through seven focus groups and one interview. Three main themes, with associated subthemes, emerged from the data; Patient-level issues, System and process issues and Interprofessional collaboration. Integrative solutions aligned with the implementation science framework focused on patient centered communication and improved transitions of care. At the patient level, strategies emphasised individualised support for high-risk groups by tailoring communication, education, and culturally sensitive materials to diverse literacy needs. Transition of care improvements included early risk identification, proactive discharge planning, strengthened post discharge follow up, and clearer role delineation—particularly enhancing collaboration between hospital teams, community pharmacists, and GPs.

Finally, digital tools such as shared records and innovations to support specialist access, especially for regional patients, were identified as essential enablers of the model.

Conclusion: The study's findings highlight the critical need for a patient-centered, pharmacist-led ToC service that addresses patient knowledge deficits, psychosocial barriers, and the communication gaps between hospital and community care settings. The results from this study will inform the development of the RECARD program's "Adaptive ToC Pathway," ensuring it is tailored to meet the specific needs and expectations of both patients and clinicians, ultimately aiming to reduce medication-related harm and hospital readmissions.

Multiple benefits of tirzepatide on cardio-renal and hepatic outcomes in T2D and obesity: A literature review

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Background: Type 2 diabetes (T2D) and obesity are frequently complicated by non-alcoholic fatty liver disease (NAFLD), chronic kidney disease (CKD), and increased cardiovascular (CV) risk. While current therapies address individual aspects of these comorbidities, there is a need for treatments that offer comprehensive metabolic benefits. Tirzepatide is a novel, once-weekly dual glucose-dependent insulinotropic polypeptide (GIP) and glucagon-like peptide-1 (GLP-1) receptor agonist. By targeting GIP receptors abundant in adipose tissue, Tirzepatide may improve lipid homeostasis and energy metabolism beyond the effects of GLP-1 mono-agonists.

Objective: To review the efficacy of Tirzepatide regarding liver fat content (LFC), abdominal adipose tissue, kidney function preservation, and cardiovascular health based on data from the SURPASS-3 MRI sub-study, SURMOUNT-1 trial, and SURPASS-4 trial.

Method: This review synthesizes findings from three key Phase 3 trials: 1. SURPASS-3 MRI Sub-study: A 52-week randomized trial comparing Tirzepatide (5, 10, 15 mg) vs. Insulin Degludec in 296 T2D patients, measuring LFC and abdominal fat via MRI-PDFF. 2. SURPASS-4: An assessment of 2002 T2D patients with high CV risk treated with Tirzepatide vs. Insulin Glargine (median 85 weeks) to evaluate major adverse cardiovascular events (MACE-4) and kidney outcomes (eGFR decline, UACR). 3. SURMOUNT-1: A 72-week trial in 2539 adults with obesity (without diabetes) evaluating weight reduction with Tirzepatide vs. Placebo.

Results: • **Liver & Fat Metabolism:** In SURPASS-3 MRI, pooled Tirzepatide (10/15 mg) achieved a significantly greater absolute reduction in LFC compared to Insulin Degludec (-8.09% vs. -3.38%, $p < 0.0001$). Tirzepatide significantly reduced visceral (VAT) and subcutaneous (ASAT) adipose tissue volumes, whereas insulin treated patients experienced increases in abdominal fat. LFC reduction correlated significantly with VAT and body weight reductions. • **Kidney Outcomes:** In SURPASS-4, Tirzepatide slowed the annual rate of eGFR decline compared to Insulin Glargine (-1.4 vs. -3.6 mL/min/1.73 m²/year) and reduced the risk of the composite kidney endpoint (eGFR decline 40%, renal death, etc.) by 42% (HR 0.58). While UACR increased by 36.9% with Insulin Glargine, it decreased by 6.8% with Tirzepatide. • **CV Health & Weight:** In SURPASS-4, Tirzepatide demonstrated CV safety with no increase in MACE-4 risk (HR 0.74; 95% CI 0.51–1.08) compared to glargine. In SURMOUNT-1, Tirzepatide 15 mg resulted in a mean weight reduction of 20.9% vs. 3.1% for placebo, with improvements in blood pressure and lipid profiles. Discussion: Tirzepatide demonstrates a unique profile of metabolic benefits. Its ability to substantially decrease liver fat and visceral adiposity likely contributes to the observed improvements in insulin sensitivity and CV risk factors. The renal analysis indicates a potential nephroprotective effect, particularly in delaying eGFR decline and preventing macroalbuminuria, distinct from glycemic control alone. The safety profile was consistent with GLP-1 receptor agonists, primarily involving mild-to-moderate gastrointestinal events.

Conclusion: Tirzepatide acts as a potent metabolic modulator that extends benefits beyond glycemic control. It significantly clears liver fat, reduces visceral adiposity, slows kidney function decline, and achieves substantial weight loss while maintaining cardiovascular safety. These findings support Tirzepatide as a comprehensive therapeutic option for T2D and obesity-related cardio-renal-metabolic complications.

QR code-assisted medication counseling: reducing pharmacist workload for special administration devices in a Hsinchu Regional Hospital

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Background: Traditional oral counseling for special administration devices is highly time-consuming. It often leads to pharmacist burnout and patient information overload. According to Wilson et al. (2010), patients' memory of medical information decays rapidly without supportive media. This study aims to implement a QR code-assisted digital counseling system to objectively reduce repetitive

instructional time, alleviate pharmacist workload, and provide repeatable learning materials for patients.

Method: An observational study was conducted in January 2026, including prescriptions for special devices (inhalers, nasal sprays, ear drops, and sublingual NTG). Time spent per counseling session was measured using stopwatches for both the control group (traditional oral counseling) and the intervention group (QR code counseling). The post-intervention workflow simply involved patient identification and instructing them to scan the QR code.

Results: During 24 outpatient days, 2,014 prescriptions were analyzed. Post-intervention counseling time significantly decreased by 88.8% to 94.4%, averaging 10 ± 3 seconds per patient. Overall, this intervention saved approximately $10,760 \pm 187$ seconds daily. Assuming an average dispensing time of 30 seconds per prescription, the time saved equals a workload reduction of 359 ± 6 prescriptions daily. Discussion & Conclusion QR code digital counseling efficiently handles repetitive initial instructions, optimizing pharmacy workflows and reallocating pharmacists' time to complex cases requiring clinical assessment. Printed QR codes on medication bags serve as portable materials, potentially enhancing long-term memory. Limitations & Future Work This study solely evaluated pharmacist time reduction, without measuring patient compliance, operational accuracy, or clinical outcomes. Future research will track patient utilization data to assess the substantive clinical impact.

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Real-world utilisation and carbon footprint of anaesthetic techniques in general anaesthesia: A retrospective study in a regional hospital in Taiwan

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Background: Healthcare systems account for a considerable proportion of global greenhouse gas emissions, with inhalational anaesthetics recognised as a major contributor due to their high global warming potential (GWP). Desflurane,

in particular, has a substantially higher GWP compared with sevoflurane, raising concerns regarding its environmental impact. Recent international initiatives have advocated reducing the use of high-carbon anaesthetic agents; however, real-world data describing utilisation patterns and associated carbon emissions remain limited, especially in regional hospitals in Taiwan. In addition, concerns regarding potential differences in postoperative recovery profiles may influence anaesthetic selection in routine clinical practice, potentially limiting the adoption of lower-carbon alternatives. This study aimed to describe real-world utilisation patterns of anaesthetic techniques used for general anaesthesia, compare postoperative recovery outcomes, and quantify the associated carbon footprint in a regional hospital in Taiwan.

Method: A retrospective observational study was conducted in a Taiwanese regional teaching hospital. Adult patients undergoing general anaesthesia between 1 January and 30 June 2025 were included. Data were extracted from the hospital's anaesthesia information system and pharmacy inventory database to ensure comprehensive capture of both clinical and drug utilisation data. Anaesthetic techniques were categorised as sevoflurane-based anaesthesia, desflurane-based anaesthesia, or total intravenous anaesthesia (TIVA) using propofol. The primary clinical outcome was postoperative recovery time, defined as the interval from cessation of anaesthetic agents to extubation. Anaesthetic gas consumption was quantified using pharmacy inventory records, and carbon emissions were estimated by converting the amount of each inhalational anaesthetic into carbon dioxide equivalents using published GWP values. All emissions were standardised and reported as kilograms of carbon dioxide equivalent (kgCO₂e).

Results: A total of 1,084 surgical cases were analysed. Sevoflurane-based anaesthesia was the most commonly used technique (761 cases, 70.2%), followed by desflurane (299 cases, 27.6%) and TIVA (24 cases, 2.2%). The mean postoperative recovery time was 5.31 minutes in the sevoflurane group and 4.92 minutes in the desflurane group, with no statistically significant difference ($p = 0.156$). During the study period, sevoflurane consumption was 27,156 mL and desflurane consumption was 21,047 mL. The estimated carbon emissions were 5,323 kgCO₂e for sevoflurane and 77,699 kgCO₂e for desflurane, resulting in a total carbon footprint of 83,022 kgCO₂e. Notably, although desflurane accounted for only 27.6% of anaesthetic techniques, it contributed over 93% of total anaesthesia-related carbon emissions, indicating a markedly disproportionate environmental burden.

Conclusion: In this Taiwanese regional hospital, sevoflurane was the predominant anaesthetic technique, and postoperative recovery outcomes were comparable between sevoflurane and desflurane. Despite similar clinical performance, desflurane was associated with a substantially higher carbon footprint and contributed disproportionately to overall emissions. These real-world findings highlight the potential to reduce healthcare-related carbon emissions through optimisation of anaesthetic choice without

compromising patient recovery outcomes, and provide robust baseline evidence to inform future sustainable anaesthesia strategies in regional hospital settings.

Improving controlled medication management and patient safety through automated dispensing cabinet implementation in a tertiary medical centre

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Background: In hospital pharmacies, management of controlled medications—particularly high-risk opioids such as morphine—has traditionally relied on manual paper-based registers. This process is labour-intensive, susceptible to delayed traceability and documentation errors, and may compromise patient safety and regulatory compliance. To enhance efficiency, accuracy, and traceability, Automated Dispensing Cabinets (ADCs) were implemented in the inpatient pharmacy of a tertiary medical centre. This study aimed to evaluate the impact of ADC implementation on workflow efficiency, documentation accuracy, and patient safety, and to assess its potential for broader adoption in hospital pharmacy practice.

Method: The ADC, incorporating user authentication, role-based access control, and electronic activity logging, was integrated with the hospital prescribing and inventory management systems. Key measures included: (1) replacement of physical key access with electronic authorization mechanism; (2) barcode scanning linked to prescribing data to enable cabinet access and guide medication selection; (3) automatic electronic documentation of all controlled medication transactions, including date, time, operator identity, batch number and expiry date; and (4) system-based inventory monitoring with real-time alerts for discrepancies and low stock levels. A pre-post observational study was conducted over 3 months to assess workflow efficiency, documentation accuracy, and dispensing reliability, and overall impact on operational workflow.

Results: Following ADC implementation, all controlled medication transactions were electronically recorded with batch and expiry tracking, enhancing traceability and enabling first-expiry-first-out (FEFO) inventory management. Average shift handover time decreased from 20 to 5 minutes, significantly reducing pharmacist workload. Barcode-enabled access contributed to no recorded controlled medication selection errors during the evaluation period. Electronic documentation eliminated paper-based registers and streamlined audit processes, thereby enhancing efficiency and traceability. Real-time discrepancy alerts strengthened

stock monitoring, facilitated rapid investigation of any irregularities, and supported timely corrective actions. Overall, ADC integration contributed to improved operational workflow, pharmacist accountability, and reliability in controlled medication management.

Conclusion: Implementation of the ADC in a tertiary hospital pharmacy significantly improved workflow efficiency, documentation accuracy, and patient safety. Electronic transaction recording, barcode-enabled dispensing, and real-time stock monitoring optimised the management of controlled medications. The system also reduced pharmacist workload, improved audit and reporting processes, and increased confidence in medication safety practices, underscoring the effectiveness of digital solutions in hospital pharmacy practice. These findings support the broader adoption of ADC to enhance patient safety, regulatory compliance, and operational efficiency across hospital pharmacy settings.

Longitudinal analysis of inhaler prescription patterns and corresponding carbon footprints in airway diseases: A retrospective pharmacy claim data analysis

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Background: Climate change poses a critical threat to global public health, and healthcare systems contribute significantly to greenhouse gas emissions. In respiratory care, pressurized metered-dose inhalers (MDIs) utilizing hydrofluoroalkane propellants account for a substantial portion of this medical carbon footprint. Concurrently, the over-reliance on short-acting beta-agonists (SABAs) remains a prevalent clinical challenge, indicating suboptimal airway disease control while driving disproportionate environmental harm. This study aims to evaluate prescription patterns and quantify the carbon footprint of inhaler therapies by pharmacological class and device type using hospital prescription claim data, and to identify critical targets for pharmacist-led stewardship to advance "Green Pharmacy" practices.

Method: A retrospective observational study was conducted using medical center prescription claim data in Taiwan from 2022 to 2025. All inhaler prescriptions indicated for obstructive airway diseases were extracted and stratified by device type (MDI, dry powder inhaler [DPI], and soft mist inhaler [SMI]) and pharmacological class. The environmental impact was quantified by calculating the estimated carbon footprint for each dispensed prescription. Descriptive statistics were employed to evaluate longitudinal prescribing trends and analyze the proportional asymmetry between prescription proportions and their corresponding carbon footprints.

Results: Longitudinal data from 2022 to 2025 revealed a persistent and profound ecological imbalance. Throughout the study period, MDIs consistently accounted for roughly half of the prescriptions (50.38% to 54.49%) but persistently dominated the respiratory carbon footprint, generating over 96% (96.01% to 96.52%) of total emissions annually. Conversely, while DPI and SMI prescriptions combined fluctuated between 45.52% and 49.62%, their combined annual carbon footprint never exceeded 4% (3.49% to 3.99%). Stratification by pharmacological class identified SABAs as the most disproportionate environmental burden across all four years. Although SABA prescription proportions experienced a slight overall decrease (from 18.66% in 2022 to 17.97% in 2025), their contribution to the total carbon footprint remained consistently above 52% (52.77% to 56.03%). The most frequently prescribed maintenance therapy, long-acting beta-agonist/inhaled corticosteroid (LABA/ICS), showed a steady increase in prescription proportions (from 44.52% to 46.79%) while its emission share remained relatively stable (34.92% to 36.83%), coinciding with a sharp decline in single-agent ICS prescriptions (from 5.36% to 2.21%). Notably, long-acting beta-agonist/long-acting muscarinic antagonist (LABA/LAMA) therapies demonstrated a sustained model of environmental sustainability, with their prescription share growing from 19.90% to 21.05% over the four years, yet consistently contributing less than 1.7% (1.47% to 1.68%) to the total carbon footprint.

Conclusion: The profound asymmetry between prescription patterns and environmental impact—primarily driven by persistent MDI-based SABA usage—reveals a critical intersection of suboptimal airway disease management and severe ecological harm. The contrasting low-emission profile of DPI/SMI maintenance therapies provides clear evidence that eco-friendly transitions are clinically viable. Consequently, there is an urgent need for pharmacist-led respiratory stewardship. By actively reducing SABA dependency and advocating for device optimization, healthcare systems can simultaneously advance "Green Pharmacy" initiatives and improve long-term patient outcomes, a dual benefit that warrants validation in broader epidemiological cohorts.

Monte Carlo simulation for power estimation in a planned retrospective study of clozapine augmentation with amisulpride for treatment-resistant schizophrenia

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Background: Treatment-resistant schizophrenia (TRS) affects approximately one-third of patients with schizophrenia and carries a disproportionate burden of disability and healthcare use. Clozapine remains the recommended treatment for TRS, yet 40–70% of patients show incomplete response. Augmentation of clozapine with amisulpride has shown clinical promise, but evidence from real-world long-term use is lacking. The ongoing CARS (Clozapine and Amisulpride in Resistant Schizophrenia) project is a retrospective interrupted time-series study covering an 8-year observation period: four years on clozapine monotherapy followed by four years of clozapine plus amisulpride. Conventional power calculations assume simple designs and statistical tests and often fail to capture the complexity of longitudinal psychiatric outcome data. Simulation-based methods offer a more realistic framework for planning such studies.

Objective: To estimate the statistical power of the CARS study using Monte Carlo simulation calibrated with real-world clinical parameters.

Method: A patient-level simulation engine was implemented in RStudio. Synthetic cohorts were generated with baseline Positive and Negative Syndrome Scale (PANSS) scores drawn from a truncated normal distribution derived from the Campana et al. (2021) meta-analysis ($n = 1,554$; mean = 76.03, standard deviation = 15.26). Each simulated patient was assigned demographic and clinical characteristics consistent with published TRS literature, including age, illness duration, smoking status, and prior antipsychotic exposure. Clinical trajectories were modelled as a piecewise two-slope function: a pre-augmentation phase reflecting clozapine-alone stabilisation, and a post-augmentation phase representing the amisulpride effect (target mean PANSS reduction = 13 points over 16 visits, standard deviation = 9). Gaussian noise was added to simulate measurement variability. First, the engine generated simulated clinical datasets of 50 to 200 patients. Then, a linear mixed-effects model with random slopes was fitted to each simulated dataset: $PANSS \sim \text{time} + \text{post} + \text{time:post} + (\text{time} | \text{patient})$. The interaction term (time:post), capturing the change in trajectory after amisulpride augmentation, served as the primary inferential target. Finally, the engine created over 1000 simulated datasets, where Monte Carlo power was

estimated as the proportion of simulations returning $p < 0.05$ for the time:post interaction term.

Results: At $n = 50$ patients, Monte Carlo estimated power was 98% (124,575 iterations). A sample of 75 patients achieved >99% power. The mean clozapine slope (β_{pre}) was -0.718 PANSS points per quarterly visit, and the mean clozapine/amisulpride slope (β_{post}) was -0.930 PANSS points per quarterly visit. The mean total PANSS reductions were -8.97 (SD 7.8) on clozapine, and -12.8 (SD 8.1) on clozapine/amisulpride, consistent with existing literature. Power fell to a minimum (64%) near the null crossing (when $\beta_{pre} = \beta_{post}$), and rose symmetrically on both sides. A total of 103 patients received clozapine/amisulpride augmentation in the study setting since 2006, confirming the feasibility of the planned sample size.

Conclusion: Monte Carlo simulation provides a flexible, clinically grounded approach to power analysis for longitudinal psychiatric trials with complex trajectories. The simulation results indicate that the available sample size is sufficient to detect clinically meaningful changes in symptom trajectory following amisulpride augmentation.

Analysis of access and financing trends for innovative medicines in the Spanish National Health System (2020–2025)

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Background: Access to innovative therapies is widely recognised as a key indicator of health system performance. In Spain, the increasing number of approvals for oncology and orphan medicines has placed considerable pressure on conventional regulatory and reimbursement frameworks, underscoring the need to assess financing rates and access timelines to safeguard sustainability and equity.

Objective: To analyse trends in access to innovative medicines in Spain from 2020 to 2025, focusing on financing rates, administrative efficiency, and the contribution of early access mechanisms.

Method: We performed a descriptive observational study comparing two cohorts of medicines authorised through the European Union (EU) centralised procedure. Data were sourced from official records of the Spanish National Health System (NHS) and the 2024 European Federation of

Pharmaceutical Industries and Associations (EFPIA) Patients W.A.I.T. (Waiting to Access Innovative Therapies) Indicator. Key outcome measures included the proportion of medicines financed and the median time from national registration to reimbursement decision.

Results: Among 230 innovative medicines authorised by the European Commission, 149 were financed in Spain, corresponding to 78.8% of those registered nationally. Administrative efficiency improved markedly over time, with the median interval from registration to financing decision decreasing from 615 days in the earliest annual period to 303 days in the most recent. The Medicines in Special Situations (MSE) pathway enabled early access for 57.8% of authorised medicines. According to EFPIA data, Spain showed an overall availability rate of 65%, with a median waiting time of 636 days.

Conclusion: Spain's pharmaceutical access model appears to have improved over the study period, with shorter decision timelines and increased financing rates. Early access mechanism plays a relevant role in addressing unmet need; however, substantial gaps remain in meeting the 180-day regulatory benchmark for pricing and reimbursement decisions.

Evolution and trends in the funding of innovative medicines in Spain (2015–2025)

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Background: Access to innovative medicines, particularly in areas such as oncology, rare diseases, and advanced therapies, has become a global challenge, placing increasing pressure on traditional regulatory frameworks and raising concerns about financial sustainability and clinical uncertainty. In Spain, the period from 2015 to 2025 has been marked by a profound structural shift in how the Spanish National Health System (NHS) manages the entry of new therapies.

Objective: This study evaluates the evolution of funding mechanisms, identifying a transition from a binary funding model towards a indication-based reimbursement approach, while also analyzing improvements in administrative efficiency and early access pathways.

Method: This descriptive observational study was based on two main data sources: longitudinal data from the BIFIMED database (2015–2025) and two cohorts of innovative medicines authorized through the European Union (EU) centralized procedure between January 2020 and June 2024. Access indicators included the rate of national registration (allocation of a national code), the proportion of funded medicines, and the use of Medicines in Special Situations (MSE) for early access. Process indicators assessed the time from EU marketing authorization to national registration and from registration to final pricing and reimbursement resolution.

Results: The NHS maintained a high volume of funding decisions, typically ranging from 800 to 1,000 annually. However, the scope of these decisions narrowed substantially over time. Since 2021, the NHS has increasingly shifted towards selective reimbursement by clinical indication rather than reimbursement of the medicine as a whole. Among biological medicines, the proportion of products with all indications funded declined from more than 80% to 44% by 2025. Similarly, only 24% of orphan medicines had all authorized indications funded in 2025. This trend also affected biosimilars and generic medicines, for which full indication coverage declined to 44% and 77%, respectively, by 2025. Administrative efficiency improved during the study period. The median time from EU authorization to national registration in Spain fell to 35 days in the 2023–2024 period. The median time from registration to a positive funding decision was reduced from 615 days in the earlier cohort to 303 days by 2024. In addition, 57.8% of authorized innovative medicines were accessible through the MSE pathway, which acted as a critical bridge for patients with unmet medical needs before formal funding decisions were completed.

Conclusion: Between 2015 and 2025, the funding of medicines in Spain evolved into a more agile but also more selective system. The NHS streamlined administrative timelines and incorporated early access mechanisms to reduce delays associated with formal pricing and reimbursement negotiations. However, the silent shift towards indication-based funding across all drug categories, including highly innovative therapies and biosimilars, suggests that reimbursement is no longer a fixed status but rather a revisable equilibrium. This new model enables the healthcare system to manage clinical uncertainty and budget impact by aligning public funding more closely with the clinical value delivered in specific patient subgroups.

Three-dimensional printing of medicines: appraising the requirements for safe adoption in clinical pharmacy practice

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Background: Three-dimensional printing (3DP) of medicines is transitioning from proof-of-concept research to a translational phase encompassing hospital point-of-care (PoC) manufacturing, community pharmacy compounding, and industrial production. Additive manufacturing technologies such as semi-solid extrusion (SSE), fused deposition modelling (FDM), and binder jetting build dosage forms layer by layer from digital designs, enabling precise control of dose, internal geometry, and drug-release kinetics. Despite this progress, 3DP is still regarded as a complement to conventional compounding, as important limitations remain regarding printable materials, feedstock properties, and validation of quality attributes for small-batch production.

Objective: This review aimed to integrate clinical, operational, and quality-assurance evidence from diverse healthcare settings in order to appraise the requirements for the safe adoption of 3DP in clinical pharmacy practice.

Method: A situational review was conducted through searches of the Scopus and PubMed databases for studies related to 3DP and additive manufacturing in clinical, hospital, and community pharmacy settings. The search identified 10 clinical studies and 1 community pharmacy study for inclusion. Studies were analysed according to setting, study design, therapeutic target, and primary endpoints, including pharmacokinetic bioequivalence, acceptability, and cost-effectiveness.

Results: Available evidence indicates that 3DP can produce oral solid dosage forms meeting bioequivalence standards in healthy adults. In paediatric care, 3DP has shown particular promise in rare metabolic disorders. In community pharmacy, automated 3DP capsule filling reduced manual labour by 55% and costs by 20–35%, while complying with European Pharmacopoeia standards. Ongoing studies are further exploring the use of 3DP for rapid and precise multidrug dosing. Economic evaluations suggest that the unit cost of personalised 3DP tablets ranges from €1.58 to €3.11, making this technology potentially cost-competitive with conventional compounding in low-dose, high-titration therapies.

Conclusion: Current evidence supports 3DP as a technically and economically feasible modality for clinical pharmacy practice, particularly in personalised paediatric dosing and automated compounding. However, the evidence base remains limited by small sample sizes and the lack of long-term clinical data.

Look-alike sound-alike medications in the perioperative setting: Multidisciplinary perspectives

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Background: Medication safety is a global concern, with the ethos being the proactive identification of opportunities to improve safety and reduce patient harm. The perioperative setting, where many high-risk medications are administered is of concern in terms of medication safety, with Look-alike, Sound-alike medication (LASA) issues increasing, due to drug shortages resulting in the need to source different brands based on availability. International perioperative guidelines highlight multidisciplinary collaboration between clinicians as key to strengthening communication with the potential to reduce preventable patient harm. Since medication safety tools do not specifically address the issues with LASA medications, there is a lack of understanding of the risks experienced with LASA medications within both the pharmacy and perioperative care settings. The study purpose is to explore LASA medications within the pharmacy and perioperative care settings from the perspective of key clinicians.

Method: A quantitative study design involved the development of two medication safety surveys for the pharmacy and perioperative settings at the Townsville University Hospital, a large 800-bed regional Australian hospital. Key questions identified from existing medication safety tools were modified to focus on LASA medications. Clinician reviews with resulting modification and question validation were completed to ensure applicability to Australian practice. The perioperative and pharmacy survey tools using responses of yes, no, unsure or not applicable, were distributed using the Qualtrics Online Survey Platform to anaesthetists and perioperative nurses and pharmacists

and pharmacy assistants. Data were analysed descriptively and Fischer's Exact and Cramer's V tests were undertaken as appropriate, with $p \leq 0.05$ considered statistically significant.

Results: Thirteen anaesthetists and nine nurses, and thirty-seven pharmacists and fifteen pharmacy assistants participated in the perioperative and pharmacy surveys respectively. Altered labelling and packaging due to drug shortages, storage location, training, incident reporting and lessons learnt were key issues identified. Over 90% of anaesthetists and perioperative nurses highlighted the importance of reviewing the labelling and packaging of any new medications prior to introduction, using a multidisciplinary approach. Medication selection errors due to labelling and packaging changes were identified by all participants, while 80% identified a medication incorrectly stored in an anaesthetic tray or Automated Dispensing Cabinet. Across the perioperative and pharmacy settings, participants believed that system improvement is the focus rather than individual staff members, with the perioperative (82%) more committed to sharing lessons learnt compared to the pharmacy setting (17%). Reported need for LASA training was associated with clinician role in the perioperative setting (Fischer's Exact Test $p=0.046$, Cramer's $V=0.51$), with nurses reporting the need for training more frequently than anaesthetists. Similarly, reporting via the Clinical Incident Management System was associated with pharmacist and pharmacy assistants (Fisher's Exact Test, $p<0.001$, Cramer's $V=0.77$). These effects suggest moderate to large differences in LASA-related practices across roles.

Conclusion: The study has provided key clinician perspectives of LASA medication issues within the pharmacy and perioperative settings. Tangible, multifaceted action plans can now be created to inform quality improvement with future study recommended to gain in-depth clinician perspectives on multidisciplinary team roles to improve safety and reduce patient harm.

Patient perspectives and experiences of collaborative pharmacist prescribing in the hospital inpatient setting: A cross-sectional survey

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Background: Collaborative pharmacist prescribing involves pharmacists working with doctors and patients to prescribe medicines in hospitals. While staff have reported positive experiences, little is known about patient perspectives. Partnering with patients is a key healthcare standard globally. Understanding patient experiences is essential to support shared decision-making and improve collaborative prescribing practices. Therefore, the aim of this study was to evaluate patient perspectives and experiences of collaborative pharmacist prescribing in the inpatient hospital setting.

Method: A cross-sectional anonymous survey was conducted across four hospitals. Eligible inpatients were aged ≥18 years and provided informed consent. The primary outcome was patient perspectives of collaborative pharmacist prescribing and experiences during medicine prescribing as an inpatient. Questionnaire development was guided by the Donabedian's Quality of Care framework, conceptualising collaborative pharmacist prescribing as a structural model influencing care processes and outcomes. The Patient-Centred Medication Safety (P-MEDS) framework informed items on medication safety, communication, understanding, trust, and patient involvement. Questions assessing patient attitudes and perspectives towards collaborative pharmacist prescribing were adapted from prior research. Demographic questions were included. Responses were collected using tick-boxes, five-point Likert scales (strongly agree to strongly disagree), and free-text. Questionnaires were completed online via Qualtrics, on paper, or verbally, according to patient preference. Results were stratified by the type of prescribing model (collaborative pharmacist prescribing vs medical prescribing) received by the patient during their admission. Free-text responses were thematically analysed using Braun and Clark's framework. Likert scale responses were summarised using descriptive statistics, and sub-group analysis compared categorical variables between groups.

Results: Responses were received from 200 patients (100 who received collaborative pharmacist prescribing and 100

who received medical prescribing). Overall, patients had a median age of 72 years and just over half were female. Qualitative analysis found that all respondents trust pharmacists' expertise and ability to collaboratively prescribe. Patients in both groups perceived benefits of collaborative pharmacist prescribing including enhanced interprofessional communication, reductions in medication errors, and a better understanding of their medicines. These findings reinforced quantitative results with patients who received collaborative pharmacist prescribing reporting a greater level of involvement with medicine decision-making compared to patients who received medical prescribing (80% felt involved vs 69% respectively). A higher proportion of patients who received collaborative pharmacist prescribing reported feeling very or extremely involved in medicine decisions compared to patients who received medical prescribing (60% vs 14%, $p < 0.001$).

Conclusion: Patients reported higher satisfaction, increased confidence, and greater empowerment in medication management with collaborative pharmacist prescribing. Patients who received pharmacist prescribing reported a greater level of involvement in medicine decisions than patients who received medical prescribing. Qualitative data support these findings, highlighting clearer communication, enhanced safety due to the collaboration, and a deeper understanding of their medicines. A limitation of this study is the potential for social desirability bias in responses, although the inclusion of multiple hospitals and prescribers enhances generalisability. Collectively, these findings reinforce the value of embedding pharmacists in collaborative prescribing roles to enhance patient-centred care, support shared decision-making, and contribute to better health outcomes.

The clinical and healthcare system outcomes of pharmacist prescribing in the inpatient hospital setting: A systematic review

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Background: Pharmacist prescribing models have expanded across healthcare systems as strategies to improve medicine safety and optimise medicine use. Internationally, several pharmacist prescribing models exist, with emerging evidence of clinical and healthcare system outcomes. A previous systematic review on pharmacist prescribing was limited by small study numbers, exclusion of models requiring doctors' authorisation before medication administration, a common legislative requirement, and did not evaluate healthcare system outcomes. Furthermore, no systematic reviews provide a comprehensive synthesis of pharmacist prescribing models in hospitals and their associated training. Interpretation of pharmacist prescribing outcomes is limited without understanding how the prescribing occurred. A synthesis of pharmacist prescribing models and their clinical and healthcare system outcomes is needed to support broader implementation in hospitals given the great acuity of illness, use of high-risk medicines, and increased need for coordinated team-based care. Therefore, this review aimed to (i) provide a narrative summary of hospital pharmacist prescribing models, and (ii) examine the clinical and healthcare system outcomes of pharmacist prescribing in the inpatient hospital setting by model type.

Method: A systematic search was conducted in four electronic databases in May 2024. Full-text English articles published post-2004, evaluating clinical and healthcare system outcomes of pharmacist prescribing in the inpatient hospital setting were included. Two independent reviewers screened articles for eligibility, performed data extraction using Covidence and performed critical appraisal using the Johanna Briggs Institute tools. Narrative synthesis was performed due to heterogeneity of included studies. Clinical and healthcare system outcomes are reported by type of prescribing model used.

Results: Of 1007 articles assessed for eligibility, 66 articles were included. Most were conducted in Australia (26%) and the United States of America (26%). Just over half of the studies were quasi-experimental trials. Forty-two studies (60%) evaluated collaborative, 17 (26%) dependent and 6 (9%) independent prescribing models. Seventeen studies evaluating collaborative prescribing models assessed medication errors, with 82% (14/17) reporting reductions. Improvements were consistently seen in the completeness of medication orders (100%), medicines optimisation outcomes (100%) and reductions in potential patient harm (100%). Improvements were reported in time and efficiency outcomes (4/5, 80%), while length of stay, and therapeutic benefit outcomes had mixed findings. Evidence for dependent and independent prescribing was limited due to the smaller number of studies evaluating these models. Dependent prescribing showed improvements in potential and actual patient harm (100%), while findings for medicines optimisation and time efficiency were mixed. Independent prescribing demonstrated improvements in time and efficiency outcomes (100%), while results for medication errors and healthcare resource utilisation were inconsistent. Importantly, no studies across any pharmacist prescribing model reported worse outcomes compared to usual care.

Conclusion: Pharmacist prescribing models improve prescribing quality and medication safety outcomes, particularly with collaborative models. Evidence for dependent and independent prescribing remains limited due to the small number of studies and heterogeneity in outcome reporting. Further high-quality, standardised evaluations are needed to strengthen the evidence base and guide implementation of pharmacist prescribing models internationally.

Decoding the optimal window: A real-world data odyssey of tacrolimus therapeutic monitoring across transplant populations

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Background: Tacrolimus is essential for preventing allograft rejection but requires therapeutic drug monitoring (TDM) due to its narrow therapeutic index and significant pharmacokinetic variability. Although clinical guidelines recommend target concentration ranges, real-world evidence examining TDM practices across different transplant populations remains limited. This study aimed to evaluate real-world tacrolimus TDM patterns across various transplant types, assess compliance with recommended therapeutic windows, and identify factors associated with optimal target attainment.

Method: We conducted a retrospective analysis of tacrolimus TDM data from outpatients and inpatients at the First Affiliated Hospital of University of Science and Technology of China between January 1, 2024 and December 31, 2025. The study included liver, kidney, cardiac, lung, and haematopoietic stem cell transplant recipients. Steady-state trough concentrations were measured, and statistical analyses were performed to compare concentration distributions and compliance rates across transplant types, care settings (outpatient vs. inpatient), and monitoring frequencies. Data were managed using standardised electronic medical records and analysed with appropriate parametric and non-parametric tests.

Results: A total of 21,234 TDM episodes were analysed, comprising 17,280 outpatient visits and 3,954 inpatient admissions. The overall interquartile range (IQR) of tacrolimus concentrations was 4.35–7.46 ng/mL. Outpatient episodes ranged 4.72–7.23 ng/mL (compliance rate 69.23%), while inpatient episodes ranged 4.80–9.98 ng/mL (compliance 74.53%). Patients with multiple TDM sessions had significantly higher compliance than those with a single measurement (68.5% vs. 57.3%, $P < 0.01$). By transplant type, IQRs and compliance rates varied significantly ($P < 0.05$): renal (4.57–7.32 ng/mL; 64.12%), liver (3.60–9.15 ng/mL; 64.26%), haematopoietic stem cell (3.57–9.11 ng/mL; 63.21%), cardiac (5.58–9.15 ng/mL; 84.71%), and lung transplantation (4.89–10.45 ng/mL; 65.76%).

Conclusion: This real-world study reveals considerable variability in tacrolimus concentrations and target compliance across different transplant populations, suggesting that current one-size-fits-all therapeutic windows may require population-specific refinement. The significant association between frequent TDM and improved compliance underscores the clinical value of continuous monitoring. These findings provide foundational insights for developing machine learning models that integrate clinical and pharmacokinetic variables to predict optimal individualised doses, ultimately advancing precision therapy in transplant medicine. Future work should focus on prospective validation of population-specific targets and development of personalised dosing algorithms.

Drivers of stockout and overstock events in hospital drug supply chains: A regression-based study

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Background: Persistent stockout and overstock events remain major challenges in hospital pharmaceutical supply chains, particularly in the healthcare systems of emerging economies. Drug shortages can disrupt treatment continuity, compromise patient safety, and reduce the quality of healthcare delivery, while excess inventory leads to wastage, increased storage costs, and inefficiencies in resource utilisation. Although previous studies have identified antecedents such as procurement delays, inaccurate demand forecasting, and unreliable suppliers, limited empirical research has examined the operational and managerial factors of inventory imbalances within hospital settings. Addressing this gap is critical for improving pharmaceutical supply chain efficiency and ensuring consistent drug availability in hospitals. The study aims to examine the key drivers of stockout and overstock events in hospital drug supply chains. Specifically, it investigated how operational, managerial, and external supply chain factors influence pharmaceutical inventory imbalances. The study hypothesised that procurement efficiency, demand forecasting accuracy, supplier reliability, and inventory management practices significantly influence the occurrence of stockouts and overstock situations.

Method: The study employed a cross-sectional research design coupled with a regression-based analytical approach. Data were collected through structured questionnaires administered to pharmacists, pharmacy technicians, procurement officers, and supply chain managers. The questionnaire captured data on procurement lead time, demand forecasting accuracy, supplier reliability, inventory monitoring practices, storage capacity, ordering frequency, internal distribution efficiency, and budget availability. The collected data were coded and analysed using multiple regression analysis to determine the statistical significance and relative influence of these variables on stockout and overstock events.

Results: The regression analysis showed that several operational and managerial factors significantly influenced stockout and overstock events. The stockout model was statistically significant ($F = 21.47$, $p < 0.001$) and explained 58.3% of the variance ($R^2 = 0.583$). Procurement lead time ($\beta = 0.38$), demand forecasting accuracy ($\beta = -0.34$), and supplier reliability ($\beta = -0.27$) were the main predictors of stockouts. The overstock model was also significant ($F = 18.92$, $p < 0.001$).

and explained 52.1% of the variance ($R^2 = 0.521$). Storage capacity ($\beta = 0.31$), ordering frequency ($\beta = 0.25$), and budget availability ($\beta = 0.29$) significantly influenced overstock events. These findings highlight the importance of procurement efficiency, forecasting accuracy, and inventory management in reducing pharmaceutical inventory imbalances.

Conclusion: The findings highlight the importance of strengthening procurement planning, improving demand forecasting accuracy, enhancing supplier management, and implementing more effective inventory monitoring systems to reduce stockout and overstock events in hospital pharmacies. Enhancing these processes can contribute to more reliable and improved healthcare service delivery. Future research may explore the role of digital inventory management systems and predictive analytics in optimising pharmaceutical supply chain performance.

A real-world data analysis of venetoclax impact on QT prolongation

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Background: Venetoclax, a selective BCL-2 inhibitor, is associated with cardiac events, including arrhythmias. While QT prolongation is a known risk factor for torsade de pointes and other life-threatening ventricular arrhythmia, to date little is known about whether venetoclax prolongs QT interval in a clinical setting. Purpose: We aimed to clarify QT interval changes and potential factors influencing QT prolongation in patients receiving venetoclax.

Objective: We aimed to clarify QT interval changes and potential factors influencing QT prolongation in patients receiving venetoclax.

Method: This retrospective single-center study was conducted at the Institute of Science Tokyo Hospital, Japan. Patients aged 18 years who were administered venetoclax with electrocardiographic monitoring were included. Clinical data, including demographics, comorbidities, laboratory parameters, electrocardiogram findings, and concomitant medications, were extracted from electronic medical records. All patients who received venetoclax in conjunction with a cytochrome P450 3A4 (CYP3A4) inhibitor received a reduced dose of venetoclax in accord with prescribing information. QT intervals were corrected using the Bazett formula. The primary endpoint was defined as the maximum change in QT interval (ΔQT_c) from baseline during venetoclax treatment. Intervals between QT baseline and peak were compared using the Wilcoxon signed-rank test. Factors influencing QT_c were analyzed using the Mann–Whitney U test and Spearman

rank correlation. In a subgroup undergoing both venetoclax and fluconazole (a CYP3A4 inhibitor primarily eliminated via the kidney), additional analysis was performed to evaluate the correlation between ΔQT_c and fluconazole dose corrected by estimated glomerular filtration rate (eGFR).

Results: Among all included patients ($n=18$), median ΔQT_c was 13 [3–35] ms. QT interval was significantly prolonged by venetoclax treatment (baseline: 437 [408–450] ms vs. peak: 451 [425–478] ms, $p=0.012$). A greater ΔQT_c was significantly associated with co-existing hypertension (35 [23–42] ms vs. 9 [–5–14] ms, $p=0.043$) whereas ΔQT_c positively correlated with serum creatinine level ($r=0.479$, $p=0.044$). In subgroup analyses, a moderate correlation between ΔQT_c and fluconazole dose corrected by eGFR was found, although this was not statistically significant ($n=13$, $r=0.479$, $p=0.098$).

Conclusion: QT prolongation was observed during venetoclax treatment in this real-world cohort study. Renal function and hypertension were associated with greater changes in QT_c . Pharmacokinetic variability under co-administration of fluconazole due to CYP3A4 inhibition may contribute to QT prolongation despite the recommended venetoclax dose adjustments. Careful electrocardiographic monitoring may help prevent unfavorable cardiac events during venetoclax therapy.

Exploring the pathways and practices of pharmacist role transformation under the smart pharmacy model: Aiming for high-quality development of hospital pharmaceutical services

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Background: Driven by rapid advances in digital and intelligent technologies, smart pharmacy has emerged as a core trend reshaping global pharmaceutical services. Traditional hospital pharmacy practice, dominated by routine drug dispensing, inventory control and other administrative duties, fails to satisfy the evolving demands for clinical medication safety safeguards, personalised medication guidance and pharmaceutical data mining. The deployment of smart pharmacy systems, such as intelligent drug storage cabinets, artificial intelligence (AI) prescription review platforms and online pharmaceutical service portals, has triggered profound shifts in pharmacists' professional roles, job scopes and working patterns. Nevertheless, systematic exploration of targeted transformation pathways and targeted solutions to practical obstacles in this process remains a critical research priority for the advancement of modern pharmaceutical care.

Method: This study adopts a mixed-methods approach, combining cross-sectional questionnaires and semi-structured in-depth interviews, based on the smart pharmacy construction practice of a tertiary general hospital. It systematically analyses the core connotations of pharmacist role transformation under the smart pharmacy model, by comparing changes in pharmacists' job function allocation and workflow reengineering pre- and post-transformation. Key indicators including pharmacist job satisfaction, clinical pharmacy service response efficiency, irrational prescription intervention rate and patient medication compliance are measured to evaluate transformation efficacy. The study also targets core dilemmas including role adaptation, competency requirements and workflow connectivity, to explore feasible and replicable optimisation strategies for peer medical institutions.

Results: The smart pharmacy model drives three pivotal transformations in pharmacist practice. Functionally, the proportion of administrative tasks drops from 65.2% to 28.7%, with a marked rise in high-value professional services such as clinical pharmacy support, medication decision consultation and pharmaceutical data monitoring. In terms of role, pharmacists evolve from mere drug dispensers to clinical medication partners, patient medication management consultants and pharmaceutical data analysts. For competency, digital literacy, interdisciplinary collaboration and personalised pharmaceutical guidance become core required skills. Post-transformation, clinical prescription review response time is shortened by 72.3%, irrational prescription intervention rate rises by 58.6%, and patient medication satisfaction reaches 96.2%, significantly elevating pharmacists' professional value.

Conclusion: The smart pharmacy model facilitates the fundamental shift of pharmacists from administration-focused performers to professional and patient-centred service providers, forging a full-process, precise and collaborative pharmaceutical service paradigm. Pharmacist role transformation relies on post restructuring, competency upgrading and workflow optimisation, supported by targeted digital training and improved collaborative mechanisms to unlock the full potential of intelligent technologies. This practice offers valuable referential experience for pharmacist role transformation nationwide, and carries vital significance in boosting high-quality development of hospital pharmaceutical services and guaranteeing clinical medication safety.

Rethinking the mix: Mortality risks of opioid and benzodiazepine prescribing pattern

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Background: In 2016, the United States Food and Drug Administration issued a boxed warning regarding the concurrent use of opioids and benzodiazepines (BZDs) due to the heightened risk of severe respiratory depression, overdose, and death. While this pharmacological synergy is extensively investigated within Western populations, robust epidemiological evidence within Asian healthcare settings remains scarce. Given variations in prescribing cultures, healthcare accessibility, and patient characteristics, real-world clinical data derived from Asian populations are urgently required to inform clinical decision-making and health policy development. The objective of this study was to evaluate the real-world mortality risks associated with longitudinal prescribing patterns of concurrent opioid and BZD use in Taiwan.

Method: A retrospective cohort study was conducted utilizing a large multi-institutional electronic health record database in Taiwan. The study population encompassed 418,549 patients who received opioid prescriptions. To assess the impact of concomitant medications, patients were categorized into four distinct exposure trajectories based on their longitudinal BZD utilization patterns: an opioid-only group (PureO), a past BZD use group (PastB), a continuous BZD use group (ContiB), and a newly initiated BZD use group (NewB). The primary endpoint evaluated was two-year all-cause mortality. Cox proportional hazards models were applied to calculate adjusted hazard ratios (aHRs) alongside corresponding 95 percent confidence intervals (CIs). The observation window spanned a two-year follow-up period subsequent to an initial one-year baseline exposure assessment. The models adjusted for covariates, including demographic factors, chronic comorbidities, and Charlson Comorbidity Index (CCI) scores.

Results: When compared with the PureO control group, patients within all concurrent opioid and BZD co-use categories demonstrated statistically significant increased risks of all-cause mortality. For the primary outcome of two-year all-cause mortality, the derived aHRs were 1.38 (95% CI: 1.31-1.46) for the NewB group, 1.22 (95% CI: 1.14-1.30) for the PastB group, and 1.60 (95% CI: 1.50-1.71) for the ContiB group, which represented the highest risk cohort. Furthermore, comprehensive subgroup analyses consistently

revealed particularly elevated mortality risks concentrated among older adult populations, as well as among vulnerable patients with an active cancer diagnosis or those presenting with higher baseline CCI scores, highlighting the physiological vulnerability of these clinical subsets when exposed to this medication combination.

Conclusion: The concurrent administration of opioids and BZDs is independently associated with a substantially increased risk of all-cause mortality over a two-year follow-up period within the Taiwanese healthcare context. These findings critically underscore the necessity for cautious prescribing behaviors, comprehensive clinical risk assessments, and the strategic implementation of individualized deprescribing protocols. Clinical practitioners must exercise heightened vigilance toward older adults and patients navigating multiple complex comorbidities, for whom the mortality risks are notably pronounced. From a healthcare policy perspective, these epidemiological results strongly advocate for the proactive development of integrated prescription monitoring programmes and multidisciplinary clinical intervention approaches to mitigate the risk of fatal outcomes and safeguard patient safety.

Immune checkpoint inhibitor therapy and thrombotic events in patients with lung cancer: A real-world hospital-based cohort study

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Background: Lung cancer remains one of the most common cancers and the leading cause of cancer-related mortality in Taiwan. Although immune checkpoint inhibitors (ICIs) have substantially improved survival outcomes, their potential impact on thrombotic risk remains uncertain. Evidence regarding thrombotic events associated with ICIs is particularly limited in Asian populations. This study aimed to evaluate the association between ICI therapy and the risk of thrombotic events in patients with lung cancer compared with those receiving targeted therapy.

Method: We conducted an active-comparator cohort study using a hospital-based clinical research database from 2011 to 2023. A total of 1,951 adult patients with lung cancer and no prior history of thrombosis were included and categorized into an ICI group (n = 526) and a targeted therapy (TT) group (n = 1,425). The primary outcome was any new-onset thrombotic event. Secondary outcomes included

abnormalities in coagulation-related laboratory parameters, including prothrombin time (PT), activated partial thromboplastin time (aPTT), and international normalized ratio (INR). Cox proportional hazards regression models were used to estimate crude and adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) for thrombotic events. Coagulation-related laboratory abnormalities were summarized descriptively and compared between treatment groups.

Results: A total of 132 thrombotic events were observed during the study period. Thrombotic events occurred in 23 patients (4.4%) in the ICI group and 109 patients (7.6%) in the targeted therapy group, corresponding to incidence rates of 39.48 and 45.93 per 1,000 person-years, respectively (p = 0.012). The crude HR for thrombotic events in the ICI group was 0.763 (95% CI: 0.485–1.203). After adjustment for potential confounders, the adjusted HR was 0.788 (95% CI: 0.482–1.288). In addition, abnormalities in coagulation-related laboratory parameters, including prolonged PT/aPTT and elevated INR, were more frequently observed among patients receiving ICIs. These abnormalities also tended to occur earlier during treatment.

Conclusion: In this study, lung cancer patients receiving ICIs showed a lower incidence of thrombotic events compared with those receiving targeted therapy. However, adjusted analyses did not demonstrate a statistically significant difference in thrombotic risk between the two treatment groups. Further studies are needed to better characterize the thrombotic risk associated with ICI therapy.

Disability evolution among multiple sclerosis patients in relation to switched drugs-experience in a university hospital

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Background: Keywords: Multiple sclerosis; expanded disability status scale, disease modifying therapies, treatment switching. In the past two decades, Food and Drug Administration approved more than 20 Disease-modifying therapies (DMTs) to treat multiple sclerosis (MS). Because DMTs are partially effective in controlling disease activity, switches are common clinical practice and is primarily driven by breakthrough disease activity, safety concerns, or tolerability issues, with the goal of minimizing long-term disability progression.

Objective: This study aims to identify the trajectories of disability among MS patients who underwent switching between DMTs.

Method: Observational retrospective study, (2022-2024), data was collected from patients with MS who receiving moderate-efficacy DMTs for years and changed at least one time. Variables collected: average age at diagnosis, sex, Expanded Disability Status Scale (EDSS) baseline score, previous failed treatment and long-time DMTs exposure. Sustained disability progression was defined as at least a 1-point increase from baseline EDSS score ≤ 5.5 (or at least a 0.5-point increase for those with a baseline EDSS score >5.5) sustained for at least 12 weeks. Causal inference methods were applied to evaluate the impact of treatment switching on disability progression.

Results: -106 patients (69 women), with a median exposure to DMTs 9.61 years, mean age at diagnostic 29.54 years (16-55 years), mean baseline EDSS=2.05. -82 patients have switched treatment once and 24 at least twice. Previous failed treatment was interferon beta (95 patients) and glatiramer acetate (11 patients). -47 patients switching to a higher efficacy therapy and the rest of them -to a DMT with a similar level of efficacy but a different mechanism of action, suggesting that there is no uniformly appropriate approach after breakthrough disease occurs. Regarding disability level at DMT initiation, more than half (55 patients) had a low EDSS score (0–1.5) at baseline with no disability. During the follow-up period, EDSS remained stable for 21 patients, by contrast 23 of patients reached severe disability ,EDSS ≥ 6 , and 8 evolved from relapsing MS to secondary progressive MS, illustrating the unpredictable course of MS, with considerable differences in disease course for individual patients. Causal inference analysis demonstrated a statistically significant association between treatment switch and disability progression ($p=0.01$). Also, the mean increase in EDSS evolution was 1 point, in line with established EDSS criteria for disability worsening. These findings suggest a potential impact of treatment switch on long-term disability.

Conclusion: Although treatment switching may be necessary for clinical reasons and may affect disability accumulation, these findings highlight the need for careful monitoring of disability progression after switch, in order to minimize the risk of disability worsening. Consideration of a patient's individual risk and tolerance profile needs to be taken into account when selecting the most appropriate switch therapy. Further studies, with larger sample sizes are needed to better elucidate the long-term clinical implication of therapy switching.

Association between long-term inhaler use and lower urinary tract symptoms in patients with chronic Obstructive Pulmonary Disease

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Background: A Taiwanese retrospective cohort study has shown that patients with chronic obstructive pulmonary disease (COPD) carry a higher risk of developing benign prostatic hyperplasia (BPH). Furthermore, case-control research has reported that both short- and long-acting inhaled anticholinergics are associated with an increased risk of acute urinary retention (AUR) in men with COPD. While inhalers are a cornerstone of standard COPD management, the prevalence and incidence of lower urinary tract symptoms (LUTS) specifically associated with two-in-one fixed-dose combination (FDC) inhalers remain unknown. This study aimed to explore the prevalence and incidence of LUTS in COPD patients using hospital-based clinical data and to investigate the association between two-in-one FDC inhalers and LUTS risk.

Method: A two-part retrospective cohort study was conducted using the Kaohsiung Medical University Hospital (KMUH) database from 2016 to 2022. In the first part, patients aged 18 years and over were recruited and categorised into either a COPD group or a gastrointestinal (GI) control group. Propensity score matching (PSM) at a 1:1 ratio was employed to balance baseline characteristics between groups. Univariate and multivariate Cox proportional hazards regression models were used to analyse hazard ratios and risk factors, alongside calculating LUTS prevalence in the COPD cohort. In the second part, COPD patients were sub-divided into those using long-acting muscarinic antagonist/long-acting beta2-agonist (LAMA/LABA) inhalers and those using inhaled corticosteroids/long-acting beta2-agonist (ICS/LABA) inhalers. Again, 1:1 PSM was applied to balance baseline characteristics for comparative analysis.

Results: A total of 181,251 patients were initially included, comprising 16,989 in the COPD group and 79,828 in the GI control group. Following exclusion of ineligible cases and 1:1 PSM, 1,689 patients remained in each group. After adjusting for covariates, the incidence of LUTS was 12% lower in the COPD group compared to the GI group (9.00 vs 10.70; 95% CI 0.71–1.10, $p=0.251$). The mean prevalence of LUTS among COPD patients was 1.5% between 2016 and 2022. In the second phase, 181,026 COPD patients were screened, identifying 612 in the LAMA/LABA group and 459 in the ICS/LABA group. Following 1:1 PSM, 300 patients were retained in each group. The incidence of LUTS was 19% lower in the LAMA/LABA group than in the ICS/LABA group (14.00 vs 19.33; 95% CI 0.54–1.21, $p=0.307$) after covariate adjustment.

Conclusion: Following propensity score matching and adjustment for confounding variables, no statistically significant difference was observed in the incidence of LUTS between COPD patients and the GI control group, nor between LAMA/LABA and ICS/LABA users. Although LUTS prevalence remained low, clinicians should remain vigilant regarding LUTS progression in COPD patients using LAMA/LABA inhalers, particularly when other risk factors are present.

Artificial intelligence-driven inventory management and supply chain automation in hospital pharmacy practice

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Background: Hospital pharmacies worldwide face mounting pressure to ensure medication availability while maintaining operational efficiency, regulatory compliance, and patient safety. Traditional inventory management systems rely heavily on manual stocktaking and pharmacists' empirical judgement to determine safety stock levels and procurement needs. Such approaches frequently result in inaccurate demand forecasting, stockouts, overstocking, and medication expiration, which may compromise patient care, increase operational costs, and waste critical medical resources. These challenges are amplified in large hospital settings, where multiple wards, high patient turnover, and diverse pharmaceutical products complicate inventory management. To address these issues, an Artificial Intelligence (AI)-driven Inventory Management System was developed and implemented in a hospital pharmacy. The system integrates predictive analytics, automated procurement algorithms, and real-time monitoring technologies to enhance inventory precision, optimise supply chain coordination, reduce operational burden, minimise human error, and ensure consistent medication availability across units and departments.

Method: The AI-driven platform is built on a secure cloud-based infrastructure enabling real-time data synchronisation, automated analytics, and mobile notification services. Three major functional modules were implemented. First, a dynamic safety stock estimation model with a dual-track procurement mechanism combines routine weekly replenishment with automated emergency ordering. Predictive trend analysis allows autonomous procurement to anticipate potential shortages, ensuring critical medications remain available without manual intervention. Second, end-to-end supply chain visibility is achieved through an integrated Order Tracking System (OTS), monitoring

procurement from order placement to delivery. Upon receipt, key data—including quantity, batch number, and expiry date—are automatically synchronised with the inventory database, reducing manual entry errors, enhancing data integrity, and supporting compliance with regulatory requirements. Third, an intelligent auditing and analytical reporting module provides multidimensional reports, including 180-day near-expiry monitoring, utilisation ranking, daily prescription fluctuation analysis, and stagnant stock alerts. Insights and alerts are delivered via mobile notifications, enabling timely interventions, proactive decision-making, and quality improvement. The system architecture is designed for replicability and scalable deployment across diverse hospital environments, supporting wider adoption.

Results: Following implementation, inventory turnover increased from 1.246 to 1.879, representing a 50.8% improvement in operational efficiency. The incidence of stockouts decreased by 80.5%, while near-expiry medication volume was reduced by 65%, enhancing patient safety, improving workflow efficiency, and reducing waste. Automated workflows eliminated approximately 48 administrative labour hours per month, allowing pharmacists to allocate more time to clinical, patient-centred activities and interprofessional collaboration. The integrated analytics provided actionable insights supporting proactive management, standardised decision-making, and optimisation of inventory and procurement strategies, demonstrating the system's capacity to strengthen governance, reduce risk, and improve overall hospital pharmacy performance.

Conclusion: The AI-driven Inventory Management System markedly strengthens medication supply chain governance in hospital pharmacy practice. By leveraging predictive analytics, automated procurement, and real-time monitoring, it enhances inventory accuracy, minimizes stockouts and expiry-related waste, and optimizes resource utilization. Consequently, pharmacists can focus their efforts on high-value clinical interventions, patient-centered pharmaceutical care, and continuous quality improvement within hospital settings. This approach provides a practical and innovative model for modernising hospital pharmacy operations and improving healthcare delivery efficiency.

Enhancing pharmaceutical care documentation efficiency and quality via generative AI: A medical center's implementation experience in Taiwan

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Background: "No documentation, no work!" Pharmaceutical care records (SOAP) are essential for demonstrating the professional value of pharmacists and facilitating multidisciplinary communication. They also serve as the basis for hospital accreditation, disease-specific certifications, and health insurance reimbursement in Taiwan. However, clinical pharmacists at our medical center manage high workloads, covering 20–30 ICU beds alongside general wards or outpatient services. Due to limited manpower, clinical pharmacists must balance clinical duties with dispensing responsibilities, which significantly limits the time available for SOAP documentation. Despite existing systems integrating clinical data, pharmacists must still manually query and synthesize information before applying professional judgment. Optimizing the quantity, quality, and timeliness of documentation remains a critical management challenge.

Method: Starting in late February 2025, the Pharmacy Department collaborated with the Big Data and Digital Promotion Center and the IT Department to develop a Generative AI tool. By integrating patient medication profiles and clinical data, we established standardized "Public Prompts" for both ICU and general wards. These prompts were iteratively tested and optimized by pharmacists and could be customized for specific clinical scenarios. The system officially launched in early May 2025 for all clinical pharmacists. A subsequent satisfaction survey was conducted to guide further system optimization.

Results: From May 1 to October 30, 2025, the system produced 7 public prompts and 23 personalized prompts. Currently, 14 clinical pharmacists (including 6 in the ICU) utilize the system, generating a total of 6,857 records with an average processing time of 6 seconds per entry. Among users, 70% have over five years of clinical experience. Satisfaction scores ranged from 80% to 90% across three dimensions: Convenience (system operation), Efficiency (data integration and content generation), and Utility/Accuracy (structured output and correctness). Pharmacists highlighted the flexibility of personalized prompts and an average 50% reduction in time spent on Subjective/Objective (S/O) data collection and writing. The tool also significantly aided data preparation before clinical rounds. Areas for improvement included occasional formatting inconsistencies with prompt instructions and unexpected content generation, requiring careful manual verification. Currently, the tool does not support clinical decision-making. Notably, the number of records meeting National Health Insurance (NHI)

reimbursement criteria for ICU pharmaceutical care in October increased by 29% compared to the January–April average.

Conclusion: AI-assisted documentation tools aim to rapidly synthesize structured clinical information without replacing the pharmacist's final professional judgment. The integration of an optimized hospital data platform with personalized prompts enhances system utility and user acceptance, thereby improving writing efficiency and record completeness. This implementation effectively showcases the clinical value of pharmacists. Future efforts will focus on incorporating evidence-based data into AI tools to support clinical decision-making and automated referencing, further enhancing documentation accuracy and efficiency.

Sustainable smart pharmacy: Leveraging optical wireless communication for next-generation electronic shelf labels and inventory management

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Background: The acceleration of smart healthcare and digital transformation has driven the evolution of pharmacy labelling from traditional paper-based methods to Electronic Shelf Labels (ESL). Conventional ESL systems relying on Radio Frequency (RF) or Wi-Fi often encounter limitations in high-density medical environments, including electromagnetic interference (EMI), latency, and cybersecurity vulnerabilities. These challenges can compromise medication safety, slow operational workflows, and increase administrative burden, potentially affecting clinical outcomes, patient satisfaction, and overall healthcare quality. To address these issues, an Optical Wireless Communication (OWC)-based ESL system was implemented and integrated with a dynamic inventory management platform. The system is designed to enhance medication safety, operational efficiency, real-time data visibility, environmental sustainability, and overall workflow reliability, offering a comprehensive, practical, and scalable solution for modern hospital pharmacy practice across diverse healthcare environments.

Method: The OWC-based ESL system employs LED light signals for data transmission, replacing traditional RF or Wi-Fi protocols. This unidirectional optical approach ensures high signal integrity, enhanced data security, and minimal penetration to reduce interference risk. Key functional modules include: 1. Real-Time Data Synchronisation – Drug information, including nomenclature, active ingredients, and Tall-man lettering alerts, is updated instantaneously across

the inventory system, allowing pharmacists to access current information efficiently without manual intervention. 2. Visual Alert Mechanism – A colour-coded display identifies High-Alert Medications (HAM) and low-stock warnings, enabling pharmacists to recognise critical inventory statuses at a glance, thereby supporting clinical risk management, timely interventions, and reduction of human errors. The system architecture is designed for reliability, energy efficiency, and scalability, with a closed-field optical setup minimising EMI, optimising environmental performance, and supporting integration with existing pharmacy workflows. Additionally, the platform allows continuous performance monitoring and advanced analytics, facilitating ongoing evaluation, process improvement, and evidence-based decision-making.

Results: Implementation demonstrated that OWC-based ESLs effectively replace paper labels while significantly reducing dispensing errors for High-Alert Medications through intuitive colour-coded alerts. Integration with the inventory platform accelerated identification of low-stock items and automated alert notifications, contributing to an 80% reduction in stockout incidents. Technical evaluation confirmed superior EMI resistance compared with conventional RF/Wi-Fi ESLs. Moreover, the optical solution reduced energy consumption to approximately 20% of traditional RF/Wi-Fi systems and extended battery life up to ten years, highlighting environmental sustainability. Overall, these outcomes indicate improved operational efficiency, strengthened patient safety, reduced administrative workload, and enhanced pharmacy workflow coordination, validating the system's value, adaptability, and practicality in modern pharmacy practice.

Conclusion: OWC-based electronic labelling surpasses paper-based and RF/Wi-Fi ESL systems in security, real-time synchronisation, operational reliability, and ecological impact. Integration of optical labelling with inventory management optimises pharmacy workflows, reduces dispensing errors, and establishes a robust foundation for next-generation intelligent medication management. This scalable, sustainable, and adaptable system demonstrates practical applicability in high-density healthcare environments and provides a replicable, evidence-based model for modern, efficient, safe, and environmentally conscious pharmacy operations.

Characteristics of drug-related problems and acceptance of pharmacist interventions in Hong Kong general medical wards

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Background: This study aimed to describe the characteristics of drug-related problems (DRP) identified by ward pharmacist service, and assess the physicians' acceptance of pharmacist interventions in the general medical wards of Hong Kong.

Method: The DRPs reported by pharmacists between October 2024 to December 2024 in two general medical wards (total 80 beds) with ward pharmacist service in the North District Hospital, Hong Kong SAR, were evaluated. Interventions recommended by the ward pharmacists and prescribers' acceptance were retrieved from medical records.

Results: A total of 498 DRPs were identified over the three-month study period, and 55% were unintended discrepancies during transitions-of-care. The most commonly reported DRP at admission was inappropriate/unnecessary drugs (45%). The most frequently implicated medication class was anti-hypertensives (11%). Pharmacist issued 386 interventions to prescribers and 97% were accepted.

Conclusion: The ward pharmacist service played a pivotal role in identifying DRPs in acute general medical wards. The pharmacist interventions on DRPs were highly accepted by prescribers.

Antibiotics prescribing, utilisation and resistance pattern in a university medical centre

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Background: Antimicrobial stewardship (AMS) has become a critical component of modern healthcare systems. It focuses on optimising the use of antibiotics to improve patient outcomes while minimising the emergence and spread of antimicrobial resistance (AMR). Misuse and overuse of antibiotics in clinical practice contribute significantly to the development of resistant microorganisms. Consequently, monitoring antibiotic prescribing patterns, utilisation, and

resistance profiles is essential for evaluating antimicrobial stewardship practices within healthcare facilities. The study aimed to evaluate antimicrobial stewardship practices in the University of Port Harcourt Health Centre. Specifically, it sought to assess antibiotic prescribing patterns, to determine antibiotic utilisation among patients, and to examine the resistance patterns of bacterial isolates to commonly prescribed or used antibiotics.

Method: A survey of antimicrobial stewardship was conducted using a combined retrospective and prospective study design at a university health centre. Data were collected on antibiotic prescribing and utilisation among patients, including those enrolled in the National Health Insurance Scheme (NHIS) and the Tertiary Institutions' Social Health Insurance Programme (TISHIP). In addition, bacterial isolates were subjected to antibiotic susceptibility testing before and after plasmid curing to determine resistance patterns and the possible role of plasmids in mediating resistance to antibiotics.

Results: The results showed that most antibiotics prescribed belonged to the "Access" and "Watch" categories of the World Health Organization (WHO) AWaRe antibiotic classification. A total of 993 (26%) and 192 (7%) antibiotics were prescribed to patients under the NHIS and TISHIP schemes, respectively. Approximately 90 – 91% of antibiotic treatments were initiated as definitive therapy. The most frequently prescribed antibiotics were amoxicillin (39.8%; 19.8%), ciprofloxacin (12.9%; 15.6%), and metronidazole (11.9%; 23.4%) in both NHIS and TISHIP schemes, respectively. The pattern of antibiotic utilisation among patients indicated varied use, including instances of overuse and misuse. Antibiotic susceptibility testing of Gram-negative isolates revealed the presence of some species with a multiple antibiotic resistance (MAR) index greater than 0.2, suggesting exposure to environments with high antimicrobial use. Resistance rates prior to plasmid curing were highest for ampicillin-cloxacillin and cefotaxime (95% each), followed by amoxicillin-clavulanic acid and cefixime (65% each), and ceftriaxone (50%). After plasmid curing, resistance levels decreased significantly to a range of 20 – 45%, indicating that plasmid-mediated mechanisms contributed substantially to the observed resistance patterns.

Conclusion: The findings suggest that antimicrobial stewardship practices are being implemented to a considerable extent at the University of Port Harcourt Health Centre, particularly through the use of antibiotics within recommended WHO AWaRe categories. However, the presence of multidrug-resistant (MDR) bacterial isolates and evidence of antibiotic misuse highlight the need for strengthened interventions. Improved hygiene practices, enhanced infection control measures, and continued stewardship efforts are recommended to further reduce the development and spread of antibiotic resistance.

Risk factors for dapagliflozin-associated diabetic ketosis/ketoacidosis and clinical features of euglycemic DKA

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Background: Sodium-glucose cotransporter 2 inhibitors (SGLT2is) lower blood glucose by promoting urinary glucose excretion and confer additional cardio-renal benefits, establishing their widespread use in type 2 diabetes mellitus. Dapagliflozin, the first SGLT2i approved in China, is extensively prescribed in clinical practice. However, with increasing real-world use, the risk of dapagliflozin-associated diabetic ketosis (DK) and diabetic ketoacidosis (DKA)—particularly euglycemic DKA (euDKA)—has garnered increasing recognition. euDKA often presents insidiously and is prone to misdiagnosis or delayed identification. Current evidence regarding risk factors for DK/DKA in dapagliflozin users remains limited and inconsistent. This study aims to systematically investigate risk factors for DK/DKA among hospitalized patients receiving dapagliflozin and characterize the clinical profile of euDKA, thereby informing safer prescribing practices.

Method: We conducted a retrospective analysis of 590 hospitalized patients with diabetes who received dapagliflozin between January 2022 and October 2024 at a tertiary hospital. Patients were stratified into DK/DKA (n=194) and non-DK/DKA (n=396) groups. Multivariable logistic regression was employed to identify independent risk factors for DK/DKA, with a subanalysis focusing specifically on DKA.

Results: Among 590 inpatients, the overall incidence of DK/DKA was 32.9% (194/590). Classic DKA (blood glucose ≥ 11.1 mmol/L) occurred in 46 patients, while euDKA (blood glucose < 11.1 mmol/L) was documented in 44 patients. Multivariable regression identified concomitant insulin use (aOR=1.94, P=0.018), duration of in-hospital dapagliflozin exposure (aOR=1.04 per day, P=0.020), infection (aOR=1.57, P=0.031), and heart failure (aOR=1.63, P=0.035) as independent risk factors for DK/DKA. In the subanalysis restricted to DKA (classic + euDKA, n=90), infection (aOR=1.73, P=0.040), liver dysfunction (aOR=1.76, P=0.033), fasting blood glucose (aOR=1.07, P=0.009), and serum creatinine (aOR=1.01, P<0.001) emerged as independent predictors. Notably, euDKA accounted for nearly half (48.9%, 44/90) of all DKA cases. Compared with classic DKA, patients experiencing euDKA exhibited significantly lower fasting glucose (7.4 vs. 13.6 mmol/L, P<0.001), lower HbA1c (7.9% vs. 10.1%, P<0.001), longer duration of dapagliflozin therapy (7.0 vs. 4.0 days, P=0.007), higher prevalence of diuretic use

(56.8% vs. 32.6%, $P=0.036$), and reduced creatinine clearance (53.0 vs. 83.7 mL/min, $P=0.033$).

Conclusion: The incidence of DK/DKA among hospitalized dapagliflozin users is substantial. Risk factor analysis suggests a cumulative effect of infection, heart failure, and diuretic use, with risk escalating as the number of coexisting factors increases. euDKA is characterized by relatively well-controlled baseline glycemia, prolonged dapagliflozin exposure, frequent diuretic co-administration, and impaired renal function. Clinicians should maintain a high index of suspicion for high-risk patients, particularly regarding the insidious onset of euDKA. During dapagliflozin therapy, abrupt insulin dose reduction should be avoided, and enhanced monitoring of blood ketones and acid-base status is warranted in patients with infection, heart failure, renal insufficiency, or concomitant diuretic therapy. Temporary discontinuation of dapagliflozin should be considered when clinically indicated.

A study on inpatient medication reconciliation for patients with cardiovascular chronic diseases by ward-based clinical pharmacists

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Background: Cardiovascular disease (CVD) remains a prevalent chronic condition in China, affecting over 330 million individuals in 2023, accounting for 24.7% of the national population. Patients with CVD often present with multimorbidity and complex medication regimens, making them highly susceptible to drug-related problems (DRPs). Medication reconciliation (MR), which systematically compares admission orders with actual medication use, can reduce medication errors and adverse events. The 2024 pilot program on the "Embedded Clinical Pharmacist Model" has shifted the primary responsibility for MR from traditional clinical pharmacists to those embedded inwards. However, its application in cardiovascular chronic care remains limited. This study evaluates the implementation of admission MR by embedded pharmacists, analyzing the characteristics and intervention outcomes of DRPs, with the aim of enhancing medication safety and providing a practical foundation for pharmacist integration into clinical medication management.

Method: A total of 142 inpatients with chronic CVD from the cardiology ward of a tertiary hospital between February 2024 and March 2025 were enrolled. Embedded pharmacists conducted standardized MR within 24–48 hours of admission through medication interviews, medical record review, and medication list reconciliation. DRPs were identified and

classified using the PCNE V9.1 system. Individualized recommendations were proposed to physicians, and patients received medication education and discharge counseling, forming a closed-loop "identification–intervention–follow-up" process.

Results: Among the 142 patients, 85 (59.86%) were male and 57 (40.14%) female, aged 26 to 91 years, with the majority aged over 60. A total of 403 DRPs were identified (mean 2.84 per patient). The predominant problem type was treatment effectiveness (226, 56.08%), followed by safety issues (108, 26.80%). Causes were primarily related to drug selection (56.72%), dose selection (25.07%), and drug form (13.43%). Pharmacists conducted 409 medication-level interventions (56.03%), including adjustments, initiation, discontinuation, and dose optimization. All patients received medication education, with a 91.2% physician acceptance rate of recommendations.

Conclusion: This study establishes an embedded pharmacist model integrated into the ward workflow, enabling systematic MR at the critical point of admission. Embedded pharmacists optimized drug selection, tailored regimens to clinical contexts, precisely adjusted dosages based on monitoring indicators, and delivered targeted interventions addressing DRP determinants. This approach significantly enhanced medication safety and therapeutic effectiveness. The model represents a dual transformation of pharmaceutical care—from passive review to proactive intervention, and from fragmented guidance to integrated management—offering an innovative pathway for comprehensive medication management in cardiovascular patients and providing empirical support for the advancement of the embedded pharmacist system in China.

Development and application of drug utilization evaluation criteria for Henagliflozin based on the Delphi method and weighted TOPSIS method

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Background: Henagliflozin, the first domestically developed sodium-glucose cotransporter 2 inhibitor (SGLT2i) in China, has been increasingly used since its 2022 market approval due to its glycemic efficacy and pleiotropic benefits including cardio-renal protection, weight loss, and blood pressure reduction. However, with expanded clinical use, concerns

have emerged regarding adverse reactions, off-label use, and inappropriate combinations. Currently, no drug use evaluation (DUE) criteria for henagliflozin exist. This study aims to establish DUE criteria using the Delphi method and quantitatively assess its clinical application, providing evidence for rational use of innovative medications.

Objective: Henagliflozin, the first domestically developed sodium-glucose cotransporter 2 inhibitor (SGLT2i) in China, has been increasingly used since its 2022 market approval due to its glycemic efficacy and pleiotropic benefits including cardio-renal protection, weight loss, and blood pressure reduction. However, with expanded clinical use, concerns have emerged regarding adverse reactions, off-label use, and inappropriate combinations. Currently, no drug use evaluation (DUE) criteria for henagliflozin exist. This study aims to establish DUE criteria using the Delphi method and quantitatively assess its clinical application, providing evidence for rational use of innovative medications.

Method: Preliminary indicators were developed based on the drug label and international/national guidelines. A two-round Delphi survey involving 23 experts was conducted to finalize the criteria. The attribute hierarchy model (AHM) was introduced to calculate indicator weights, minimizing subjective bias. Subsequently, the weighted TOPSIS method was applied to evaluate 291 discharge records of patients receiving henagliflozin in 2024, calculating the relative closeness to the ideal solution and classifying cases as rational, basically rational, or irrational.

Results: The expert authority coefficients were 0.884 and 0.906 in the two Delphi rounds, with a 100% response rate. The final DUE criteria comprised 3 primary and 12 secondary indicators. The highest-weighted indicators (0.096212 each) included indications, contraindications, combination therapy, monitoring parameters, and target achievement. Weighted TOPSIS revealed that 149 cases (51.20%) were rational, 133 (45.70%) basically rational, and 9 (3.09%) irrational, yielding a 96.91% overall rationality rate. Major irrationalities included failure to achieve glycemic targets (36.77%), lack of insulin dose adjustment upon combination (6.87%), initiating henagliflozin without metformin (6.53%), and occasional contraindication or precaution violations.

Conclusion: This study pioneers the establishment of henagliflozin-specific DUE criteria through an innovative integration of Delphi, AHM, and weighted TOPSIS. Empirical evaluation demonstrated generally rational use but identified suboptimal target attainment and combination safety concerns, underscoring the need for a closed-loop management throughout treatment. The criteria can be embedded into clinical decision support systems to enable pre-prescription alerts, in-process control, and post-hoc evaluation, advancing patient-outcome-oriented precision prescribing. This work provides both a quantitative tool for henagliflozin and a methodological foundation for DUE of other novel glucose-lowering agents and chronic disease medications.

Developing and deploying a pharmaceutical drug management system using a big data business intelligence to enhance clinical decision-making application

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Background: Medication safety and pharmacists' work environments are critical issues. Medications, as high-risk items, are heavily utilized in hospitals. Pharmacists often face challenges such as staff shortages, time constraints, and insufficient tools, limiting their ability to provide optimal services. Digitalizing pharmaceutical management can enhance service quality, while data analytics support informed decisions regarding medication use, improving productivity and safety.

Objective: This study aims to explore the feasibility and benefits of constructing a Pharmaceutical Drug Management System (PDMS) using Big Data Business Intelligence (BI) technology, specifically with Tableau software, to support hospital pharmacists in clinical medication management decision-making.

Method: A Design Science Research Methodology (DSRM) was employed, encompassing six activities: 1) problem identification and motivation, 2) defining solution objectives, 3) design and development, 4) demonstration, 5) evaluation, and 6) communication. The effectiveness of the PDMS was assessed using the Poster-Study System Usability Questionnaire (PSSUQ), measuring aspects such as usability, ease of learning, information quality, and interface design.

Results: The PDMS was successfully developed and applied in clinical settings, demonstrating an overall satisfaction rate of 91.2% (4.56±0.53). Users reported high satisfaction in system usability, ease of learning, and interface quality, with over 90% satisfaction achieved in these dimensions. However, areas related to problem-solving assistance and error recovery recorded slightly lower satisfaction levels. The results indicated that simplicity and high-quality information are critical factors in enhancing pharmacists' efficiency and reducing manual workload.

Conclusion: This study validates the implementation of the PDMS in hospital pharmacy management, showcasing its capability to support decisions regarding medication selection, procurement, stock management, prescribing

trends, and physician behavior analysis. Positive feedback from users and management highlights the system's effectiveness and potential for broader application. Future work will focus on addressing areas of lower satisfaction and expanding the system's use in diverse healthcare settings.

Efficacy and safety of Tacrolimus Monotherapy or combined with low-dose Corticosteroids for Minimal Change Disease in adults: A systematic review and meta-analysis

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Background: Tacrolimus (TAC) is increasingly used as a steroid-sparing agent in the management of adult minimal change disease (MCD). However, the efficacy and safety profile of TAC monotherapy or its combination with low-dose corticosteroids, compared to conventional high-dose corticosteroid regimens, remain to be fully elucidated.

Method: We conducted a comprehensive literature search across PubMed, Embase, The Cochrane Library, Web of Science, Scopus, ICTRP, ClinicalTrials.gov, CNKI, WanFang, VIP, and CBM databases, covering studies up to October 2021. Eligible studies included randomized controlled trials (RCTs), non-randomized controlled trials, and cohort studies involving adult MCD patients treated with TAC monotherapy or TAC combined with low-dose corticosteroids. Two independent reviewers performed study selection, data extraction, and risk of bias assessment. Meta-analyses were performed using Review Manager Version 5.4.

Results: A total of 5 RCTs encompassing 408 patients met the inclusion criteria. In adult MCD treatment, the complete remission (CR) rates for TAC monotherapy or TAC combined with low-dose corticosteroids ranged from 64% to 96.2%, comparable to those observed with standard corticosteroid therapy. The time to achieve CR varied between 15 and 77.69 days across the studies. Notably, one RCT demonstrated a significantly lower relapse rate in the TAC plus low-dose steroid group compared to the high-dose steroid group (5.7% vs. 22.6%, $P = 0.01$). While overall drug-related adverse events, such as infections, were similar between the two regimens, the incidence of osteoporosis/fracture was significantly reduced in the TAC group (RR = 0.21, 95% CI: 0.05–0.93, $P = 0.04$).

Conclusion: Tacrolimus, either as monotherapy or in combination with low-dose corticosteroids, is non-inferior to conventional high-dose steroid therapy for inducing remission in adult MCD patients and offers a favorable safety profile, particularly in reducing the risk of steroid-induced osteoporosis. These findings support the consideration of

TAC-based regimens as viable steroid-sparing alternatives in clinical practice.

Comparative effectiveness of platelet-rich plasma, hyaluronic acid, and corticosteroids in knee osteoarthritis: A network meta-analysis across multiple time points

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Background: Knee osteoarthritis (OA) is a common degenerative joint disease associated with pain, functional impairment, and reduced quality of life. Intra-articular injections such as platelet-rich plasma (PRP), hyaluronic acid (HA), and corticosteroids (CS) are widely used non-surgical treatment options. With the emergence of new randomised controlled trials (RCTs), this study aimed to evaluate the comparative efficacy of PRP, HA, and CS in knee OA using a network meta-analysis (NMA).

Method: A systematic literature search was conducted across multiple databases, including PubMed, Cochrane Library, Embase, CINAHL, Web of Science, and Airtiti Library to identify RCTs assessing intra-articular PRP, HA, CS, and related comparators in knee OA. Outcomes of interest included pain and functional improvement measured using validated scales, including the Visual Analogue Scale (VAS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Knee injury and Osteoarthritis Outcome Score (KOOS), International Knee Documentation Committee (IKDC) score, and Lequesne Index. Adverse events were also evaluated to assess safety profiles. A network meta-analysis was performed to compare relative treatment effects at 3, 6, and 12 months of follow-up. Study selection, data extraction, and risk of bias assessment were performed independently by reviewers.

Results: Network meta-analysis showed that PRP-based therapies were associated with superior outcomes compared with HA and CS, particularly at longer follow-up durations. PRP demonstrated greater improvement at all time points in both VAS and WOMAC scores, indicating consistent benefits in pain reduction and functional recovery. PRP combined with HA appeared to provide the greatest functional benefit among all evaluated interventions. For quality of life, as

measured by the KOOS quality-of-life subscale, PRP showed significant improvement at 6 and 12 months, but not at 3 months. HA demonstrated moderate benefits across outcomes, whereas CS primarily provided short-term pain relief with limited sustained efficacy beyond early follow-up periods. Adverse events were generally mild and transient across all treatment groups. PRP was associated with slightly higher rates of local post-injection pain; however, no significant differences in serious complications were observed among the interventions. Although PRP appeared statistically superior to HA and CS, the certainty of evidence comparing PRP and HA was mostly low to very low, indicating uncertainty regarding the magnitude and clinical relevance of benefit. In contrast, both PRP and HA consistently outperformed CS and saline, particularly in longer-term follow-up analyses.

Conclusion: PRP and HA appear to provide more sustained improvements in pain, function, and quality of life compared with corticosteroid injections in patients with knee OA. Corticosteroids may remain appropriate for short-term symptom relief, particularly in acute exacerbations. However, given the low certainty of evidence directly comparing PRP and HA, along with differences in treatment costs and accessibility, clinical decision-making should consider both the strength of evidence and patient preferences. Further high-quality RCTs with standardised protocols are required to determine whether PRP offers clinically meaningful advantages over HA and to guide optimal treatment selection.

Cold Stress accelerates renin–angiotensin–aldosterone system–driven vascular ageing and selectively preserves angiotensin II Type 1 receptor blockade

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Background: Blood pressure and cardiovascular events rise during colder seasons, yet the vascular mechanisms underlying this phenomenon and its pharmacological implications remain insufficiently defined. Epidemiological studies indicate enhanced responsiveness to angiotensin receptor blockers in winter, suggesting temperature-dependent biological modulation of drug efficacy. We hypothesised that cold stress accelerates vascular ageing through renin–angiotensin–aldosterone system overactivation, producing a hyperfunctional arterial phenotype dominated by angiotensin II type 1 receptor signalling and thereby reshaping antihypertensive class responses.

Method: Spontaneously hypertensive rats underwent 30 days of 4°C exposure; Sprague–Dawley rats underwent 14 days. Controls were maintained at 22°C. Longitudinal systolic blood pressure was measured alongside aortic Doppler haemodynamics, mesenteric artery histomorphometry, ex vivo wire myography, and systemic and tissue renin–angiotensin–aldosterone system profiling. Drug-class comparisons in spontaneously hypertensive rats included irbesartan, captopril, amlodipine, and bisoprolol administered during cold versus room temperature exposure. Mechanistic feasibility of nucleic-acid interventions was assessed using angiotensin-converting enzyme 2 messenger RNA lipid nanoparticles and combined angiotensin-converting enzyme 2 plus sirtuin 3 circular RNA lipid nanoparticles.

Results: Cold exposure significantly increased plasma renin and angiotensin II concentrations and upregulated vascular angiotensin-converting enzyme and angiotensin II type 1 receptor expression. Aortic ejection velocity and systolic load rose markedly, accompanied by mesenteric arterial wall thickening and increased fibrosis area. Despite structural remodelling, acetylcholine-mediated vasorelaxation and phenylephrine-induced contraction remained preserved, indicating an early hyperfunctional stage of vascular ageing characterised by growth and matrix deposition rather than endothelial failure. Drug-class responses diverged under cold stress. Irbesartan achieved greater systolic blood pressure reduction during cold exposure compared with room temperature conditions, whereas angiotensin-converting enzyme inhibition, calcium-channel blockade, and beta-1 receptor blockade showed attenuated effects. These findings indicate functional dominance of angiotensin II type 1 receptor-mediated signalling in cold-induced hypertension. Nucleic-acid constructs achieved robust vascular expression of angiotensin-converting enzyme 2 and sirtuin 3, reduced pulse-wave velocity, attenuated fibrosis, and lowered senescence-associated markers in cold-exposed animals. This dual-target approach simultaneously counteracts renin–angiotensin–aldosterone system overactivation and mitochondrial dysfunction, two mechanistic pillars of vascular ageing.

Conclusion: Cold stress functions as an environmental accelerator of vascular ageing, inducing a renin–angiotensin–aldosterone system–dominant hyperfunctional arterial state characterised by increased central haemodynamic load and fibrotic remodelling. Within this biology, angiotensin II type 1 receptor blockade uniquely retains therapeutic efficacy, whereas other antihypertensive classes are comparatively attenuated. These findings provide mechanistic rationale for season-aware hypertension management and identify dual-target nucleic-acid therapeutics as a translational strategy to reverse cold-induced vascular ageing.

The role and practical application of pharmacists in ICOPE

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Background: As Taiwan rapidly approaches a super-aged society by 2025, Integrated Care for Older People (ICOPE) has become crucial for improving the health and quality of life of the elderly. With the rising life expectancy, the extended years of unhealthy survival highlight the challenge of dependency and disability in older adults. The WHO's ICOPE guidelines promote "healthy aging" by enhancing intrinsic capacity and functional ability to prevent and delay age-related decline.

Method: Within this framework, pharmacists use the 4Ms framework (What Matters, Medication, Mentation, Mobility) to optimize polypharmacy management and reduce the risks associated with high-risk medications (such as delirium, falls).

Results: Among ICOPE's eight assessments, the medication section places special emphasis on the assessment of polypharmacy and seven categories of inappropriate medication. Pharmacists are encouraged to use three simple questions to initially assess the elderly's medication problems, intervene early, and conduct referrals and health care. Pharmacists are advised to consult Beers Criteria and STOPP & START guidelines to identify high-risk medications and consider alternative or non-pharmacological interventions to support intrinsic capacity.

Conclusion: This paper explores the pharmacist's role in ICOPE, offering practical recommendations to use expertise in reducing medication-related risks, ultimately helping delay or reverse declines in physical and mental capacities in older adults.

Protocol for a national qualitative interview study exploring work-related stress and professional wellbeing among hospital pharmacists in Canada

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Background: Work-related stress and burnout among hospital pharmacists have emerged as important workforce challenges within contemporary health systems. Expanding clinical responsibilities, workforce shortages, and increasing service demands have intensified pressures within hospital pharmacy practice. While quantitative studies have documented elevated levels of burnout among health professionals, comparatively little qualitative research has explored how hospital pharmacists themselves interpret workplace stressors and identify the organisational conditions that shape professional wellbeing. Eliciting in-depth accounts from practising hospital pharmacists provides actionable insight and addressing this knowledge gap is important to inform workforce sustainability strategies within hospital pharmacy and broader health-system policy discussions. This study aims to advance understanding of the structural, organisational, and professional factors influencing pharmacist wellbeing within Canadian hospital pharmacy practice, with relevance to comparable health-system context.

Method: This national qualitative study employs semi-structured interviews with licensed hospital pharmacists practising across Canada (target sample approximately of 30 participants; recruitment ongoing). Participants are recruited through national professional pharmacy organisations, including the Canadian Society of Healthcare-systems Pharmacy (CSHP), representing more than 3,500 health-system pharmacy professionals nationally, and the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), representing more than 2,000 pharmacists practising in Quebec healthcare institutions. These organisations were selected to ensure representation from both pan-Canadian and Quebec-specific hospital pharmacy contexts. The study is informed by organisational and professional wellbeing frameworks that examine relationships between workforce structures, professional roles, and occupational stress within health systems. Eligible participants include pharmacists currently practising hospital pharmacy with clinical, operational, or direct patient care responsibilities. Interviews are conducted virtually using a semi-structured guide exploring role-based stressors, perceived proximity to burnout, and organisational supports influencing professional wellbeing. Interviews are audio recorded with participant consent and transcribed verbatim. Data collection and analysis are ongoing and follow an

inductive thematic analysis approach using iterative coding and constant comparison across interviews until thematic saturation is reached. Graduate trainees are involved in qualitative coding, analysis, and knowledge mobilisation activities. This project was reviewed and approved by the Carleton University Research Ethics Board A and by the CHEO Research Ethics Board and is funded by Social Sciences and Humanities Research Council (SSHRC).

Results: Data collection has begun and interviews are currently being conducted with hospital pharmacists across multiple Canadian jurisdictions. Thematic coding and framework development will proceed concurrently with ongoing recruitment.

Conclusion: This study is generating qualitative insights into how organisational structures, professional expectations, and workforce conditions shape pharmacist wellbeing within hospital practice. Findings from this study will inform the development of a survey instrument to be administered to hospital pharmacists across Canada. Findings are expected to inform workforce planning, organisational strategies, and policy discussions aimed at strengthening supportive work environments and promoting sustainable hospital pharmacy practice.

Understanding gender and role differences in hospital pharmacy employment preferences to inform recruitment and retention strategies

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Background: Hospital pharmacy departments across Canada face ongoing recruitment and retention challenges. While employment preferences are recognised as relevant, their relationship with job satisfaction drivers and perceptions of recruitment effectiveness across roles and genders remains unclear. The objective of this project is to examine employment preferences, job satisfaction drivers, and perceptions of recruitment effectiveness among healthcare system pharmacy professionals and learners in Canada, with subgroup analyses by role and gender.

Method: A cross-sectional survey was conducted via REDCap from April 19 to May 31, 2024. The survey was distributed via multiple online platforms and included pharmacy employees (pharmacists, pharmacy technicians, and pharmacy assistants) and students enrolled in pharmacy or post-secondary health science programmes. Survey items included

multiple-choice, Likert-scale, and open-ended formats. Quantitative data were analysed using descriptive statistics, and subgroup comparisons were conducted by gender and employment role.

Results: There was a total of 807 respondents, including 267 pharmacists, 173 pharmacy technicians, and 157 students; 66% identified as female. Female respondents preferred reduced full-time or part-time schedules (66%) compared with males (14%), while pharmacy technicians were more likely than pharmacists to prefer reduced full-time or part-time hours. Across all respondents, the most commonly reported contributors to job satisfaction were supportive management (15%), recognition (13%), access to professional development (12%), and workload sustainability (5%), with respondents selecting multiple factors. Perceptions of current recruitment strategies were frequently neutral or negative.

Conclusion: Our survey highlights that although employment preferences related to working hours and scheduling varied by gender and professional role, the primary contributors to job satisfaction were largely consistent across hospital pharmacy personnel within healthcare systems.

Perspectives of international pharmacy graduates on integrating into institutional practice: A survey-based analysis

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Background: International pharmacy graduates (IPGs) have limited access to institutional practice despite their significant numbers in Ontario's and Canada's pharmacist workforce. IPGs' perspectives on their inability to integrate into hospital pharmacy practice has not been studied.

Objective: To examine IPGs' understanding of barriers to integrate into hospital pharmacy practice and to identify potential facilitators through a survey analysis.

Method: A cross-sectional survey of IPGs in Ontario was conducted. Descriptive statistics and cross-tabulations were used to summarize the sample characteristics (gender, graduation year, credentialing, work conditions, and experiential training) as well as responses to questions pertaining to finding a position in hospitals and perceived role of different pharmacy organizations in the process. Content

analysis was performed on text-based questions to extract themes of perceived barriers and facilitators to working in hospitals.

Results: We distributed the survey to 7,818 Ontario pharmacists who had agreed to be contacted for research, of whom an estimated 3,909 were IPGs. We received 442 responses (11.3%). After excluding individuals who did not consent, were not registered with the OCP, or did not complete their pharmacy degree outside Canada, the final sample included 317 IPGs. Most respondents were women, had graduated between 2004 and 2013, and were registered with the OCP for fewer than ten years. The majority practiced in community settings with only 15.4% reported practicing in hospital or LTC settings. Half of respondents held no Canadian credential beyond licensure, although 29% completed a bridging program. Hospital pharmacy was ranked as the top practice interest by 32.7% of participants, just behind community pharmacy at 33.0%. An additional 24.8% of participants ranked hospital pharmacy as their second choice. IPGs lack awareness of Canadian residency programs and most rated institutional experiential placement resources as insufficient. IPGs recognize that not having hospital experiential placements is a major barrier which limits their options to community pharmacy practice. Respondents perceive academic institutions as having a role in facilitating experiential placements.

Conclusion: Structural barriers persist for IPGs seeking institutional roles. Most IPGs rely on independent efforts rather than organizational support to secure early hospital job or placement experiences. These structural gaps likely contribute to IPGs' lack of representation in institutional practice settings.

Impact of fluconazole on tacrolimus trough level in liver transplant recipients

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Background: Solid organ transplantation has increased worldwide over recent decades. As immunosuppressive therapy has improved transplant survival, a rising incidence of opportunistic infections has been observed. Fluconazole is usually prescribed for antifungal prophylaxis or treatment after liver transplantation. Azoles are well known to inhibit cytochrome P450 3A4 (CYP3A4) system, which significantly increases blood concentrations of the preferred calcineurin inhibitor, tacrolimus. Elevated tacrolimus concentrations are associated with an increased risk of adverse effects, most notably nephrotoxicity. The magnitude of this drug interaction varies considerably among individuals, making dose adjustment essential upon co-administration to avoid toxicity. However, data on the time-dependent magnitude of

this interaction in liver transplant recipients remain limited. Interestingly, this interaction may also be leveraged therapeutically in patients whose tacrolimus trough concentrations persistently fail to reach target levels.

Objective: To evaluate the impact of tacrolimus trough level when co-administrating with fluconazole in liver transplant recipients, and to offer preliminary insights to guide proactive dose adjustment and therapeutic drug monitoring in clinical practice.

Method: This was a single center retrospective chart review. Adult liver transplant recipients who simultaneously received tacrolimus and fluconazole from March 2023 to June 2025 were included. Patients were excluded if they were of pediatric age, had missing data or no chart available, or concomitantly used medications known to significantly alter CYP3A4 drug metabolism. Daily dosage of fluconazole ranged from 50 to 600mg. Tacrolimus dosage was adjusted according to trough levels. Tacrolimus doses and concentrations were obtained at different time points during fluconazole treatment. The magnitude of fluconazole's inhibitory effect on tacrolimus metabolism was assessed by analyzing dose-corrected trough level (Concentration/Daily dose, C₀/D, ng/ml/mg), expressed as mean±SD. The primary outcome was the maximum fold-increase in C₀/D during fluconazole therapy. Secondary outcomes included time to maximum effect and recovery time after discontinuation.

Results: A total of 24 adult liver transplant recipients were included in the final analysis. Mean C₀/D increased from 2.04±1.37 ng/ml/mg to maximum 7.70±7.53 ng/ml/mg during fluconazole administration, representing a mean maximum 3.83 ± 3.65-fold increase. The maximum effect was reached after a median exposure of 16 days (range: 1–52 days). A median exposure of 7 days was associated with a 1.5-fold increase in C₀/D with an average dose of 177.5 mg fluconazole administration. One week after discontinuation of fluconazole, mean tacrolimus trough levels returned to baseline values.

Conclusion: Co-administration of fluconazole with tacrolimus in liver transplant recipients results in a clinically significant, time-dependent increase in C₀/D. This characteristic provides a strategic choice for patients whose tacrolimus trough concentration was difficult to achieve target therapeutic level. This interaction necessitates proactive dose reductions and close therapeutic drug monitoring to maintain safe and effective tacrolimus levels. Importantly, tacrolimus concentrations returned to baseline within one week after discontinuation of fluconazole, highlighting the reversible nature of this interaction. These findings underscore the need for vigilant pharmacokinetic monitoring and individualized dose adjustment when managing patients receiving both agents.

Constructing an intelligent medication management framework in the ICU: From process redesign to precision pharmacotherapy outcomes

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Background: Critically ill patients often experience rapid and unpredictable changes in their clinical condition, frequently requiring multiple injectable medications, controlled substances, and high-alert medications. Ensuring accurate prescribing including appropriate dose, frequency, and concentration along with timely pharmacist verification and safe medication dispensing, is critical to patient safety. However, traditional medication-use processes have largely relied on manual review, dispensing, and delivery workflows. These complex and labor-intensive procedures increase the risk of dispensing errors, medication stock discrepancies, and delays in medication availability for nursing administration, potentially compromising the efficiency, safety, and quality of pharmacotherapy in critical care settings.

Method: Applying the ECRS (Eliminate, Combine, Rearrange, Simplify) lean management principles, pharmacists collaborated with the multidisciplinary team to redesign the medication-use process and implement intelligent automation technologies. A closed-loop pharmaceutical care system was established, encompassing the entire medication management pathway from prescribing verification and dispensing to administration and medication return. Key interventions included:

1. Implementation of a ward-based Automated Dispensing Cabinet (ADC) system under a full-prescription model, enabling pharmacists to perform prospective prescription review and ensuring the accuracy, traceability, and timely availability of medications for clinical use.
2. Establishment of a nursing staff identification and barcode verification mechanism, integrated with pharmacist dispensing verification, to strengthen the safety management of high-alert and high-risk medications.
3. Optimization of floor stock and controlled substance management processes, reducing manual handling and associated error risks while enhancing medication inventory control, traceability, and auditability under pharmacist oversight.

Results: Following implementation, the initiative yielded significant and measurable outcomes, summarized as follows:

1. Enhanced Medication Safety: The implementation of barcode scanning and access control mechanisms effectively reduced dispensing and administration errors. Dispensing-related incidents decreased from five cases to zero, and administration-related

incidents declined from three cases to zero.

2. Optimization of Operational Efficiency: (1) Pharmacists' daily dispensing and verification efficiency both improved by 87%, and total time spent processing medication returns in the ICU was reduced by 82%. (2) Nursing medication preparation time decreased by 81%. The time required for per-bed medication inventory checks decreased by 97%, and the time spent organizing returned medications per bed decreased by 78%.

3. Increased Pharmacist Involvement in Clinical Care: The number of pharmacist-generated medication recommendations increased by 64%, with a significant rise in the proportion of recommendations related to antimicrobial therapy and therapeutic drug monitoring.

4. Reduced Resource Utilization: Through paperless initiatives and reduction of packaging materials, carbon emissions were reduced by approximately 4.8 metric tons, aligning with ESG sustainability objectives.

Conclusion: By implementing smart medication cabinets integrated with barcode verification systems, the medication access workflow in intensive care units is optimized. Pharmacists perform real-time restocking, and the system provides automated alerts for inventory discrepancies. Nurses are thereby enabled to administer medications rapidly and safely at the bedside, reducing medication errors and alleviating workforce burden.

The impact of generic prescribing policy on medication incidents and prescribing practices in a Saudi Hospital

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Background: Mandatory generic prescribing is required by the Saudi Ministry of Health and the Council of Cooperative Health Insurance. This policy aims to enhance transparency, reduce commercial bias, and standardize prescribing practices. In 2025, our hospital transitioned from mixed brand/generic prescribing to mandatory generic ordering in alignment with national policy. This change altered system functionality, removed auto-populated default dose, frequency, and route fields, increasing the burden on prescribers. The full impact of this transition has not yet been fully characterized.

Objective: To examine the safety impact of this transition and describe corrective actions undertaken to optimize prescribing practices.

Method: A retrospective review of medication incident reports compared 2024 (pre-implementation) and 2025 (post-implementation) reports in a 200-bed private hospital in Saudi Arabia. Incident types were analyzed, focusing on

prescriber-related errors. Contributing system factors were reviewed.

Results: The number of reported medication incidents increased from 271 in 2024 to 815 in 2025. Prescriber-related errors decreased proportionally (49% vs. 35%). Reports of wrong prescribing frequency declined (37% vs 14.5%). Conversely, unclear or incorrect dose selection increased (9% vs 21.6%), and wrong route errors increased (1.5% vs 3%), emerging after removal of default prescribing fields. The transition to generic prescribing eliminated brand preference patterns and improved utilization of previously underused equivalent products, promoting more neutral and standardized prescribing behavior. Improved reporting culture likely contributed to higher incident capture. Interventions included targeted physician education, formal requests to reinstate default dosing support within the electronic prescribing system, and reinforcement of medication safety culture through recognition of “good catch” events.

Conclusion: Mandatory generic prescribing can reduce commercial bias and standardize medication terminology. However, removal of embedded clinical decision support and auto-populated fields may unintentionally increase prescribing variability. Early identification of system-design gaps, combined with governance actions, IT collaboration, and strengthened reporting culture, is essential to ensure that digital transitions enhance rather than compromise medication safety. This experience highlights the importance of aligning national prescribing policies with safe digital health system design.

Hospital pharmacist-led monitoring of satralizumab therapy in aquaporin-4 antibody-positive neuromyelitis optica spectrum disorder: A case report

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Background: Neuromyelitis Optica Spectrum Disorder (NMOSD) is a rare autoimmune inflammatory disease of the central nervous system characterised by recurrent optic neuritis and transverse myelitis, which may lead to severe neurological disability and visual impairment. The majority of patients with NMOSD test positive for autoantibodies against aquaporin-4 (AQP4-IgG), a water channel protein expressed on astrocytes. Interleukin-6 (IL-6) is known to play an important role in the pathogenesis of NMOSD by promoting inflammatory responses and the production of pathogenic antibodies. Satralizumab is a humanised monoclonal antibody that targets the IL-6 receptor and inhibits IL-6 mediated signalling pathways. Clinical trials have demonstrated that satralizumab significantly reduces relapse

risk in patients with AQP4-IgG positive NMOSD. In hospital practice, pharmacists play an important role in the safe management of biologic therapies through medication review, monitoring of adverse events and patient counselling. This case report illustrates both the therapeutic impact of satralizumab and the essential contribution of pharmacists in the multidisciplinary management of NMOSD. 

Method: A 33-year-old female presented with progressive visual impairment and was initially diagnosed with optic neuritis and Sjögren’s syndrome. Due to worsening visual symptoms and radiological progression, the patient was admitted for therapeutic plasma exchange. Following the second course of plasma exchange therapy, visual symptoms gradually improved. The patient initially received high-dose corticosteroids in combination with hydroxychloroquine and azathioprine as immunosuppressive therapy. In October 2023, the patient was confirmed to have AQP4-IgG positive NMOSD. Treatment with satralizumab was initiated in December 2023 at a dose of 120 mg administered subcutaneously at weeks 0, 2 and 4, followed by maintenance dosing every four weeks. Hospital pharmacists participated in the multidisciplinary care team and were involved in medication management, including reviewing potential drug interactions, monitoring laboratory parameters such as liver function, lipid profiles, and absolute neutrophil count, assessing infection risks and providing patient counselling to support adherence and safe administration of the biologic therapy. 

Results: During two years of satralizumab therapy, the patient experienced no clinical relapse. Magnetic resonance imaging showed no newly developed lesions, and both visual function and gait remained stable throughout the follow-up period. The treatment was generally well tolerated. The only adverse event observed was mild injection-site erythema, which resolved without medical intervention. No clinically significant abnormalities were detected in laboratory monitoring. Patient adherence to therapy was good following pharmacist counselling and ongoing follow-up. 

Conclusion: Satralizumab demonstrated favourable effectiveness and tolerability in this patient with AQP4-IgG positive NMOSD. The findings support the clinical value of IL-6 receptor inhibition for relapse prevention and disease stabilisation. In addition, this case highlights the important role of hospital pharmacists in ensuring the safe use of biologic therapies through medication review, safety monitoring and patient education. Pharmacist involvement may contribute to improved treatment outcomes and optimal medication management in patients receiving satralizumab therapy. These findings reinforce the international relevance of pharmacist involvement in advanced immunotherapy, offering practical insights that can be applied across diverse healthcare settings.

Profile of scientific publications by Quebec hospital pharmacists: Creation of a scientific publication observatory

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Background: Scientific dissemination by pharmacists occurs mainly through conference posters and journal publications. Although publication is often valued in academic careers and may contribute to promotion criteria for preceptors and faculty members, Canadian hospital pharmacists have no formal requirements or incentives to publish. While articles indexed in databases such as PubMed or Embase are relatively easy to retrieve, works published in professional journals or presented at conferences are more difficult to identify. As a result, a substantial portion of scientific activity in hospital pharmacy remains poorly visible or non-indexed. This situation highlights the need to better document and showcase these contributions. The objective was to describe the profile of scientific publications by Quebec hospital pharmacists through the creation of an online publication observatory.

Method: Descriptive retrospective study. Citations for conference posters and articles published in indexed and non-indexed journals were identified through web searches (PubMed, Embase, CINAHL, Google Scholar), the website of the Association des pharmaciens des  tablissements de sant  du Qu bec (APES), and direct solicitation of pharmacy department heads across Quebec. Data were compiled in a spreadsheet (Excel, Microsoft, Seattle, WA, USA), duplicates were removed, and a dedicated website was developed to present the results.

Results: The Quebec Pharmacists' Publication Observatory was launched on September 8, 2025 (<https://observatoireppq.org>). It provides an overview of scientific output from January 1, 2014, to the present, with biannual updates supported by pharmacy trainees who participate in data collection while learning about scientific dissemination. The platform allows users to filter results by institution or author and reports twelve indicators. As of March 18, 2026, the observatory included 3,020 publications: 57% journal articles (1,720), 42% conference posters (1,254), and 2% books (46). A substantial proportion of articles were non-indexed (52%, 889/1,720) and would otherwise remain difficult to identify. Because French is the official language in Quebec, most publications were written in French (53%, 1,609/3,020), with the remainder in English (47%, 1,411/3,020). The mean number of authors was 5.9 per poster, 5.7 per article, and 2.0 per book. Publications involved 5,087 unique authors. Most work originated from university-affiliated health institutions (90%, 2,728/3,020) and was

often associated with the supervision of pharmacy residents and students. Publications mainly involved evaluative research (62%, 1,860/3,020), followed by literature reviews (23%, 686/3,020) and clinical research (16%, 474/3,020). Approximately 48% of projects (1,456/3,020) examined at least one medication. The most frequent conferences were pharmacy-related: the APES Grand Forum (23%, 293/1,260), the Canadian Society of Hospital Pharmacists Professional Practice Conference (10%, 125/1,260), the Canadian Pharmacy Education and Research Conference (6%, 71/1,260), the Universit  de Montr al Faculty of Pharmacy Research Day (5%, 63/1,260), and Hopipharm (5%, 59/1,260). The most common journals were *Pharmactuel* (26%, 449/1,720), *Qu bec Pharmacie* (12%, 199/1,720), the *Canadian Journal of Hospital Pharmacy* (9%, 154/1,720), *Annales Pharmaceutiques Fran aises* (3%, 43/1,720), and *Pharmacien Clinicien* (2%, 31/1,720).

Conclusion: Quebec hospital pharmacists have been highly active in scientific dissemination since 2014. The online observatory provides a comprehensive and structured overview of their scientific output, highlighting numerous publications and conference presentations that would otherwise remain difficult to identify.

Evaluative research and professional practice evaluation: The URPP Model

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Background: Evaluative research and professional practice evaluation are essential aspects of pharmacy practice. They enable benchmarking, the assessment of new practices, and the dissemination of knowledge. In Canada, there are few structured units dedicated to this kind of research within healthcare institutions. This may be explained by the lack of funding sources, lack of expertise, and the need to prioritise pharmaceutical care and services. The objective of this study was to describe the Pharmacy Practice Research Unit (URPP).

Method: Descriptive study. The URPP is based in the pharmacy department of a 500-bed mother-and-child university hospital centre located in Qu bec, Canada. The pharmacy department includes a team of approximately 100 full-time equivalents (pharmacists, technicians, research professionals) and trainees. The URPP archives and annual reports were extracted from 2002 to 2026. A chronological narrative was developed to describe its implementation and operations. Descriptive statistics were done to report its activities as of March 2026.

Results: The URPP was established in 2002 and celebrated its 23rd anniversary in 2025. Since its inception, its mission was to foster the development of pharmacist-researchers and to promote innovative research activities in pharmacy practice. The unit relies on a structured team including a stable core consisting of a senior pharmacist, a scientific coordinator and staff from the pharmacy department. Experts are sought to add specific expertise for specific projects, which led to long-term partnerships with various organizations. The URPP offers research project-based training to various students, either undergraduate (PharmD, Bachelor of Biopharmaceutical Sciences) or postgraduate (hospital pharmacy residency) pharmacy students. Over the years, more than 420 students performed internships that spanned from 3 to 24 months duration. Approximately 50% of trainees came from other French-speaking countries such as France, Belgium and Switzerland. This diversity represents an incredible opportunity for knowledge transfer about the best pharmacy practices. Most projects are designed to support the pharmacy department activities and needs. They are categorized in ten areas of interest: medication appropriateness, medication-use circuit, history, legislation, education, pharmacoeconomics and management, clinical research, occupational health and safety, pharmaceutical care, and technologies. These projects led to ~900 scientific articles, ~900 conference posters and ~ 350 oral presentations. Throughout the years, most of its operations remained constant. Key updates include an increase in online presence starting in 2011 and managing communities of practices starting in 2018. The pharmacy-related blogs attracted over 300,000 visits. These websites helped increase the visibility of professional practice evaluation research and highlighted some useful initiatives for healthcare centres. Similarly, the communities of practice proved an excellent mean to gather a multidisciplinary team interested in working together toward a common goal and share their local initiatives.

Conclusion: The integration of the URPP within the pharmacy department represented a strong example of continuity, productivity, and support for a culture of quality improvement. The impact of many projects was amplified through the publication of their results and their online dissemination, while also supporting the training of students from different backgrounds. The communities of practice were a great way to allow their provincial implementation.

Development of a structured approach to reviewing and presenting medication-associated risks: The case of unfractionated heparin

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Background: An increasing number of medicines are available on the market. Clinicians have access to numerous sources of information regarding medication-associated risks. These risks relate to a drug's pharmacology, formulation, and use. When multiple therapeutic options exist, clinicians must weigh the risks associated with each. No standardised tool currently supports this comparison. Product monographs remain the default reference, but their heterogeneous format and variable content limit their usefulness for systematic risk appraisal. There is currently no comparative profile summarising of medications. We developed a structured approach for reviewing and presenting the risks and applied it to heparin.

Method: Descriptive study conducted within the Pharmacy Practice Research Unit (URPP) at CHU Sainte-Justine (CHUSJ), in collaboration with the pharmacovigilance team. A literature search was performed (PubMed, Embase, Google), along with a review of data from organisations (e.g. FDA, EMA, Health Canada, CPS, ISMP, MSSS, SQ), government procurement centres, and local databases. Data were extracted on pharmacological characteristics (indications, precautions and warnings, contraindications, drug interactions, adverse effects), extrinsic characteristics (e.g. manufacturing, packaging, labelling), and risks related to medication use (e.g. incidents/accidents). Several knowledge synthesis tools were tested: a chronological timeline of key milestones in the history of heparin, quantitative and qualitative dashboards of relevant data, and mapping of key terms. A summary sheet was developed and discussed.

Results: Discovered in 1916, heparin was introduced into clinical practice in the 1930s and has been available on the Canadian market since 1939 as an anticoagulant. Exploratory studies have also been conducted for non-anticoagulant indications. In the literature, it is associated with twelve therapeutic targets, has a short half-life (0.5–2 hours), and a molecular weight ranging from 3,000 to 30,000 Daltons. Heparin binds strongly to proteins and exhibits two types of elimination (zero-order and first-order kinetics). Depending on the sources consulted, it has between 1 and 7 indications, 17 to 31 precautions and warnings, 4 to 12 contraindications, 14 to 648 drug interactions, and 10 to 17 adverse effects, the most common being minor or major bleeding. The drug is generally stored at a temperature between 15 and 30 C. No reports were identified in Info-Vigilance. Health Canada has

recorded 17 batch recalls and no withdrawal notices. A major contamination event occurred in 2008, resulting in deaths worldwide. Several incidents and accidents have been reported in the literature, including a massive heparin overdose in newborn twins of an American actor. Within our institution, heparin is used mainly for three indications and is included in 90 protocols, with 4 precautions, 3 contraindications, and 29 drug interactions. Sixteen adverse drug reactions associated with this medication have been reported to Health Canada, while six cases were not reported.

Conclusion: The use of heparin is associated with multiple risks, and it is feasible to develop a structured summary sheet describing these risks derived from the literature and local practice. Work to refine the tool and apply it to other medications is ongoing.

Pharmaceutical consultation standard in hospital pharmacy

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Background: The increasing complexity of therapeutic regimens, combined with population ageing, multimorbidity, and polypharmacy, has been demonstrated to result in an elevated risk of medication-related problems and preventable adverse events. Frequent transitions between levels of care have been demonstrated to contribute to medication discrepancies and difficulties in treatment adherence. The pharmaceutical consultation in a hospital setting is defined as a structured, patient-centred clinical intervention. The aim of this intervention is twofold: firstly, to optimise pharmacotherapy and, secondly, to improve medication safety and promote adherence. However, the implementation of pharmaceutical consultations in hospital settings often lacks standardised procedures. The objective of this standard is to establish a structured framework for the organisation, implementation, and monitoring of hospital pharmaceutical consultations. It does this by defining eligibility criteria and clinical procedures for both initial and follow-up consultations.

Method: The standard in question delineates the organisational and clinical requirements for the implementation of pharmaceutical consultations within hospital and proximate healthcare settings. The eligibility

criteria encompass clinical complexity, polypharmacy, elevated risk of drug–drug interactions, and barriers to treatment adherence. The care process is structured into two stages: the initial consultation and follow-up consultations. The preliminary consultation encompasses a thorough clinical and pharmacotherapeutic evaluation, encompassing the corroboration of clinical data stored within the electronic health record and a structured patient-centred interview to ascertain the complete medication history. Medication reconciliation and review are performed to identify discrepancies in therapy, potential interactions between drugs, adverse reactions to drugs, and other problems related to medication. Following a comprehensive evaluation, a bespoke pharmacotherapeutic monitoring plan is formulated. This plan encompasses therapeutic recommendations, monitoring parameters, and strategies to ensure adherence to the treatment regimen. Furthermore, patients are provided with education regarding the correct storage, administration, and disposal of medicines. The subsequent consultations are centred on the following: the monitoring of pharmacotherapy, the updating of clinical information, the identification of new medication-related problems, the evaluation of previous interventions, and the reinforcement of patient education. Depending on the patient's requirements and the clinical progression, consultations may be conducted in person or via teleconsultation.

Results: The implementation of this structured model supports a systematic approach to pharmacist-led consultations, facilitating medication review, identification of medication-related problems, and development of individualised monitoring plans. Furthermore, it is conducive to the documentation of pharmaceutical interventions and the enhancement of multidisciplinary collaboration.

Conclusion: The integration of pharmacists into the management of patients in hospital settings can be supported by the implementation of a structured and standardised pharmaceutical consultation framework. Standardised procedures have been shown to improve medication safety, optimise pharmacotherapy, and promote patient-centred care. In addition, they contribute to better coordination within healthcare teams and support the quality and sustainability of healthcare systems.

Investigating the efficacy of belimumab in reducing proteinuria for patients with systemic lupus erythematosus: A hospital-based case-series study

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Background: Belimumab is a human IgG1 λ monoclonal antibody approved for treatment of systemic lupus erythematosus (SLE). While several studies have investigated their efficacy, the results have been inconsistent. Furthermore, limited research has explored its effects on SLE-related renal outcomes. Therefore, this study aims to evaluate the efficacy of belimumab in improving renal outcomes for SLE patients with proteinuria.

Method: This retrospective case-series study was conducted at Taichung Veterans General Hospital (TCVGH) from December 2023 to December 2025 (IRB No. CE26035B). All patients were diagnosed with SLE with higher UPCR (urine protein-creatinine ratio) than 150 mg/g and received belimumab. Participants were excluded if they had lower UPCR than 150 mg/g, or use other biologic agents, immunoglobulin, or cyclophosphamide within 6 months before belimumab treatment. The primary outcome was including reduction in UPCR (%) for proteinuria and improvements in eGFR (estimated Glomerular filtration rate, %) for SLE patients with proteinuria. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 22.0.

Results: A total of 14 patients were enrolled in the study. After belimumab treatment at 3, 6, 9 and 12 months compared with baseline, UPCR was decrease of 24%, 36%, 58% and 57%, respectively. The UPCR at 9 and 12 months compared with that of 3 months was significantly decreased ($p = 0.002$, 0.032). The eGFR at 3, 6, 9 and 12 months compared with baseline was increase of 6%, 7%, 9% and 12%, respectively. The eGFR was not significantly increased ($p = 0.647$). As 12-month belimumab therapy had led to a significant decrease in proteinuria, its continued administration is recommended as an adjunct to standard care to optimize clinical improvement.

Conclusion: The present study observed that belimumab might provide benefits and emphasize management of renal outcome for SLE patients with proteinuria and higher UPCR. Key words: belimumab, systemic lupus erythematosus, proteinuria, urine protein-creatinine ratio

AI-powered socially assistive educational robot and gamified learning: enhancing prescription review skills in pharmacy residents

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Background: Hospital pharmacists are crucial for medication safety; however, traditional training often lacks engagement. Despite the potential of game-based learning as an innovative solution, empirical research regarding its application in clinical pharmacy training remains limited. Consequently, this pilot study evaluated the effectiveness of an artificial intelligence (AI)-powered socially assistive educational robot in enhancing Post-Graduate Year (PGY) pharmacists' prescription review skills, and assessed learner acceptance and satisfaction.

Method: A randomised controlled trial was conducted at a single medical centre. 16 PGY pharmacists were randomly assigned to either a robot-assisted game-based learning group ($n=8$) or a traditional online learning group ($n=8$). An assessment tool (100-point scale), validated by three clinical experts, was used. Initially, both groups completed a pre-test. Subsequently, the robot group participated in an interactive dual-player gaming competition, while the control group received standard online training. Finally, both groups completed a post-test and a 5-point Likert scale questionnaire, adapted from the Technology Acceptance Model (TAM). Both groups evaluated perceived usefulness (PU) and overall satisfaction; only the robot group evaluated perceived ease of use (PEOU) and behavioural intention. Data were analysed using independent-samples t-tests via SPSS.

Results: The assessment tool demonstrated high content validity (Scale-level Content Validity Index, S-CVI/Ave = 0.99) and internal consistency (Cronbach's $\alpha = 0.992$). In terms of learning outcomes, baseline pre-test scores differed significantly between the two groups (robot group: 58.75 vs traditional group: 70.00, $p = 0.049$). After the intervention, the robot group demonstrated a greater mean improvement (21.25 vs 7.50 points). However, post-test scores showed no significant difference between the two groups (80.00 vs 77.50, $p = 0.812$). Technology acceptance analysis revealed that both groups provided comparably high positive ratings for PU (4.83 vs 4.79) and overall satisfaction (4.88 vs 4.75). The robot group reported a PEOU of 4.83, and scores of 4.88 for both learning engagement and willingness to recommend.

Conclusion: Gamified learning integrated with an AI-powered socially assistive educational robot was associated with greater score improvements among PGY pharmacists. This model demonstrates substantial learning gains, particularly in bridging initial competency gaps for lower-baseline learners. Pharmacists exhibited high acceptance and satisfaction

towards this technology, valuing its clinical utility, engaging nature, and enhanced learning motivation. Overall, this approach establishes a highly interactive and innovative model for future pharmacy education.

Effectiveness and safety of off-label dutasteride for androgenetic alopecia: A retrospective case series

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Background: Androgenetic alopecia (AGA) is the predominant progressive hair loss disorder affecting males, conventionally managed with finasteride as the standard of care. Nevertheless, dutasteride, functioning as a dual 5-alpha-reductase inhibitor, demonstrates superior efficacy in suppressing serum dihydrotestosterone levels. While regulatory approval for dutasteride in AGA treatment exists in certain East Asian regions, it primarily serves as an off-label rescue therapy in Western clinical practice. In Taiwan, following the market withdrawal of the alopecia-specific formulation, the benign prostatic hyperplasia variant has emerged as the off-label standard of care. Consequently, capturing real-world evidence from this specific setting is imperative. This retrospective case series aims to evaluate the clinical outcomes and safety profile of off-label oral dutasteride for AGA.

Method: A retrospective chart review was executed within a military medical centre, encompassing male patients diagnosed with AGA. The inclusion criteria required patients to have received off-label oral dutasteride (0.5 mg daily) for at least 3 months. The evaluation focused on establishing both clinical efficacy and safety parameters.

Results: The final cohort consisted of 38 male patients, demonstrating substantial long-term treatment adherence with continuous therapy extending up to 34 months. Importantly, a distinct subset of the study population initiated dutasteride following suboptimal responses to prior finasteride therapy, illustrating its clinical utility as a step-up rescue intervention. Longitudinal medical records consistently indicated disease stabilisation across the entire cohort. Furthermore, attending physicians documented clinically significant symptomatic improvement in over 25% of the study population. The safety analysis revealed a highly favourable profile. Objective biochemical assessments, including hepatic panels, thyroid function tests, and testosterone levels, remained within normal physiological limits for all monitored patients. Significantly, there were no reported cases of new-onset sexual dysfunction or treatment cessation attributable to adverse outcomes.

Conclusion: This real-world case series indicates that the off-label use of dutasteride for AGA is clinically effective. Dutasteride is also well tolerated over extended treatment periods. The study highlights sustained patient compliance paired with objective biochemical safety. Furthermore, patients showed notable clinical improvements, particularly those refractory to finasteride, which underscores dutasteride's viability as a robust step-up therapeutic option. Aligning with recent long-term Asian cohort studies, these results provide valuable insights into the manageable safety profile of dutasteride. This evidence supports its continued utility as a clinical standard in regions lacking an alopecia-specific formulation.

Transforming the hospital pharmacy workforce in Wales

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Background: In response to the 2023 independent review of hospital clinical pharmacy services in Wales, commissioned by the Welsh Government and led by the Royal Pharmaceutical Society, a comprehensive set of 36 recommendations was issued to advance patient-centred care, integration, digital innovation, workforce development, and leadership. The Welsh Government accepted these recommendations, initiating a coordinated national effort to transform pharmaceutical care delivery across NHS Wales. This abstract describes the strategic actions and progress of the Pharmacy Workforce Delivery Assurance Group (WDAG), established to oversee workforce planning and professional development, align roles and career pathways, and ensure the pharmacy workforce meets evolving NHS priorities and service demands in Wales.

Method: The Workforce Delivery Assurance Group (WDAG) comprises representatives from diverse pharmacy roles across all seven Health Boards and one NHS trust in Wales. The group systematically prioritised actions arising from the national clinical services review using RICE framework approach (Reach, Impact, Confidence, Effort) as well as consideration of interdependencies between actions. Subject matter leads were appointed to drive forward specific priority workstreams. Initial priorities include developing and standardising job plans, prescribing skills, and fostering professional development at all career stages through credentialling. Progress is continuously monitored through regular reporting, active stakeholder engagement, and alignment with national policy.

Results: Significant progress has been achieved: •A collaborative approach between Higher Education Institutions, Health Education and Improvement Wales (HEIW), and NHS pharmacy teams has resulted in the full

integration of prescribing skills into undergraduate and foundation training. The WDAG is now reviewing how these skills will be utilised within multidisciplinary teams. •The WDAG is embedding credentialing at all levels of practice. To provide clear direction for the profession, a position statement has been agreed by the Directors of Pharmacy Peer Group and published, with associated guidance developed to support implementation. •Template job plans for pharmacists at all career stages are in development, and a pathfinder programme is planned to accelerate their implementation. •Standardised job descriptions for NHS Wales will include essential criteria requiring individuals to obtain, or already hold, the appropriate credential for their career stage, ensuring consistent and effective implementation.

Conclusion: The WDAG's collaborative, evidence-based approach is driving the transformation of the pharmacy workforce in Wales. By aligning education, training, and leadership with national priorities, the group is ensuring a sustainable, skilled, and adaptable workforce ready to deliver innovative pharmaceutical care. Ongoing evaluation and stakeholder engagement will be critical to sustaining momentum and achieving long-term impact.

Closing the loop on polypharmacy: Impact of a CPOE-Integrated pharmacist-led intervention to optimize medication use in older adults

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Background: Polypharmacy is increasingly prevalent among older adults and is associated with higher risks of potentially inappropriate medications (PIMs), therapeutic duplication, and adverse drug events. These medication-related problems (MRPs) compromise patient safety and healthcare quality, particularly among geriatric patients receiving prescriptions from multiple specialties. Although pharmacist-led medication reviews improve prescribing quality, integrating these assessments into routine clinical workflows remains challenging. To address this integration gap, our institution developed a pharmacist-led, closed-loop polypharmacy management program. This program leverages a dedicated surveillance system for automated patient identification and a CPOE-integrated electronic feedback platform. By incorporating National Health Insurance (NHI) PharmaCloud data, pharmacists provide targeted recommendations and

direct feedback to physicians to support continuous medication optimization. This study aimed to evaluate the impact of this dual-platform, pharmacist-led closed-loop intervention on medication use among older adults.

Method: This study was conducted in the outpatient clinics of a regional hospital (2024–2025), where a pharmacist-led surveillance system automatically identified high-risk patients meeting these criteria: age ≥ 70 years, concurrent use of ≥ 10 medications, and visits to ≥ 3 specialties. Pharmacists conducted comprehensive clinical assessments by reconciling hospital and NHI PharmaCloud prescriptions while incorporating patient-specific data, including laboratory values, body weight, gender, and tube-feeding status. Identified MRPs—including PIMs, therapeutic duplication, and inappropriate dosing—were communicated via an electronic feedback platform integrated within the prescribing interface. When physicians entered the prescribing interface, pharmacist recommendations were displayed in real time and required acknowledgment before proceeding. Pharmacists monitored prescription changes to evaluate outcomes, analyzing review volume, the physician acceptance rate, and changes in the number of prescribed medications.

Results: A total of 5,520 medication reviews were conducted. The mean patient age was 78.15 ± 8.85 years, and 31.2% of patients experienced severe polypharmacy (≥ 15 medications). Among these reviews, 161 MRPs requiring clinical intervention were identified, resulting in 161 targeted recommendations with a physician acceptance rate of 72.7%. In accepted cases ($n = 117$), the mean number of medications decreased significantly from 15.07 to 13.47, representing a mean reduction of 1.60 ± 2.46 medications per patient (95% CI: 1.15–2.05; $p < 0.001$). The intervention yielded a moderate-to-large effect size (Cohen's $d = 0.65$). The most common MRP was therapeutic duplication (61.5%), followed by potential adverse drug effects (9.9%) and complex dose adjustment issues (9.3%), highlighting the importance of cross-specialty medication reconciliation.

Conclusion: The integration of a pharmacist-led surveillance system with a CPOE-embedded feedback platform established a robust closed-loop process that supports proactive identification, intervention, and follow-up of MRPs. By transitioning from passive consultation to real-time, integrated clinical decision support, this dual-platform approach facilitated effective interdisciplinary collaboration and clinical adoption of medication optimization recommendations. These findings demonstrate that this integrated model can significantly reduce medication burden and improve prescribing safety in vulnerable older adults. This scalable strategy provides a practical blueprint for healthcare systems seeking to leverage NHI cloud-based data and digital health technologies to optimize geriatric care.

Trends and causes of drug shortages in a Taiwanese medical center: A five-year retrospective analysis

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Background: Drug shortages have become a growing global public health concern in recent years. Disruptions in pharmaceutical supply chains caused by the COVID-19 pandemic, geopolitical conflicts, and instability in the supply of raw materials have increasingly affected the availability of medicines worldwide. These shortages may compromise medication safety, delay treatment, and increase the burden on healthcare systems. Hospitals are often required to rapidly identify alternative therapies or adjust treatment plans when essential medicines are unavailable. In Taiwan, healthcare institutions have experienced recurrent supply interruptions that may threaten the continuity of patient care. Understanding the patterns and underlying causes of drug shortages is therefore essential for improving hospital preparedness and pharmaceutical supply management. This study aimed to analyze the trends, causes, and management responses to drug shortages in a Taiwanese medical center over a five-year period.

Method: This retrospective study analyzed drug shortage and product discontinuation records extracted from the hospital's internal drug shortage reporting system. A total of 1,297 shortage events reported between 2021 and 2025 were included. Variables analyzed included annual case numbers, manufacturer origin, dosage form distribution, therapeutic classes based on the Anatomical Therapeutic Chemical (ATC) classification system, and institutional response strategies.

Results: Drug shortage events showed a marked upward trend during the study period, rising from 152 cases in 2021 to a peak of 347 cases in 2023, followed by a gradual decline to 201 cases in 2025. This increase was likely associated with the COVID-19 pandemic, the energy crisis, and global logistics disruptions following the Russia–Ukraine war. Regarding manufacturing origin, Asian pharmaceutical manufacturers (primarily domestic Taiwanese companies) accounted for the largest proportion (48.7%), followed by European manufacturers (38.2%), and manufacturers from North America and other regions (13.1%). In terms of dosage forms, oral medications represented 47.5% of shortages, followed by injectable formulations (38.2%). The leading causes of shortages were manufacturing and production adjustments (33.1%), international logistics disruptions and geopolitical factors (24.5%), and shortages of raw materials (19.8%). The most affected therapeutic classes were nervous system drugs (28.4%), anti-infective agents (22.1%), and drugs for the alimentary tract and metabolism (18.5%). For management responses, 77.1% of shortages were addressed through substitution with products containing the same active

ingredient, 6.3% through alternative agents with similar pharmacological mechanisms, and 9.1% required special importation. However, 7.5% of shortages had no suitable alternatives and required consultation with clinicians to modify treatment regimens.

Conclusion: Drug shortages have become a significant challenge in hospital pharmaceutical management. Strengthening early warning systems, diversifying procurement channels, and improving coordination of special importation mechanisms are essential strategies to enhance pharmaceutical supply chain resilience and ensure continuity of patient care. Pharmacists play a key role in monitoring shortages, identifying therapeutic alternatives, and collaborating with clinicians to maintain safe and effective medication therapy during supply disruptions.

Incidence and clinical characteristics of postoperative ketosis in patients receiving sodium-glucose cotransporter-2 inhibitors: A single-center study

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Background: Sodium-glucose cotransporter 2 inhibitors (SGLT2 inhibitors) are widely used to treat cardiovascular diseases and type 2 diabetes mellitus. However, perioperative use of SGLT2 inhibitors has been associated with euglycemic ketoacidosis, a potentially underrecognized complication. This study aimed to determine the incidence of postoperative ketosis and ketoacidosis in patients receiving SGLT2 inhibitors and to explore associated clinical characteristics.

Method: This retrospective cohort study included adult patients undergoing surgery with general anesthesia on the day of admission or the following day between January 2022 and December 2024. Patients who had been receiving SGLT2 inhibitors for at least 7 days prior to admission were included. Because institutional perioperative discontinuation guidance for SGLT2 inhibitors had not yet been implemented during the study period, patients were assumed to have continued SGLT2 inhibitor therapy until admission. Patients with type 1 diabetes mellitus or pre-existing ketosis (urine ketone $\geq 1+$ or blood ketone ≥ 0.6 mmol/L) within 30 days prior to surgery were excluded. Surgical procedures were categorized as minor, intermediate, or major/complex surgery according to the surgery grades defined by the National Institute for Health and Care Excellence (NICE). The primary outcomes were postoperative ketosis (urine ketone $\geq 1+$ or blood ketone ≥ 0.6 mmol/L) and ketoacidosis (urine ketone $\geq 2+$ or blood ketone ≥ 3 mmol/L with pH < 7.3) occurring within 7 days after surgery. Baseline characteristics were compared between patients with and without postoperative ketosis.

Results: Among 49,771 surgical cases, 786 patients had received SGLT2 inhibitors for at least 7 days prior to admission. After excluding patients with type 1 diabetes mellitus or preoperative ketosis, 778 patients were included in the final analysis. The mean age of the study population was 66 ± 11 years, and 64.7% were male. The mean body mass index was 26.4 ± 4.9 kg/m². The mean preoperative estimated glomerular filtration rate was 69 ± 31 mL/min/1.73 m², and chronic kidney disease was present in 36.1% of patients. Type 2 diabetes mellitus was present in 78.7% of patients and heart failure in 10.7%. Most procedures were classified as intermediate surgery (52.4%) or major/complex surgery (39.6%), while minor surgery accounted for 8.0% of cases. Postoperative ketosis occurred in 14 cases (1.80%), including 2 cases (0.26%) of ketoacidosis. The median onset time of ketosis was 1.05 days after surgery, with most cases occurring within the first 2 postoperative days (IQR 0.24–1.48; range 0.17–6.61 days). Patients who developed postoperative ketosis tended to have lower BMI and better baseline renal function.

Conclusion: In this real-world surgical cohort receiving SGLT2 inhibitors, postoperative ketosis occurred in 1.8% of patients, while ketoacidosis was rare (0.26%). Most postoperative ketosis developed within the first 48 hours after surgery. These findings reflect clinical practice prior to implementation of institutional perioperative SGLT2 inhibitor discontinuation guidance. Although the overall incidence of postoperative ketosis was low, the results highlight the importance of early postoperative metabolic monitoring in patients receiving SGLT2 inhibitors undergoing surgery. Institutional perioperative discontinuation guidance for SGLT2 inhibitors has since been implemented in accordance with international guidelines.

Economic analysis of IV phenylephrine prefilled syringe use in the OR, a tale of 2 hospitals

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Background: Phenylephrine syringes used as a vasopressor for the management of intraoperative hypotension are commonly prepared from vials either in central pharmacy or at the bedside in the operating room (OR). The latter increase drug wastage, contamination risk and adverse drug events (ADE). These could be mitigated by commercially available phenylephrine prefilled syringes (PFS), but their higher acquisition cost requires evaluation within institutional workflows. Objectives: To quantify phenylephrine syringe production and wastage in two adult teaching hospitals within the McGill University Health Centre, estimate the costs associated with in-house preparation, and evaluate the

economic impact of alternative preparation strategies, including PFS.

Method: A retrospective economic analysis was conducted at the Royal Victoria Hospital (RVH) and the Montreal General Hospital (MGH) in 2024-2025. Waste was defined as phenylephrine syringes remaining unused at the end of their assigned 9-day stability period. Syringe production and waste data were obtained from adult ICU pharmacy manual tracking records where syringes are prepared in batches and distributed across units and rotated according to stability to optimize use. Vial dispensing was obtained from the pharmacy software. Material acquisition costs were obtained through institutional procurement records. Pharmacy technician preparation time was estimated through structured interviews and labour costs were calculated using publicly available Canadian wage data. Physician wages for preparation time were excluded. Contamination, medication error, and ADE rates were extracted from previous studies. The most conservative estimates of rates or ranges were used for bedside OR preparations when applicable. Three scenario analyses compared bedside OR preparation with PFS use in the OR and centralized pharmacy compounding of syringes.

Results: At the RVH, 15,315 phenylephrine syringes were produced during the study period, of which 957 expired unused, corresponding to a 6.25% waste rate. Total phenylephrine vial consumption was 4,318 vials, with 978 vials (23%) used for bolus administration. At the MGH, 4,033 vials were used, with 3,407 vials (84%) attributed to bolus dosing, reflecting a decentralized preparation model. The waste rate of syringes was 5%. The estimated cost of pharmacy-compounded syringes was \$0.55 CAD per syringe, including materials and labour. The estimated cost in the OR was \$1.10 to \$10.15 depending on preparation methods. Conservative scenario analyses showed that pharmacy-based and OR-based preparations generated costs of \$2803.93 and \$8768.38 respectively depending on production volume. Replacing all syringes with commercially available PFS would eliminate drug waste but increase annual acquisition costs to \$64,733 at the MGH. Safety modeling suggested substantially higher costs associated with bedside preparation due to contamination and adverse drug events, with estimated annual ADE costs of \$373,090–\$975,615 compared with \$357,6418 with PFS use and \$293,767 with centralized pharmacy compounding.

Conclusion: Preparation workflows strongly influence both the economic and safety profiles of phenylephrine syringe use. Centralized pharmacy compounding with batch preparation and rotation across units minimizes waste and maintains low production costs in high-volume settings. Phenylephrine prefilled syringes compared to bedside preparations represent a safer cost-effective alternative despite higher acquisition costs.

Automated dispensing units in operating rooms: A pharmacy-led implementation science approach to medication safety in a Canadian community teaching hospital

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Background: Medication management in operating rooms presents unique patient safety and controlled substance risks due to time-critical decision-making, manual labelling practices, variable workflows, and limited real-time pharmacy oversight. These challenges contribute to medication errors, documentation gaps, and an increased risk of medication diversion. Automated anesthesia workstations (AWS)—a specialized form of automated dispensing units with integrated barcode labelling—have demonstrated potential to strengthen perioperative medication systems by improving traceability, standardization, and accountability. However, successful adoption depends on the local context, leadership, interprofessional engagement, technical infrastructure, and alignment with local clinical workflows. The PRISM (Practical, Robust Implementation and Sustainability Model) framework was used to inform our Implementation strategy to ensure a sustainable and successful roll-out of AWS in a large community teaching hospital.

Objective: To implement an anesthesia workstation model (Pyxis Anesthesia System with Codonics Safe Label System) across 26 operating rooms at Trillium Health Partners by evaluating local contextual and organizational determinants of adoption and sustainability. To inform Plan-Do-Study-Act (PDSA) cycles by analyzing early impacts on medication safety and anesthesia workflow.

Method: A multi-phase implementation science approach (guided by PRISM and Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) model) was conducted across three hospital sites performing over 65,000 surgeries annually. Phase 1 focused on pre-implementation assessment, including external site visits, structured workflow shadowing of anesthesia providers, baseline medication safety and efficiency metrics, and semi-structured stakeholder interviews mapped to PRISM domains. In parallel, thematic analysis of peer hospital AWS implementations across Ontario informed local system design, workflow alignment, and readiness planning.

Results: (Early Findings) Pre-implementation qualitative findings highlighted key enablers, including engaged clinical leadership, early and visible pharmacy involvement, and framing AWS as a medication safety intervention. Peer sites reported improved narcotic documentation, reduced discrepancies, and enhanced inventory control following

AWS implementation. Common challenges included EHR integration limitations, technical support requirements, resistance to barcode labelling steps, drawer configuration changes, and impacts on pharmacy staffing and consumable planning. These insights are informing pilot governance, workflow co-design, and engagement strategies. Future Phases Subsequent phases will include co-designed pilot deployment with targeted training and real-time usability observation, followed by staged rollout and iterative refinement. Long-term impact will be assessed using RE-AIM outcomes and the NHS Sustainability Model.

Conclusion: This pharmacy-led, implementation science-informed initiative demonstrates how automated anesthesia dispensing can enhance medication safety, traceability, and controlled substance stewardship in operating rooms, in alignment with the FIP Basel Statements on technology and labelling. The findings provide practical guidance on governance, interprofessional collaboration, and system design to support sustainable perioperative medication management in community teaching hospitals and beyond.

From implementation dip to enhanced safety: Managing dispensing errors after automated dispensing cabinet deployment at a tertiary medical center in Taiwan

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Background: Automated Dispensing Cabinets (ADCs) enhance medication safety. However, the transition period often brings cognitive load and workflow disruptions. This study evaluates the initial spike in dispensing errors after ADC implementation. It also examines targeted quality improvement (QI) interventions that restore and surpass baseline safety levels.

Method: A retrospective pre-post intervention analysis of "Wrong Drug" dispensing errors for inpatients was conducted at a Tertiary Medical Center in northern Taiwan from April 2025 to February 2026. ADCs with pick-to-light and barcode verification were implemented in September 2025. System-related omission errors, due to initial configuration faults, were excluded to focus on human-machine interaction outcomes. After an error surge in October, a multifaceted QI intervention was launched. This included: (1) staff re-training to counter "automation complacency;" (2) workflow standardization; and (3) a data-driven feedback loop using monthly error reports in departmental meetings, fostering a continuous safety culture.

Results: Pre-implementation (April-August 2025), "Wrong Drug" errors averaged 15.8 incidents/month. In October 2025 (the second month of implementation), errors peaked at 38 incidents—a 2.4-fold increase—reflecting the maximum workflow disruption and over-reliance on technology. Following the implementation of QI interventions, a rapid recovery was observed. By January and February 2026 (the fourth and fifth months), errors dropped significantly to 17 and 15 incidents respectively, achieving a nearly 60% reduction from the peak. This precise return to the pre-implementation baseline clearly demonstrates the sustainability of the QI interventions.

Conclusion: The implementation of ADCs inevitably introduces a critical "implementation dip." Our findings emphasize that securing medication safety requires a two-phase strategy. Pre-implementation proactive measures—such as preemptive training on automation complacency, workflow simulation, and rigorous system parameter verification—are essential to minimize initial risks. Furthermore, post-implementation data-driven feedback is crucial to rapidly correct residual errors. Together, this comprehensive approach effectively shortens the learning curve, proving that properly managed ADCs provide robust systemic safeguards that surpass the limitations of traditional manual dispensing, ultimately minimizing human errors and maximizing long-term patient safety.

Colistin monotherapy versus colistin-meropenem combination therapy in critically ill adult patients with carbapenem-resistant *Acinetobacter baumannii* infections: A retrospective cohort study from Palestine

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Background: *Acinetobacter baumannii* is a gram-negative pathogen characterized by multidrug resistance and high virulence. The global emergence of carbapenem-resistant *Acinetobacter baumannii* (CRAB) poses a significant public health threat, with associated increases in morbidity and mortality, particularly among critically ill patients. The high incidence of CRAB infections, particularly in the Middle East, highlights the need for effective treatment strategies. Colistin has reemerged as a last-resort treatment option but is limited by nephrotoxicity, neurotoxicity and documented treatment failures. Although current IDSA guidance supports combination therapy for CRAB infections, real-world clinical evidence from the Middle East, on whether colistin should be used as monotherapy or in combination with other agents in critically ill patients remains scarce. This study aimed to

compare the efficacy and safety of colistin monotherapy versus colistin-meropenem combination therapy in critically ill adult patients with microbiologically confirmed CRAB infections

Method: A retrospective cohort study was conducted across two medical intensive care units (ICUs) in the West Bank, Palestine, between January 2022 and March 2025. Adult patients aged 18 years or older, admitted to the ICU with microbiologically confirmed CRAB infection and treated with colistin for more than two days as a single course, were included. Patients with incomplete records or CRAB colonization without active infection were excluded. The patients were divided into two groups: colistin monotherapy and colistin-meropenem combination. Primary outcomes included 11-day infection-related mortality and microbiological response at day 6. Secondary outcomes included clinical recovery at day 6, relapse rate, nephrotoxicity assessed by RIFLE criteria and length of hospital stay. Statistical analysis was performed using IBM SPSS (version 28); comparisons between groups utilized chi-square and independent samples t-tests, with $p < 0.05$ considered significant. Given the retrospective design, analyses were unadjusted bivariate comparisons.

Results: One hundred and ninety-six cases of CRAB infections were recorded, of which 133 met the inclusion criteria. The two groups, colistin monotherapy ($n=61$) and colistin-meropenem combination ($n=72$), were comparable at baseline with respect to age, sex, and illness severity (median Acute Physiology and Chronic Health Evaluation II (APACHE II) score 43 in both groups). Treatment with combination therapy showed lower 11-day mortality rate (2.8% vs. 18.0%, $p = 0.003$), a stronger microbiological response (86.1% vs. 3.3%, $p < 0.001$), a superior clinical recovery by day 6 (80.6% vs. 1.6%, $p < 0.001$), a lower relapse rate (9.7% vs. 52.5%, $p < 0.001$), reduced severe nephrotoxicity (6.9% vs. 26.2%, $p = 0.008$), and shorter hospital stay (17.79 vs. 20.28 days, $p = 0.023$).

Conclusion: Colistin-meropenem combination therapy was associated with superior efficacy and safety outcomes compared to colistin monotherapy in critically ill adult patients with CRAB infections. These findings support the use of combination therapy as a preferred strategy in this high-risk population, pending validation through prospective multicenter trials.

Defining, evaluating and translating pharmaceutical care bundle delivery

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Background: Clinical pharmacists perform patient-centred activities to optimise medicines use and prevent patient harm. Historically, clinical pharmacy services have been measured using individual activity process measures which are not linked to patient outcomes. Aims - To define a consensus agreed pharmaceutical care bundle (PCB) and patient outcome measures. - To determine the proportion of patients who receive a complete PCB and to investigate the relationship with patient outcomes. - To develop a health-service wide PCB monitoring dashboard.

Method: A four round modified Delphi approach with Directors of Pharmacy across Queensland, Australia, was undertaken to define individual, bundled, and patient outcome measures to monitor clinical pharmacy service delivery. Routinely recorded data across 12 months from 10 Queensland Hospitals for four key medication-related activities was extracted from statewide systems and a data linkage study performed to investigate the associations between PCB delivery and length of stay (LOS), unplanned readmission, and mortality. The relationships were assessed using Chi-squared or Fisher's exact test and Spearman's rank correlations. Statistical significance was defined as $P < 0.05$.

Results: Consensus Consensus was reached on a single PCB consisting of seven clinical pharmacist activities: documentation of an accurate list of medicines (medication history) during admission, documentation of patient allergy/ADR information, medication reconciliation on admission, medication review, discharge medication reconciliation, provision of a medication list to the patient upon discharge and provision of medication counselling/education at discharge. Sixteen outcomes reached consensus including hospital acquired complications, readmission due to medication misadventure and unplanned readmission within 10 days. Data linkage In total 283,813 patient hospital stays were evaluated. The delivery of a PCB consisting of four activities (medication history, medication review, medicine list provision, medicines present on the discharge summary) occurred in 26.9% of patients (range 0.55% to 61.18%). Patients with a longer LOS were more likely

to receive delivery of the complete PCB ($P < 0.001$). There was no correlation between PCB and hospital standardised mortality ratio ($r = -0.03$, $p = 0.93$). Higher rates of delivery of the PCB were associated with lower rates of unplanned readmission within 30 days ($r = -0.993$, $p < 0.001$). Translation A health service wide dashboard which monitors a four-activity PCB has been developed to support monitoring, evaluation and service improvement. It utilises routinely recorded data from multiple enterprise systems.

Conclusion: A consensus agreed PCB and patient outcome measures have been defined. Higher rates of PCB delivery were associated with a significantly lower rate of unplanned readmission within 30 days. A PCB monitoring dashboard has been developed. There is an opportunity to further evaluate the impact of clinical pharmacy services through broadening the PCB to include emerging activities such as collaborative pharmacist prescribing as well as including patient and medication-related factors to ensure service delivery is being targeted at patients at the highest risk of medication misadventure. There is opportunity to broaden the health service wide dashboard to statewide, national and international reporting, resulting in standardised monitoring and benchmarking, as well as an enabler to rapidly evaluate outcomes into the future.

Develop the first China specific standardized antimicrobial administration ratio (SAAR) model for optimizing evaluation of antimicrobial stewardship in Shanghai

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Background: Antibiotics use density (AUD) is a key indicator for optimal antimicrobial use in healthcare institutions, playing a critical role in antimicrobial stewardship (AMS) management. However, AUD is influenced by hospital type, department structure, and patient complexity, making cross-hospital comparisons ineffective. CDC's proposed SAAR serves as a benchmark to evaluate antimicrobial use in hospitals, calculated by dividing actual AUD by predicted AUD. A SAAR > 1 indicates antimicrobial overuse.

Method: Data from 2019 to 2024 were collected on factors influencing AUD, including healthcare institution type, discharged patient numbers, average length of stay (LOS), surgical volume, Class I incision surgeries, antimicrobial use for Class I prophylaxis, and CMI etc. A multiple linear regression model identified key factors influencing AUD, and a China-specific SAAR model was developed and validated at the institutional level.

Results: Data from 15 healthcare institutions were included: 11 comprehensive healthcare institutions and 13 teaching hospitals. After adjusting the model, R^2 for healthcare institution level was 0.5729. AUD was significantly correlated with teaching hospital status, total bed capacity, CMI, number of discharged patients, average LOS, and total number of hospitalized patients using antimicrobials ($P < 0.05$). Three hospitals had SAAR > 1 , indicating potential antimicrobial overuse and a need for focused monitoring.

Conclusion: This Shanghai(China) specific SAAR model was successfully established, enabling medical institutions to compare actual antimicrobial use with predicted values. If SAAR > 1 , early warning management can be triggered, providing a benchmarking tool to promote rational antimicrobial use in healthcare institutions.

A real-time AI-based image recognition system for medication identification in the emergency pharmacy of Southern Taiwan regional hospital

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Background: Artificial Intelligence (AI) has rapidly progressed in recent years due to breakthroughs in deep learning. In addition to its applications in general technology fields, AI has been widely adopted in healthcare, assisting in disease diagnosis, drug development, and long-term patient care. In pharmacy practice, AI can also effectively support prescription review, such as detecting potential drug–drug interactions and patient allergies. However, reports from the World Health Organization continue to show that medication errors account for a significant proportion of healthcare-related incidents. Traditional verification methods rely primarily on manual review, which is prone to human error. This challenge is particularly critical in emergency pharmacy settings, where accuracy is essential and even minor errors may result in significant clinical consequences. With the increasing maturity of AI-based image recognition technology, it has the potential to assist emergency pharmacists in reducing dispensing errors.

Objective: This study aims to develop and evaluate a real-time AI-based image recognition system for verifying medication accuracy in an emergency pharmacy.

Method: Approximately 150 commonly used medications in the emergency pharmacy were first included in this project. Images of each medication were collected under various conditions, including different angles, lighting environments, and orientations (front and back), resulting in a dataset of approximately 3,000 images. All images were manually annotated using Roboflow, followed by data augmentation to expand the dataset to approximately 6,000 training images. A YOLOv26 (You Only Look Once) model was then trained for real-time medication identification. The trained model was subsequently integrated into a self-developed application. Besides the function of medication recognition, the system includes several other functions: (1) automatic image capture and documentation after correct or incorrect identification for future tracking; (2) logging of recognition results, including the total number of medications per prescription, the number of correctly identified, incorrectly identified, and unrecognized items, enabling calculation of real-world accuracy and usage rates; and (3) bilingual audio alerts that provide immediate feedback upon correct or incorrect identification.

Results: The trained model achieved mean average precision (mAP@50) of 0.99 and mAP@50–95 of 0.94, showing high accuracy in detecting and classifying both injectable and oral medications. The system maintained a real-time processing latency of approximately 75 ± 15 ms per frame on a cpu only workstation, ensuring a seamless, near instantaneous verification experience for pharmacists. During simulation-based testing, the system effectively captured and stored images while generating detailed recognition logs. In addition, bilingual audio alerts were successfully triggered under corresponding conditions of correct and incorrect identification. The system was further evaluated in a simulated dispensing workflow, demonstrating high identification accuracy and potential to reduce medication errors.

Conclusion: The real-time AI-based medication recognition system provides an effective approach to enhancing medication safety in the emergency pharmacy. Furthermore, the system can be easily deployed on any computer with a webcam, enabling flexible implementation in various clinical settings. Future research will evaluate the long-term impact on clinical outcome and expand the library to include a wider range of high-alert medications.

A comparison of cancer treatment protocols in Australia, Canada, and the United Kingdom

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Background: National cancer treatment protocols guide drug selection, dosing, and access to care. While Australia, Canada, and the United Kingdom (UK) have similar socialised healthcare systems, the extent to which their treatment protocols align remains unclear. This study compared protocols across these countries, examining drug selection, distribution by cancer type, and dosing.

Method: A cross-sectional analysis was conducted of in-use protocols as of January 2025 from eviQ (Australia), Cancer Care Ontario (Canada), and the Clatterbridge Cancer Centre (UK). Protocols were reviewed to identify and compare chemotherapy drugs, their cancer indications, and recommended doses.

Results: Among 243 chemotherapy drugs across 2,450 protocols, 51% (123/243) were used in all three countries and 72% (175/243) appeared in at least two. Overlap was greatest for commonly used cytotoxic agents in high-incidence cancers. Dosing practices varied: Canadian protocols often recommended higher median doses, UK protocols used narrower minimum dose ranges, and Australian protocols demonstrated wider minimum–maximum dose ranges across several drugs.

Conclusion: Despite comparable access to internationally available therapies, treatment approaches vary across Australia, Canada, and the UK. As countries that frequently participate in multinational clinical trials and operate within similar evidence-based guideline and appraisal systems, these differences highlight opportunities for greater alignment. Cross-country comparisons may support collaborative efforts in protocol development and data sharing to standardise care, particularly for rare and emerging therapies targeting smaller patient populations.

Determinants of chemotherapy dose reduction in a tertiary hospital cohort: a retrospective analysis

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Background: Chemotherapy dose modification is a common clinical strategy to manage toxicity; however, factors influencing dose reduction across patient and treatment characteristics remain incompletely understood. This study aimed to identify predictors of chemotherapy dose reduction using both traditional statistical modelling and machine learning approaches.

Method: A retrospective dataset of chemotherapy treatment protocols was analysed. Dose variation (%) was used to define a binary outcome indicating dose reduction (<0%) versus no reduction (≥0%). Multivariable logistic regression was performed to estimate associations between patient factors (age, sex, body surface area [BSA]) and treatment characteristics (drug group, cancer type) with the likelihood of dose reduction. A random forest classification model was additionally implemented to assess predictive performance and variable importance. Analyses were conducted on complete-case data.

Results: Among 8,995 evaluable observations, dose reduction occurred in 65% of cases. Logistic regression demonstrated that increasing age was associated with a higher likelihood of dose reduction (approximately 1% increase in odds per year), while male sex was associated with reduced odds compared to females. Drug group and cancer type were strong predictors: mitotic inhibitors and certain cancer types (e.g. neurological, upper gastrointestinal) were associated with increased likelihood of dose reduction, whereas monoclonal antibodies and haematological malignancies (e.g. leukaemias) were associated with decreased likelihood. BSA was not a significant predictor in the regression model. The random forest model achieved an out-of-bag error rate of 11.9% (≈88% accuracy). Variable importance analysis identified BSA and age as the most influential predictors, followed by cancer type and drug group, suggesting potential nonlinear or interaction effects not captured by the regression model.

Conclusion: Chemotherapy dose reduction is influenced by a combination of patient demographics, treatment class, and

cancer type. While logistic regression identified clinically interpretable associations, machine learning revealed additional predictive importance of BSA, highlighting potential non-linear relationships. These findings support the use of complementary modelling approaches to better understand and predict dose modification patterns in oncology practice.

Perceived barriers, facilitators, and needs to the current use of an EMR system among pharmacists in a tertiary hospital: A qualitative study

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Background: The Computerized Registry on Admissions and Discharges (RADISH) is an electronic medical record (EMR) system implemented in the University of the Philippines-Philippine General Hospital (UP-PGH), a tertiary hospital in the Philippines, since 2020. Its aim is to streamline medical records in the provision of patient care. Pharmacists in both clinical and dispensing roles are important users of this system. However, it is not clear if the functions of clinical and dispensing pharmacists are sufficiently integrated into RADISH. This study aimed to describe how clinical and dispensing pharmacists use RADISH, identify their perceived barriers, facilitators, and needs related to their use, and to formulate potential interventions in order to address emergent needs.

Method: Twenty (20) pharmacists performing either clinical or dispensing roles were selected through purposive sampling from the twelve (12) satellite pharmacy areas of the Philippine General Hospital. Pharmacists with at least one (1) year of experience using the EMR were invited. A semi-structured interview format was used to elicit current uses of the EMR along with barriers and facilitators. The resulting narratives were thematically analyzed through the Capability, Opportunity, Motivation-Behavior (COM-B) and Theoretical Domains Framework (TDF).

Results: Clinical and dispensing pharmacists use the EMR differently. Common uses among clinical pharmacists include reading patient charts and making chart entries, while dispensing pharmacists primarily use the charts to view medication approvals. Both clinical and dispensing pharmacists cited lack of resources as a barrier to EMR use, particularly due to poor internet connectivity. For facilitators, fulfillment of social/professional role was the most frequently mentioned theme among clinical pharmacists, both in terms

of allowing interprofessional collaboration, and the EMR being an avenue for pharmacist interventions. Among possible interventions are 1) to provide features that pharmacists request, such as automatic saving of drafts, interface for transition of medicines, tagging features for emergency cases, etc.; 2) capacity building through training; 3) interprofessional support, such as by incorporating telepharmacy counseling referral through RADISH in the medicine clinics' procedure; 4) infrastructure and resource improvements; and 5) information dissemination.

Conclusion: This study employed the use of thematic analysis using COM-B and TDF to thematically analyze barriers and facilitators to EMR use among pharmacists in the Philippines. The EMR system is essential to the role of clinical and dispensing pharmacists. They interact with the system in different ways, and have unique sets of facilitators, barriers, and needs. The implementation and ongoing development of the EMR should take into account pharmacist perspectives not only to address barriers, but also to support the profession towards the shared goal of complete and quality patient care.

Antibiotic utilisation, antimicrobial stewardship opportunities, and economic burden among patients hospitalised with community-acquired pneumonia in Nepal

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Background: Community-acquired pneumonia (CAP) remains a leading cause of hospitalisation worldwide, particularly among older adults. Optimising antibiotic use and ensuring cost-effective management are critical to improving clinical outcomes and reducing healthcare burden. This study aimed to assess antibiotic utilisation patterns and direct treatment costs among patients hospitalised with CAP.

Method: A prospective observational study was conducted from March to June 2024 at Dhulikhel Hospital, Nepal, including 64 adult patients (≥ 18 years) hospitalised with CAP. Data on demographics, clinical characteristics, microbiological findings, antibiotic utilisation, treatment outcomes, and costs were collected using a structured proforma. Pneumonia severity was assessed using the CURB-65 score. Categorical variables were analysed using the Chi-square test, and risk estimates were expressed as odds ratios (ORs) derived from binary logistic regression. Statistical significance was defined as $P < 0.05$ with 95% confidence intervals.

Results: The prevalence of CAP among the admitted patients during the study period was 10.30%. Median age of patients was 71 years (IQR 60–79), with 64.1% aged ≥ 65 years and 62.5% female. Smoking and alcohol consumption were common, while pneumococcal (1.6%) and influenza (0%) vaccination coverage was extremely low. Based on CURB-65 scores, 81.2% of patients had moderate CAP, 14.1% had low-severity disease, and 4.7% had severe disease. Sputum culture results showed normal respiratory flora in 68.7% of cases, positive growth in 17.2%, and were not performed in 14.1%. Streptococcal pneumoniae was the most frequently isolated pathogen, followed by Klebsiella pneumoniae and methicillin-resistant Staphylococcus aureus (MRSA). Streptococcus pneumoniae isolates were highly sensitive to amoxicillin, ceftriaxone, and penicillin G, but resistant to azithromycin and erythromycin. Klebsiella pneumoniae and MRSA exhibited multidrug resistance. Combination therapy (cephalosporin plus macrolide or fluoroquinolone) was the most frequently prescribed regimen, used in 70.3% of cases. The median duration of antibiotic therapy was 10 days (IQR 7–12) during hospitalisation and 6 days (IQR 5–7.75) following discharge. Age was a significant predictor of moderate to severe CAP (OR 1.072; 95% CI: 1.024–1.122; $p = 0.003$). Quality indicators revealed low rates of pre-antibiotic culture collection (32.8%), pathogen-directed therapy adjustment (17.2%), de-escalation (6.3%), and intravenous to oral transition (15.6%). The 30-day readmission rate was 7.8%. The median direct medical cost was USD 140.47 (IQR 98.20–189.84), accounting for 88% of total costs, with antibiotics representing the largest share.

Conclusion: CAP in hospitalised adults in Nepal imposes a substantial clinical and economic burden. Frequent use of broad-spectrum and combination antibiotics, prolonged therapy, low vaccination coverage, and limited adherence to stewardship practices highlight critical areas for intervention. Strengthening antimicrobial stewardship programs and implementing cost-effective management strategies are essential to improve clinical outcomes and reduce healthcare costs.

Medication adherence and health-related quality of life in COPD patients: An SGRQ-based analysis

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Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder associated with substantial impairment in health-related quality of life

(HRQoL). Medication adherence plays a critical role in disease management; however, its impact on disease-specific HRQoL remains insufficiently characterised. This study aimed to evaluate the association between medication adherence levels and HRQoL using the St George's Respiratory Questionnaire (SGRQ) in patients with COPD.

Method: A cross-sectional study was conducted between 1 July and 31 December 2024 at a regional hospital, enrolling outpatients diagnosed with chronic obstructive pulmonary disease (COPD; ICD-10-CM: J44). Medication adherence was assessed using the Adherence to Refills and Medications Scale (ARMS), a validated self-reported instrument. Participants were categorized into high- and low-adherence groups using a cut-off score of 16. Health-related quality of life (HRQoL) was evaluated using the St George's Respiratory Questionnaire (SGRQ), including total and domain scores. Comparative analyses were conducted to assess differences in HRQoL between adherence groups.

Results: A total of 152 patients with COPD were included in the analysis, with a mean age of 71.0 ± 10.6 years, and the majority were male (86.8%). When comparing disease-specific health-related quality of life between adherence groups, no statistically significant differences were observed in the SGRQ total score between patients with high and low medication adherence (29.48 ± 21.61 vs. 32.42 ± 22.66 , $p = 0.42$). Similarly, no significant differences were identified across the SGRQ domains, including symptoms (26.45 ± 20.27 vs. 29.97 ± 20.14 , $p = 0.29$), activity (44.56 ± 32.70 vs. 47.44 ± 31.81 , $p = 0.58$), and impact (21.69 ± 19.53 vs. 24.48 ± 21.68 , $p = 0.41$).

Conclusion: Medication adherence, when categorized into binary groups, was not significantly associated with disease-specific health-related quality of life as measured by the SGRQ in patients with COPD. These findings suggest that simple dichotomization of adherence may not adequately reflect its relationship with patient-reported outcomes. Nevertheless, maintaining optimal medication adherence remains a key component of COPD management according to current clinical guidelines, and should continue to be promoted in routine practice. Further research using more comprehensive and continuous measures of adherence is warranted to better elucidate the relationship between adherence and quality of life.

Bridging science, practice, and education: AI-supported multilingual inhaler education by pharmacists to advance health equity

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Background: In Taiwan, patients with asthma and COPD—especially those cared for by foreign caregivers, along with migrant workers and new residents—often struggle with correct inhaler use due to language barriers and limited health literacy, which may adversely affect disease management. Lack of multilingual pharmacist support may lead to inequities in pharmaceutical care, affecting treatment outcomes and patient safety. This study addresses this gap by implementing AI-supported multilingual inhaler education to enhance health equity.

Method: To optimize the inhaler medication education workflow delivered by Postgraduate Year (PGY) pharmacists, a Quality Control Circle (QCC) was established. Quality improvement strategies included topic selection, current state assessment, root cause analysis, intervention planning and implementation, outcome evaluation, and standardization. A cause-and-effect (fishbone) diagram identified language barriers as a primary factor limiting education quality. Continuous improvement was implemented using the Plan–Do–Check–Act (PDCA) cycle, with particular attention to addressing multitasking and limited staffing during evening shifts, thereby enhancing workflow efficiency, care quality, and team cohesion. An AI-assisted translation system was introduced to support multilingual patient education. Printed inhaler educational materials (e.g., Relvar Ellipta) were developed in seven languages (English, Japanese, Korean, Indonesian, Filipino, Vietnamese, and Thai) with Chinese references, complemented by QR-coded digital instructional videos. Patient comprehension of correct inhaler technique was assessed in real time using a standardized medication-use evaluation form. Standardized teaching workflows, hands-on device demonstrations, and a bilingual pharmacist collaboration model were implemented to improve understanding among patients, caregivers, and international patients. Targeted training for PGY pharmacists ensured consistent and standardized medication education even during high-workload night shifts.

Results: A cognitive accuracy assessment for Relvar Ellipta was conducted among 30 participants. The results demonstrated a significant improvement in mean scores, rising from 60.33 ± 8.09 before the intervention to 92.00 ± 7.14 after the intervention. Paired t-test analysis yielded a p-value < 0.001 , indicating that the standardized medication

education model effectively enhanced learning outcomes. Furthermore, the reduction in standard deviation (from 8.09 to 7.14) reflects the achievement of providing consistent and standardized education. Following the intervention, the average maintenance rate remained high at 88.7. First-time users' knowledge scores improved from 41 to 96 points. Education time decreased from 22 to 5 minutes, improving efficiency by over 70%. Video of Relvar Ellipta usage reached 7,027 views, and pharmacist documentation became complete. Patient satisfaction reached 94%. Notably, foreign patients, migrant workers, and new residents who comprehended the education not only improved self-care but also demonstrated enhanced work performance, particularly when caring for employers requiring inhaler therapy.

Conclusion: AI-supported multilingual inhaler education effectively integrates scientific knowledge, clinical practice, and patient education. This approach helps overcome language barriers, reduce health disparities, and improve inhaler technique among diverse patient populations. By empowering patients in self-management and supporting healthcare providers in delivering culturally responsive care, this model represents a scalable, patient-centered strategy to promote equitable pharmaceutical care in multicultural healthcare settings.

Stability evaluation of an extemporaneously prepared captopril oral solution (2mg/ml)

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Background: The stability of pharmaceutical products can be described as the ability of pharmaceutical formulation to remain within its physical, chemical, microbiological and therapeutic specifications. Aim: Design a captopril solution for oral use that has greater stability than the official formulation.

Method: Preparation of formulations: The study included captopril oral solutions prepared from commercially available tablets and pure substance. Storage conditions: All formulations were stored in a refrigerator and in an incubator. Analytical methods: Organoleptic tests include visual examination of the solution with purified water as a control sample. Measurement of the pH value was performed separately. The spectrophotometric method was used to determine the content of captopril. Statistical analysis: Statistical comparison was performed by ANOVA to determine a significant difference between 2 groups or more groups.

Results: Changes in the pH value of captopril solutions, made from tablets and from pure captopril substance (solvent purified water + vit.C), room temperature storage, are accompanied by changes in the appearance and smell. Determination of the captopril content in solutions indicates a constant decrease at room temperature. The results of determining the captopril content in solutions stored in the refrigerator show that the content does not have a sudden quantitative drop in relation to the initial concentrations, for all three samples.

Conclusion: Based on the overall results of the research, it can be determined that the product is more stable if 0.1% Na2-EDTA solution is used instead of vit. C in the preparation and if the solution is buffered to pH 3.3.

Reducing system errors in traditional Chinese medicine dispensing processes

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Background: Traditional Chinese Medicine powders often have similar colours and appearances, requiring a high level of real-time accuracy during dispensing. Errors cannot be effectively corrected through retrospective review. With the progressive upgrading of hospital information systems, the existing dispensing system in our Traditional Chinese Medicine pharmacy is no longer sufficient to meet current operational demands. This not only affects workflow efficiency but also increases the risk of human error. Therefore, comprehensive improvements at both the system and process levels are urgently needed to reduce dispensing errors and enhance patient medication safety.

Method: A quality improvement project was conducted using Healthcare Failure Mode and Effects Analysis (HFMEA). The dispensing process was mapped into four major processes, 14 sub-processes, and 33 detailed steps. A total of 47 potential failure modes and 69 possible causes were identified and analysed using risk scoring and decision tree analysis. Based on team discussions, three main areas for improvement were defined: system optimisation, process standardisation and information traceability, and enhancement of medication guidance for foreign patients. Interventions included upgrading the dispensing system, implementing barcode verification, establishing a medication opening date management system, introducing a refill checking system, and providing multilingual audio instructions.

Results: Following implementation, the system error rate decreased from 6.8% to 2.0%. The total risk score for 12 key

failure modes was reduced from 106 to 35. Improvements were observed across multiple domains. For patients, medication accuracy was improved. For staff, workflow efficiency was enhanced, with an estimated annual reduction of 479.1 hours in error handling and troubleshooting, and 295.2 hours saved in expiry date management. For the institution, annual savings of approximately TWD 26,808 in consumables and labelling costs were achieved.

Conclusion: This study demonstrates that integrating HFMEA-based risk management with system optimisation and process standardisation can effectively reduce system errors in Traditional Chinese Medicine dispensing. The interventions not only improved operational safety but also enhanced workflow efficiency and resource utilisation. While this study reflects the experience of a single institution, the findings suggest that similar approaches may be applicable in other healthcare settings. Further studies are warranted to validate the generalisability of these interventions and to continue refining system design and training strategies for sustained quality improvement.

A 10-year evaluation of a single-institution therapeutic duplication search system: Focusing on bisphosphonate prescription cases at the veterans' health service medical center

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Background: Bisphosphonates are gold-standard treatments for osteoporosis, especially among the elderly population—the primary patient demographic at the Veterans Health Service (VHS) Medical Center. However, long-term use is associated with severe adverse events, such as Medication-Related Osteonecrosis of the Jaw (MRONJ) and Atypical Femoral Fractures (AFF). Duplicate prescriptions of therapeutic equivalents can further exacerbate these risks. To address this, the VHS Medical Center integrated a "Therapeutic Equivalent Search and Alert System" into its Electronic Medical Record (EMR) in 2014. This study evaluates the 10-year impact of this system on bisphosphonate prescription trends, patient safety, and the incidence of adverse effects.

Method: This retrospective cohort study analyzed data from patients aged 60 and older who were prescribed bisphosphonates between April 2008 and December 2023. The EMR-based system provides visual alerts (icons) to medical staff when duplicate therapies or long-term prescriptions (exceeding 5 years) are detected. We analyzed the trends in long-term prescription ratios and compared the annual incidence of AFF in the Department of Orthopedic Surgery before and after the system's implementation.

Results: Following the implementation of the monitoring system, the number of patients receiving continuous bisphosphonate prescriptions for over five years showed a significant downward trend. Specifically, when categorized by the year of initial prescription, the number of long-term users decreased from 506 in 2008 to 17 in 2019. Furthermore, the incidence of atypical femoral fractures (AFF) consistently declined following the introduction of the system, and duplicate prescriptions across different departments were effectively minimized through enhanced cross-departmental monitoring.

Conclusion: The integration of a therapeutic equivalent search tool within the EMR system successfully improved the monitoring of bisphosphonate use in elderly patients. By preventing duplicate prescriptions and managing long-term usage, the system proved to be an effective clinical decision-support tool for reducing drug-related complications. This model can serve as a standard for managing other therapeutic classes requiring long-term monitoring, ultimately contributing to personalized and safer pharmacological care.

Optimizing first-line treatment strategies for advanced hepatocellular carcinoma stratified by viral etiology: A network meta-analysis

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Background: The therapeutic landscape for advanced hepatocellular carcinoma (aHCC) has transitioned from tyrosine kinase inhibitor monotherapy to diverse combinations involving immune checkpoint inhibitors (ICIs) and anti-angiogenic agents. However, the impact of underlying etiology—specifically Hepatitis B virus (HBV), Hepatitis C virus (HCV), and non-viral factors—on the relative efficacy of these front-line regimens remains a critical clinical question for personalized treatment selection.

Objective: To compare the relative efficacy of current first-line systemic therapies for aHCC across different etiologic subgroups using network meta-analysis and to identify the

optimal treatment strategies for HBV, HCV, and non-viral populations.

Method: A systematic review and network meta-analysis (NMA) was conducted by searching PubMed, Embase, and the Cochrane Library for randomized controlled trials. The research was structured using the PICO framework: (P) patients with advanced HCC; (I/C) various first-line systemic therapies; and (O) overall survival (OS) as the primary outcome. For data extraction, studies were eligible for inclusion only if they provided subgroup analysis data for overall survival based on viral etiology (HBV-related, HCV-related, and non-viral infection). The quality of the included studies was assessed using the Cochrane Risk of Bias 2.0 (RoB 2.0) tool. Statistical analyses and network modeling were performed using the ShinyNMA web application. Treatment efficacy was ranked using P-scores, and Hazard Ratios (HR) with 95% confidence intervals (CI) were calculated using a random-effects model.

Results: A total of 20 phase 2 or 3 RCTs involving 21 treatment regimens were identified and included in this analysis. The NMA revealed significant variations in treatment performance based on etiology: •HBV-related aHCC: Combination therapies demonstrated superior efficacy. SCT-110A plus SCT510 achieved the highest ranking (P-score: 0.91; HR: 0.54, 95% CI: 0.39–0.74), followed by Sintilimab plus IBI305 (P-score: 0.86; HR: 0.58, 95% CI: 0.44–0.77) and Atezolizumab plus Bevacizumab (P-score: 0.85; HR: 0.58, 95% CI: 0.40–0.84). •HCV-related aHCC: Camrelizumab plus Rivoceranib ranked first (P-score: 0.93; HR: 0.37, 95% CI: 0.16–0.85), followed by Atezolizumab plus Bevacizumab (P-score: 0.92; HR: 0.43, 95% CI: 0.25–0.73). •Non-viral aHCC: While rankings were less pronounced, the STRIDE regimen (Tremelimumab plus Durvalumab) showed a statistically significant benefit over Sorafenib (P-score: 0.78; HR: 0.75, 95% CI: 0.59–0.96).

Conclusion: Survival benefits in aHCC are highly etiology-dependent. HBV and HCV-related aHCC show robust responses to ICI plus anti-VEGF combinations. In contrast, for non-viral populations, pure ICI-based combinations, such as the STRIDE regimen, provide more statistically stable advantages. These findings suggest that baseline viral etiology should be a primary consideration in the clinical selection of first-line aHCC therapy.

Strategies to minimise errors in the administration of compounded solutions for external use in a hospital pharmacy compounding unit

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Background: Solutions are among the most commonly used liquid pharmaceutical dosage forms in clinical practice. Their versatility enables multiple routes of administration, including oral, topical, and parenteral. However, these preparations may appear visually similar - particularly when compounded - where limitations in primary packaging options can further increase the potential risk of medication errors. Unsafe practices and medication errors remain among the leading causes of preventable harm within healthcare systems worldwide. Given the significant proportion of external use solutions prepared in Hospital Pharmacy Compounding Units, combined with several internal reports of administration errors, the implementation of preventive measures has become imperative (the aim of this study).

Method: An exploratory literature search was performed using international databases and documents issued by recognised professional organisations. Publications relevant to hospital pharmacy practice were identified, analysed, and cross referenced with internal incident reports. This process aimed to identify and prioritise the best practices with the greatest potential impact, ensuring their integration into our internal procedures.

Results: Having identified several strategies to mitigate medication errors across different stages of the medication use process, as following detailed: 1. Introduction of barriers and visual alerts: use of dedicated oral syringes adapters; red cap and/or sealing ring to identify solutions for external use; legible label in indelible material with 'for External Use' in red lettering or with a red background and a 'Do Not Swallow' pictogram; use of Tall Man lettering to distinguish Look-Alike, Sound-Alike (LASA) medicines. 2. Centralisation of higher-risk processes: allocation to the electronic dispensing system "Pyxis", ensuring accurate matching between patient and prescribed medicine. 3. Implementation of supportive technology: configuration of automatic alerts within clinical software applications; use of barcode assisted medication administration (BCMA) systems to compare patient and medicine information (labelling) with the electronic prescription. 4. Adoption of double-checking protocols with standardised communication: ensuring that the right medicine is administered to the right patient, at the right dose, by the right route, and at the right time, supported by dated and signed "5 Rights" records to ensure traceability and quality control. Continuous training and improved health literacy are essential to enhance competencies in medicine

use and prevent administration errors at home. Standardised pharmacy counselling—using clear language, visual aids, and route confirmation—supports correct differentiation and safe self-administration. Tailored written information further reinforces appropriate use and reduces preventable errors.

Conclusion: Medication errors should be regarded as opportunities for improvement through the adoption of preventive structural and procedural measures. This approach requires organisational and behavioural changes and must be supported by a non punitive culture focused on continuous improvement. Although the effectiveness of those strategies is well established in the literature and supported by robust evidence, further studies are warranted to evaluate their impact in our organisation. As central actors within the medication use process, pharmacists have the responsibility and expertise to lead dynamic roles in preventing medication related problems, ensuring safer practices and promoting meaningful progress across the entire system. Proactive and multidisciplinary planning, implementation, and monitoring are key elements for the safe use of medicines.

Effectiveness of interactive interdisciplinary teaching in enhancing holistic care: A multi-center analysis of hospital pharmacists in Central Taiwan

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Background: Interprofessional Practice (IPP) and education (IPE) are cornerstone strategies for enhancing patient safety and care quality within modern healthcare systems. For hospital pharmacists, the transition from theoretical academic knowledge to active clinical collaboration requires structured pedagogical support and institutional guidance. This study evaluates the impact of interactive interdisciplinary teaching meetings in cultivating a comprehensive 'holistic care' spirit—addressing the interconnected physiological, psychological, social, and spiritual needs of patients—while simultaneously bridging the professional competency gap for new pharmacy practitioners in a complex clinical setting.

Method: This research utilised a retrospective analysis of survey data collected between 2024 and 2025 from 245 participants at a medical centre in Central Taiwan. The participant pool comprised pharmacy trainees, clinical instructors, and members of various interdisciplinary teams. The evaluation instrument was a 9-indicator questionnaire focused on holistic care concepts, IPP/IPE awareness, and communication efficiency. Performance was systematically analysed across various clinical specialties, including general

wards, emergency, critical care, pediatrics, specialty medicine, and home care, . The questionnaire using a 5-point Likert scale (5-point Likert scale, 5 points for strongly agreeing and 1 point for strongly disagreeing), with descriptive statistics performed using Excel® 2021 to manage the data effectively.

Results: The analysis demonstrated exceptionally high overall satisfaction, particularly regarding learner engagement and pedagogical relevance. Notably, 99% of student participants felt that the case content facilitated effective and meaningful discussion, while 97% reported a significantly deeper understanding of the IPP model. In terms of holistic spirit, the Home Care team recorded a 98% satisfaction rate in aligning discussions with the psychosocial expectations of patients and families. A significant 'mentoring effect' was also identified: clinical instructors who actively directed trainees reported higher satisfaction with meeting implementation (96%) compared to those who did not supervise students (88%). Conversely, the data revealed a performance gap in high-risk environments such as emergency, critical care, and pediatric teams, where satisfaction regarding the 'bio-psycho-social-spiritual needs' of patients dropped to 81–85%, suggesting a need for more nuanced training in these areas.

Conclusion: This study confirms that interactive interdisciplinary team teaching sessions are highly effective at integrating holistic care principles into pharmaceutical practice. For complex and high-pressure environments like emergency and critical care, targeted PDCA (Plan-Do-Check-Act) cycles are essential to strengthen the practical application of holistic care. Furthermore, the data validates the philosophy of 'teaching and learning from each other'; actively guiding trainees to participate in these sessions not only assists them in grasping the importance of interdisciplinary collaboration but also significantly enhances the professional enthusiasm and job satisfaction of clinical teachers. Future educational strategies should leverage these positive interactive dynamics to ensure a comprehensive, patient-centred approach throughout the hospital.

Potential and clinically manifested drug interactions in hospitalized patients undergoing chemotherapy

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Background: Drug interactions represent a significant concern in oncology, where polypharmacy is highly prevalent. These interactions may reduce therapeutic efficacy and increase the risk of adverse drug reactions, thereby compromising patient safety. The present study aimed to determine the prevalence and characteristics of both potential and clinically manifested drug interactions in hospitalised patients receiving chemotherapy.

Method: A prospective descriptive study was conducted over an eight-week period (6 May to 28 June 2025) in a tertiary care hospital. Prescriptions of patients undergoing chemotherapy were systematically reviewed. Potential drug interactions (DIs) were identified using three recognised databases (Vidal, Medscape, and Drugs.com) and were defined as interactions detected by at least one database with moderate or higher severity. Clinically manifested DIs were defined as interactions associated with a clinically confirmed adverse event. Data were analysed to determine the frequency, severity, and type of interactions.

Results: A total of 107 prescriptions were analysed. The mean age of patients was 54 ± 20.63 years (range: 19–84 years). The study population consisted of 22 men (69%) and 10 women (31%). Methotrexate and daunorubicin were the anticancer agents most frequently involved in contraindicated combinations. The drugs most commonly implicated in interactions included furosemide, methylprednisolone, enoxaparin, teicoplanin, and co-trimoxazole. Potential drug interactions were identified in 29.9% of patients and were predominantly pharmacodynamic in nature. Clinically manifested interactions were observed in 6% of patients (95% confidence interval: 5–8%), with gastrointestinal bleeding being the most frequently reported adverse event.

Conclusion: Potential drug interactions are common among hospitalised patients receiving chemotherapy, whereas clinically manifested interactions remain less frequent. The relatively high prevalence observed in this study highlights the growing importance of this issue in oncology practice. These findings underline the need for targeted prevention strategies, including systematic medication review and multidisciplinary collaboration, in order to improve patient safety and optimise therapeutic outcomes.

Ensuring patient needs are central in the development of methods for accessing hospital supplied medicines

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Background: Patients in lifelong outpatient treatment often receive their medication directly from the hospital to ensure close monitoring of therapy. Traditionally, this has required regular visits to the outpatient clinic. With increasing focus in the healthcare system on meeting patients' needs and developing digital solutions, new models for hospital-based medication dispensing have been introduced, including offering patients the option to collect pre-packed hospital medicines from automated medication pickup lockers or from private community pharmacies. This development of a pharmaceutical service aligns with the political objective of a more accessible, patient centred, and integrated healthcare system. The aim is to develop and implement flexible models that offer patients different options for the collection of hospital supplied medicines, based on their needs and preferences, while reducing structural barriers within the healthcare system.

Method: Over a five year period, new methods for medication collection have been continuously tested, refined, and implemented. Initially, automated medication pickup lockers located at the hospital were introduced as alternative collection points. The model was then expanded to allow patients to collect their medicine from any medication pickup locker in the region, regardless of the outpatient clinic they are attached to. Subsequently, solutions were developed that allow patients to collect pre packed hospital medicines from their preferred private community pharmacy. Additional models are still under development, including home delivery coordinated and scheduled via digital platforms

Results: Findings from patient satisfaction surveys, ongoing dialogue with clinical departments, and hospitals' growing emphasis on providing treatment close to patients' homes have driven the continued development of new collection and delivery methods. Organizational and IT related adjustments at hospital pharmacies and clinical departments have enabled medication pickup from lockers across the entire region, independent of the patient's treatment site. A strong patient preference for greater flexibility has also led to collaborations between hospitals, private community pharmacies, and online pharmacies, allowing hospital supplied medicines to be collected locally or delivered directly to patients' homes. Satisfaction surveys indicate that patients view collection through private pharmacies positively and consider access to multiple collection and delivery options optimal, as each method provides specific advantages for different patient groups.

Conclusion: National health policy priorities to minimize the burden of hospital attendance and support treatment close to home have driven the development of flexible models for accessing hospital supplied medicines. The implementation of medication pickup lockers, partnerships with private community pharmacies, and the ongoing development of home delivery solutions collectively support new models for the collection and delivery of hospital supplied medicines tailored to patients' individual needs. These initiatives enhance treatment adherence, optimize resource utilization, and strengthen patients' experience of continuity in their care.

Beyond the brain: Managing the metabolic toll of antipsychotic medications in Ankaful Psychiatric Hospital, Cape Coast, Ghana

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Background: Antipsychotic medications have revolutionised the treatment of severe mental illnesses, offering symptom management and improved quality of life for individuals with conditions such as schizophrenia, bipolar disorder, and severe depression. However, these therapeutic benefits frequently occur alongside metabolic side effects, including weight gain, dyslipidaemia, hyperglycaemia, and an elevated risk of cardiovascular disease (CVD). Mitigating these side effects is crucial to enhancing the overall health and well-being of patients reliant on these medications. This study aimed to compare the metabolic parameters of patients prescribed atypical antipsychotic agents at the time of hospitalisation and discharge, and to evaluate associated metabolic side effects.

Method: This was a cross-sectional study design conducted at Ankaful Psychiatric Hospital, Cape Coast, Ghana, from January 2024 to June 2024. The facility manages a wide range of psychiatric conditions, including addiction, anxiety, bipolar disorder, dementia, depression, psychosis, and schizophrenia. A structured, paper-based questionnaire was administered to collect data on demographic information, types of side effects experienced, laboratory values at the time of hospitalisation, patients' daily routines, and physical measurements such as weight. Data on pharmacological interventions, including the types of medications prescribed,

dosages, and treatment duration, were extracted from patients' medical records. The two atypical antipsychotic agents under investigation were Olanzapine and Clozapine. Data collected were analysed using IBM SPSS Statistics, Version 25. The chi-square test was applied to determine associations between categorical variables, with p-values of less than 0.05 considered statistically significant.

Results: This study evaluated the metabolic side effects of Olanzapine and Clozapine amongst a cohort of 136 inpatients with mental disorders. A total of 136 patients were enrolled, comprising 79 males (58.10%) and 57 females (41.90%), with a mean age of 43.66 years (standard deviation: 10.68). Findings revealed a statistically significant increase in Body Mass Index (BMI) between hospitalisation and discharge, with p-values of 0.010 and 0.012, respectively. Weight gain was the most commonly reported side effect amongst participants. Notably, 68.4% of patients reported non-adherence to their medication regimens, contributing to frequent rehospitalisation. The mean exercise duration amongst inpatients was 16.24 minutes, with a standard deviation of 17.36 minutes, indicating generally low levels of physical activity. Despite the observed changes in weight and BMI, laboratory investigations — including lipid profile, liver function tests (LFTs), renal function tests (RFTs), and fasting blood glucose (FBG) remained within clinically acceptable ranges across the study population.

Conclusion: Patients demonstrated notable weight gain during admission, increasing their risk for Cardiovascular disease and adversely affecting their physical health. These findings underscore the need for routine metabolic monitoring, structured physical activity programmes, and targeted patient education on medication adherence within inpatient psychiatric settings. Addressing these factors holistically is essential to improving long-term outcomes for patients receiving atypical antipsychotic therapy.

Impact of pharmacist-led lipid management on stroke recurrence in high-risk ischemic stroke patients: A retrospective study

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Background: Effective lipid control is essential in preventing recurrent stroke among high-risk ischemic stroke patients. While guidelines recommend LDL-C <70 mg/dL for secondary prevention, real-world adherence remains suboptimal. Pharmacist-led lipid management may improve outcomes, yet its impact on stroke recurrence requires further evaluation.

Objective: To evaluate whether pharmacist-led lipid interventions improve LDL-C control and to describe the one-year and extended stroke recurrence outcomes in ischemic stroke patients with elevated baseline LDL-C.

Method: This retrospective study was conducted at a medical center in Taiwan. Patients with ischemic stroke who received pharmacist lipid consultation between August 2022 and July 2023 and had baseline LDL-C ≥70 mg/dL were included. Pharmacists provided statin-related recommendations during hospitalization or follow-up. LDL-C levels and stroke recurrence were tracked for at least one year, with extended follow-up until June 30, 2025. Outcomes included LDL-C changes, target attainment (<70 mg/dL), and incidence of recurrent stroke.

Results: A total of 120 patients were included (median age was 63, 51.7% were males). Mean LDL-C decreased from 120.6 to 80.6 mg/dL post-intervention, with an average reduction of 40.0 mg/dL. Forty-two patients (35.0%) achieved LDL-C <70 mg/dL. Within one year, five patients experienced recurrent stroke, four of whom had achieved LDL-C <70 mg/dL at the time (56, 60, 64, 69, and 78 mg/dL). No additional recurrences were observed during the extended follow-up through June 30, 2025.

Conclusion: Pharmacist-led interventions substantially improved LDL-C control among high-risk ischemic stroke patients. Most patients remained free of recurrence over one year and beyond. However, the occurrence of recurrent stroke despite achieving LDL-C targets suggests that LDL-C alone may not be sufficient to predict or prevent recurrence. These findings support the role of pharmacists in secondary prevention and highlight the importance of comprehensive risk factor management. Further controlled studies are warranted.

Suspected therapeutic failure associated with a generic extended-release Nifedipine: A pharmacovigilance case series from a regional hospital in Ghana

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Background: Generic substitution is central to antihypertensive therapy in resource-limited settings, yet bioequivalence approval does not guarantee post-manufacturing therapeutic equivalence. Extended-release (ER) formulations are particularly vulnerable; minor matrix failures can precipitate dose dumping and acute supra-therapeutic exposure. In sub-Saharan Africa, where hypertension is the leading cardiovascular risk factor and an estimated 16% of cardiovascular medicines are substandard,

pharmacovigilance remains the primary post-market signal detection mechanism. Regional quality surveillance consistently implicates calcium channel blockers, including nifedipine, but institutional signal detection in Ghana remains undercharacterized.

Objective: To characterise a pharmacovigilance signal of suspected therapeutic failure and adverse drug reactions (ADRs) following generic nifedipine (ER) introduction in previously controlled hypertensive patients and to document the institutional pharmacovigilance response and its implications for product quality surveillance in a resource-limited setting.

Method: A case series investigation was conducted at the outpatient department of Tema General Hospital, Ghana. Seven previously controlled hypertensive patients who developed hypertensive urgencies and new ADRs following a formulary brand transition to a generic ER nifedipine (Nifedipine Brand A) were included. Clinical records were systematically reviewed via the Hospital Information System to document demographics, comorbidity profiles, concomitant medications, baseline and on-treatment blood pressure (BP) values, and post-dechallenge outcomes. Patient-returned medicine samples were examined for batch uniformity. Causality assessment was performed using the World Health Organization–Uppsala Monitoring Centre Causality Assessment Criteria (WHO-UMC).

Results: All seven patients (57% female; 43% male; 43% with multimorbidity, including heart failure, dyslipidemia, type 2 diabetes, and previous ischaemic stroke) had achieved documented antihypertensive control before brand transition, with a mean baseline systolic blood pressure (SBP) of 133.4 ± 6.1 mmHg and diastolic blood pressure (DBP) of 79.4 ± 9.4 mmHg. Following initiation of Nifedipine Brand A, all seven patients developed hypertensive urgency: mean SBP rose to 184.4 ± 6.5 mmHg and DBP to 107.4 ± 7.5 mmHg, representing mean increases of $+51.0$ mmHg systolic (range: $+34$ to $+66$ mmHg) and $+28.0$ mmHg diastolic (range: $+3$ to $+37$ mmHg). Concurrently, 12 ADRs were documented across the cohort (mean 1.7 per patient); severe headache was most frequent (4/7; 57%), followed by palpitations and dizziness (3/7 each; 43%), with cough and angioedema each reported in 1/7 patients (14%). Critically, 100% experienced at least one vasodilatory ADR, consistent with acute supra-therapeutic nifedipine exposure. Implicated products were clustered across two distinct batches and strengths of the same brand (PT03-38 and GT-014), indicating a product-level rather than a single-batch anomaly. Following dechallenge, 86% of patients achieved BP restoration to $<140/90$ mmHg within four weeks (mean SBP reduction: -51.9 mmHg) with 86% experiencing concurrent ADR resolution. The WHO-UMC causality assessment yielded a probable/likely classification across all seven cases.

Conclusion: This case series identifies a probable therapeutic failure attributable to ER matrix failure and dose-dumping associated with Nifedipine Brand A in previously controlled hypertensive patients. Pharmacist-led pharmacovigilance

enabled early signal detection and a multidisciplinary regulatory response with the regional medical stores and FDA, affirming the pharmacist's indispensable patient safety role. These findings highlight routine post-market monitoring of modified-release generic formulations as a priority in resource-limited settings.

From automation to professional elevation: An AI-enabled smart pharmacy transformation model

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Background: Hospital pharmacies worldwide are facing increasing clinical complexity, pharmacist workforce shortages, and rising professional burnout. In tertiary care settings, fragmented digital systems and labour-intensive workflows often limit pharmacists' capacity to prioritise high-risk patients and strengthen medication safety. The International Pharmaceutical Federation (FIP) Digital Health White Paper (2023) identifies digital transformation as a foundational pillar of modern pharmaceutical practice. Nevertheless, many artificial intelligence (AI) initiatives within hospitals remain isolated tools rather than integrated care models. A medical center in the Asia-Pacific region implemented a comprehensive AI-enabled pharmacy transformation model to enhance medication safety, optimise clinical workflows, and elevate the professional role of hospital pharmacists.

Method: A structured three-layer transformation framework was implemented within the hospital pharmacy department. Clinical Intelligence Layer An AI-assisted platform ("A+ Pharmacist") was developed to support generative AI-enabled Subjective–Objective–Assessment–Plan (SOAP) documentation, risk-stratified patient prioritisation, AI-supported prescription review, and integration with Medi-Span clinical decision support, including drug–drug interaction analysis, dosing guidance, contraindication screening, and therapeutic drug monitoring alerts. Workflow Redesign and Automation Layer Robotic Process Automation (RPA) achieved 90% automation of administrative forms and repetitive documentation tasks. Microsoft Power Platform solutions were deployed to digitise handover systems, medication safety monitoring, controlled drug management, and clinical trial workflows. Real-time dashboards using Power BI (Business Intelligence) monitored 25 hospital pharmacy quality indicators. Smart Compounding Infrastructure Layer Hospital-wide Automated Dispensing Cabinets (ADC) were implemented to decentralise medication supply. Automated Robotic Compounding Technology (ARCT) was introduced for chemotherapy preparation, forming a centralised smart chemotherapy compounding centre. A structured pharmacist digital competency training programme ensured safe and

standardised AI adoption, including validation protocols, data literacy development, standardised prompting practices, and ongoing performance evaluation. Pre- and post-implementation indicators were analysed.

Results: Clinical assessment time per patient decreased from 10 minutes to 6.04 minutes ($p<0.01$). Documentation time decreased from 7.06 minutes to 5.45 minutes ($p<0.01$). Following ADC implementation, patient medication waiting time decreased by 70%, and emergency medication retrieval decreased by 35% (approximately 12,700 cases per month). Robotic chemotherapy compounding covered 73% of total chemotherapy prescriptions and is scalable to approximately 90% with dual-arm configuration. Clinical pharmacy service capacity in the intensive care unit increased progressively over a 12-month period.

Conclusion: This hospital-based transformation demonstrates that AI integration in pharmacy practice should extend beyond automation towards structured workflow redesign, infrastructure integration, and professional capability development. By embedding AI across clinical care, medication supply, and compounding services, hospital pharmacists are repositioned from task-oriented execution to high-value clinical decision-making and medication safety leadership. The model aligns with FIP Workforce Development Goals and provides a scalable framework for hospital pharmacies addressing workforce shortages and increasing medication complexity.

PohaiGPT: An AI-driven prescription review system integrating large Language models and LASA detection models for hospital pharmacy

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Background: At Luodong Poh-Ai Hospital, pharmacists review up to 500 prescriptions daily whilst simultaneously answering telephone consultations, verifying drug appearance, screening for interactions, and training junior staff. With hospital pharmacist shortages being a recognised challenge in Taiwan, this multitasking environment makes it easy to overlook important details. Our greatest concern was that important drug-related problems — therapeutic duplications, inappropriate dosing in renal impairment, serious interactions, and look-alike sound-alike (LASA) drug confusion — could be missed under time pressure. Conventional alert systems in our hospital relied on simple rule-based checks that generated many irrelevant warnings, leading to alert fatigue. We sought to build an AI-powered system that could function as a pharmacist's "second pair of eyes", proactively reviewing every prescription and

highlighting only clinically meaningful issues with actionable recommendations.

Method: We developed PohaiGPT, an AI-driven prescription review system deployed on Microsoft Azure. Patient data, including current medication orders, cloud pharmacy history, laboratory results, and renal and hepatic function, are transmitted from the hospital information system. Each prescription undergoes a multi-step review. A de-identification AI model first masks patient-identifiable information to comply with Taiwan's Personal Data Protection Act. The system then uses retrieval-augmented generation (RAG), retrieving relevant clinical guidelines and drug references from a curated knowledge base, and a large language model (GPT-4o) generates a structured clinical assessment. The review covers therapeutic duplication (same generic name or same drug class), dosage appropriateness adjusted for renal and hepatic function, serious drug-drug interactions, allergy cross-reactivity, route and frequency errors (e.g. oral medications prescribed to patients who cannot swallow), and high-alert medication verification. Two additional custom-trained AI models run concurrently: LASA-Sounds-Like detects phonetically similar drug name pairs, and LASA-Look-Alike compares tablet images to flag visually similar drugs. The output is a structured report with alerts graded by severity — critical, warning, or informational — each with a specific recommendation and supporting evidence.

Results: PohaiGPT has been deployed for initial use at our hospital. During early adoption, the system successfully identified therapeutic duplications between inpatient orders and medications recorded in the patient's cloud pharmacy history — a type of overlap that conventional hospital alert systems do not detect, as they only screen within the institution's own prescriptions. The LASA detection models provide an additional safety layer that was previously unavailable in our workflow. Beyond error detection, pharmacists reported that the system's AI-generated, evidence-grounded recommendations, citing relevant guidelines and literature, enhanced their confidence when making clinical interventions.

It's not child's play: Comparison of hazardous drug surface sampling results across pediatric oncology units

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Background: Hazardous drug (HD) surface sampling is recommended by the United States Pharmacopeia (USP) standards general chapter <800> every six months for places where HDs are handled, compounded, and administered to validate containment in these areas. The results are utilized by quality control programs to identify potential gaps in the containment of HDs.

Objective: Quantifying the amount of trace HD residue in pediatric oncology settings allows for evaluation of containment processes. Caregivers, including health care providers and family members, are at risk of acute and chronic health problems because of HD residue exposure. Limiting this exposure risk is paramount to providing a safe environment for patients, healthcare workers, and families.

Method: A standardized list of testing locations was agreed upon for pharmacy compounding areas, medication temporary storage before administration locations, and patient rooms where medications are administered by the participating sites. Testing was completed in a room where a patient had received methotrexate in the past 24 hours and in the pharmacy that prepared the dose. Surface sampling methodology included both qualitative and quantitative test methods with only antineoplastic analytes.

Results: All surface sampling has not fully resulted for all locations. Partial results thus far show that pediatric patient room contamination was higher than expected. All results will be available in time for the presentation. Historically, each site had completed testing based on an individualized site plan. All sites had positive results in pharmacy and patient care settings in the past, and each site has been using these results to guide local process improvement projects. This assessment is the first known cumulation of results across multiple pediatric oncology institutional entities to compare overall trends.

Conclusion: Contamination exists despite controls with pediatric patient rooms showing higher-than expected contamination. Unique pediatric behaviors contribute to contamination risk. Cross-site evaluation reveals shared vulnerabilities, with a focused concern on contaminated hazardous drug body fluids. The comparison of the results will allow for identification of any trends for hazardous drug contamination in the pediatric oncology setting. These trends

will be utilized to guide workflow practices and re-evaluate containment strategies. Despite being collected at different entities, contamination is one problem that pharmacies can work together to address.

Proportion of unplanned readmissions that are medication-related in rural and remote hospitals: A retrospective cohort study

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Background: Rural and remote populations face barriers to healthcare access and fragmented continuity of care, placing them at heightened risk of medication-related harm, including readmissions. Despite this elevated risk, the proportion of unplanned readmissions that are medication-related and the drivers of these readmissions in these settings remain poorly understood.

Objective: To determine the proportion of unplanned 30-day readmissions to rural and remote hospitals in New South Wales, Australia, that were medication-related. Secondary objectives included categorising medication-related readmissions and identifying factors associated with them.

Method: The medical records of patients readmitted to rural and remote hospitals collected between June 1, 2022, and August 31, 2023, were assessed to determine whether the readmissions were medication-related using the AT-HARM10 tool. Medication-related readmissions were reviewed by an

expert panel and classified using the Basger Aggregated Classification System. Univariable and multivariable logistic regression models were used to identify factors associated with medication-related readmissions.

Results: Among the 133 patients readmitted within 30 days, 23% of readmissions were medication-related. Most were attributed to drug treatment goals not being achieved. Multivariable logistic regression identified three significant factors associated with the likelihood of a readmission being medication-related: older age and a higher number of medications were associated with increased odds, whereas the presence of heart, stroke, and vascular comorbidities was associated with lower odds.

Conclusion: Nearly one in four 30-day readmissions to rural and remote hospitals were medication-related. Increasing age and a higher number of medications were associated with greater odds of a readmission being medication-related. In contrast, the presence of heart, stroke and vascular comorbidity was associated with lower odds. Further prospective research is needed to clarify causal pathways and inform targeted interventions.

Redefining the pharmacist's role in pharmacy services within the Quebec Healthcare System: Recommendations aligned with the FIP Basel Statements

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Background: In Quebec, pharmacy practice is evolving, notably due to increasing patient needs, expansion of scope of practice, and the growing role of technical staff. This evolution underscores the need to redefine roles to enable

and enhance efficient, high quality pharmacy activities that meet expectations. To describe the evolving role of pharmacists in pharmacy services (medicines distribution), a working group was established by the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.).

Method: Nine pharmacists from various institutions and regions were convened to identify challenges and priorities in pharmacy services. The A.P.E.S. five pillars of health system pharmacy practice and the microsite on pharmacy technician integration were used as reference frameworks. Pharmacy service related tasks were identified and documented. A literature review was conducted in PubMed®, supplemented by manual screening of references and grey literature. Tasks were organised into six categories: drug procurement; processing of prescriptions and requests; prescription validation, intervention and follow up; communication of medicines information; preparation and dispensing of medicines. Roles were defined for service manager pharmacists, service providing pharmacists, pharmacy technicians and pharmacy assistants. Each service was described in terms of scope, target population and key challenges. Strategies for role transformation were grouped under service organisation, technologies and workforce, leading to consensus based recommendations.

Results: Published in 2026, a pharmacy service delivery model emphasising pharmacists' clinical responsibilities was developed, together with supporting recommendations. The model positions service providing pharmacists in roles dedicated to prescription validation, authorisation or refusal of dispensing, and associated clinical interventions, follow up and provision of medicines information. Other pharmacy services, including procurement, prescription processing, preparation and dispensing of medicines, are primarily supported by technology and delivered by technical staff under the supervision of service manager pharmacists. The recommendations are presented by target audiences: Pharmacy department leadership (n=7): prioritising and aligning services with patient needs; selecting appropriate models for prescription validation; assessing the feasibility of 24/7 services; optimising technologies; supporting staff in the use of digital tools; coordinating medicines use technologies and pharmacy clinical informatics resources; and integrating environmentally sustainable practices. Healthcare institutions and health authorities (n=7): workforce development; dedicated funding for the acquisition, replacement and upgrading of medicines use technologies, including medicine information databases and clinical software; centralising medicines information management under pharmacy leadership; creating provincial and local teams dedicated to medicines use technologies; implementing integrated, interoperable closed loop medicines use systems; and conducting structured analyses of the impact of artificial intelligence deployment on pharmacy activities. Accreditation bodies and regulators (n=5): harmonising standards; adapting requirements to evolving pharmacist roles and emerging care settings; promoting sustainable practices; and establishing frameworks governing the use of artificial intelligence.

Conclusion: This model redefines pharmacists' roles in pharmacy services by placing prescription validation and clinical decision making at the core of practice, supported by technology and qualified technical staff. Endorsed by A.P.E.S. and aligned with the FIP Basel Statements and Development Goals (18,20), the recommendations provide a framework to improve the quality, safety, efficiency and sustainability of pharmacy services.

The use and barriers of technology adoption in pharmacy practice within hospital pharmacies in Accra, Ghana

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Background: Digital technologies are increasingly central to strengthening pharmaceutical services, yet their adoption among hospital pharmacists vary. Despite developed countries having achieved significant advancements in incorporating digital solutions within pharmacy operations, many developing nations such as Ghana still encounter considerable difficulties. Understanding the types of technologies used, pharmacists' perceptions and the institutional factors influencing adoption is essential for improving digital readiness within health systems. This study aimed to assess the usage and barriers of technology adoption in hospital pharmacy practice and how the attitude of pharmacists impact technology in hospital pharmacies located in Accra, Ghana

Method: A cross-sectional study was conducted among 383 hospital pharmacists working in hospitals in Accra using a structured questionnaire to assess technology availability, utilization patterns, perceptions, training, Information Technology (IT) support and institutional readiness. Data were analysed using descriptive statistics, chi square tests and logistic regression to determine factors associated with positive perceptions of technology use.

Results: Pharmacists reported extensive use of electronic prescribing systems, inventory management software, electronic health record interfaces and barcode verification tools. Perceptions toward technology were largely positive, driven by improvements in workflow efficiency, accuracy, medication safety and communication with prescribers. Barriers such as unstable connectivity, system downtime, inadequate training and limited technical support reduced confidence and consistency in digital tool usage. Strong and significant associations were observed for institutional support factors. Pharmacists with access to IT support had significantly higher odds of positive perceptions in both crude and adjusted models. Training demonstrated an even

stronger association, with trained pharmacists being twice as likely to report positive perceptions compared to those without training.

Conclusion: Technology use among hospital pharmacists is influenced primarily by institutional readiness rather than individual characteristics. Stable infrastructure, accessible technical support and continuous training are key drivers of positive perceptions and sustained adoption. Strengthening these institutional enablers will promote the effective use of digital tools, enhance pharmaceutical service delivery and support progress toward Sustainable Development Goal (SDG) 3 related to quality health systems.

Use of elastomeric pump for delivery of enzyme replacement therapies in a Portuguese hospital

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Background: Lysosomal diseases are a heterogeneous group of inherited metabolic disorders characterized by reduced production or deficient activity of specific enzymes, leading to the accumulation of undegraded substrates within lysosomes and resulting in diverse patterns of cellular dysfunction. Although no curative treatment is currently available, several lysosomal diseases can be managed with intravenous enzyme replacement therapy (ERT), usually administered once or twice weekly. In Portugal, the Directorate-General of Health encourages the expansion of home-based administration in eligible cases, a strategy associated with improved patient quality of life, reduced healthcare costs and lower risk of nosocomial infections. Elastomeric pumps (EPs) are already used for ambulatory infusion in other therapeutic areas and may offer similar benefits for ERT. EPs are considered a safe method for ambulatory administration because they are closed-system devices prepared under aseptic conditions within compounding hospital pharmacies, ensuring microbiological safety. Their use requires only a short stay for pump connection and removal, eliminating the need for chair occupancy during infusion.

Objective: Our goal is evaluating the feasibility of preparing ERT for administration via elastomeric pumps, enabling their use in day-hospital and home-based infusion programs, and to describe the experience of a Portuguese hospital in implementing this approach.

Method: A literature review was conducted to gather information on the physicochemical stability of ERTs in EPs, recommended storage conditions and infusion duration for agalsidase alfa, agalsidase beta, alglucosidase alfa, galsulfase,

idursulfase, imiglucerase, laronidase, sebelipase alfa and velaglucerase alfa. Data were collected from official regulatory documents (SmPCs, PILs and risk-minimization materials) – the sources were the Portuguese National Medicines Authority, pharmaceutical manufacturers of ERTs and EP devices and PubMed, UpToDate, Stablis databases. Our experience using EP for ERTs is reported.

Results: Although national guidance supports the outpatient and home administration of ERT, systematic stability studies in EPs are lacking for most therapies. Documented physicochemical stability is available only for imiglucerase, velaglucerase and agalsidase beta; for these medicines, accelerated infusion protocols are also described in clinically stable, previously treated patients. In our hospital, EP administration of ERT is currently implemented in five patients: three receiving imiglucerase and two receiving velaglucerase. For imiglucerase, the use of EPs reduced hospital stay to approximately one hour per session, compared with 2.5–3 hours with standard administration. Extending EP use to all patients treated with the three enzymes with favourable stability data would result in an estimated monthly saving of 80 chair-hours in the day-hospital unit.

Conclusion: Even though guidelines support home-based administration of ERT, systematic data on the stability of most ERTs in elastomeric pumps remain limited. Beyond intrinsic stability, future studies should consider the patient's history of infusion-related adverse events, feasibility of fixed-rate infusion compatible with available pumps, and device volume capacity. Additional stability evidence would support broader centralization of preparation, improve resource allocation, reduce chair-time, and enhance patient autonomy and quality of life. Given the substantial financial burden of ERT for rare diseases, greater collaboration from marketing authorization holders in generating stability data would provide significant clinical, social, economic and sustainability benefits.

Prescription patterns of ocular medications and related requested diagnostic tests

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Background: Diagnostic tests are significant for ocular diagnoses and appropriate drug prescriptions. Knowledge of patterns in therapeutic ocular prescriptions and related requested diagnostic tests could potentially influence clinical

decision making and related policy formulation. However, there is dearth of information in this key clinical aspect.

Method: A retrospective review of patient records was conducted across four (one public and three private) healthcare facilities in Kumasi, the capital of the Ashanti region of Ghana. Patient records from January to December 2024 were conveniently included if they met a preset eligibility criterion. Prescribed drugs were grouped under standard pharmaceutical drug classes for analyses. Statistical analyses included descriptive statistics and chi-square tests to evaluate associations between categorical variables. A p-value < 0.05 was considered statistically significant.

Results: A total of 8 drug classes were identified with the most prescribed being artificial tears (34.21%). This was followed by antiallergic (18.34%), antibiotics (15.10%) and antiglaucoma drugs (13.21%). NSAIDs (1.12%), steroids (0.55%), and antibiotic/steroid combinations (6.80%) were the least frequently prescribed. Ocular diagnostic tests (92.73%) were the most frequently requested. Out of this, tonometry (46.26%) was the most requested, while tear break-up time test (TBUT) (2.85%) was the least requested. Among biochemical tests, Fasting Blood Sugar (FBS)/Glycated Hemoglobin (HbA1C) (85.70%) was predominant and Angiotensin converting enzyme (ACE) test 14.29% was the least requested. Commonest serological tests included Venereal Disease Research Laboratory (VDRL) and Treponema Pallidum Hemagglutination (TPHA) (53.85%) with tests for Immunoglobulin G (IgG) and Immunoglobulin M (IgM) (46.15%) being the least requested.

Conclusion: Artificial tears were the most prescribed ocular medication, tonometry and fasting blood sugar/glycated hemoglobin test were the commonest diagnostic performed or requested. Findings of the study provide foundational knowledge in ocular drug prescription and diagnostic test patterns, with implications for eye care. More robust and larger studies are recommended to provide fuller understanding of the observed patterns and to potentially inform the development of standard guidelines for the prescription of ocular medications.

Characteristics of hospitalized patients treated with anticoagulants and prevalence of Direct Oral Anticoagulant utilization: findings from a teaching hospital in Sub-Saharan Africa

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Background: Thromboembolic disorders (TED) contribute significantly to morbidity and mortality. Direct Oral Anticoagulants (DOACs) offer some advantage over other oral anticoagulants (vitamin K antagonists) in the treatment of TED. However, there is paucity of evidence on the characteristics of hospitalized patients with TED and DOAC uptake in Ghana and other parts of Sub-Saharan Africa (SSA).

Objective: The aim of this study was to investigate characteristics of hospitalised patients treated with anticoagulants and the prevalence of DOAC use at the Korle Bu Teaching Hospital (KBTH).

Method: It was a retrospective review of hospitalized patients' medical records at KBTH. A data extraction tool was used to collect data on socio-demographic and clinical factors and anticoagulant (AC) therapy. Patients 18 years and above with an indication for a thromboembolic disorder who received at least one AC drug at full dose during admission were included. Medical records from January 2021 to December 2024 were included. All patient encounters that met the inclusion criteria were included. SPSS was used for data analysis.

Results: Of 455 hospitalised patients, more than half (54.7%; n=249) were female and 51.2% (n=233) were 60 years and above. One-fifth (20.7%; n=94) had obesity. Venous thromboembolism (VTE), Atrial fibrillation (AF)/Atrial flutter (AFL), nephrotic syndrome, acute coronary syndrome and other TED were diagnosed in 64.16% (333/519), 19.46% (101/519), 7.13% (37/519), 6.55% (34/519) and 2.70% of patient encounters respectively with some patients having multiple diagnosis. Recurrent VTE was found in 5.40% (18/333). In 50% (222/455) of patient encounters, two different anticoagulants were used during admission. The proportion of DOAC prescriptions was 42.4% (313/738) of all AC prescriptions over the study period. A vitamin K antagonist was prescribed in 8.3% (61/738). Rivaroxaban and apixaban

were prescribed in 86.6% (271/313) and 13.4% (42/313) when a DOAC was used. Rivaroxaban was prescribed for initiation of anticoagulation in 22.2% (101/455) of patient encounters.

Conclusion: A significant proportion of patients were elderly and one-fifth were obese. The predominant thromboembolic disorders were VTE and AF/AFL. In this hospitalized patient setting, DOACs were prescribed in more than 40% of AC use with DOAC prescriptions surpassing that of warfarin. Rivaroxaban was the predominantly used DOAC. These findings appear to reflect the global shift from warfarin to DOACs. Further studies of this kind are needed to track DOAC uptake in hospitals in Ghana and SSA. These findings suggest a need to update AC drug policy, including the inclusion of DOACs on the Essential Medicines List and reimbursement by National Health Insurance. The elderly age of the majority of the patients in this study suggests a need for careful anticoagulation and monitoring involving clinical pharmacists.

Characterisation of the stability of selected medicines after expiration

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Background: Medicine shortages affect the availability of medications worldwide, and the incidence is increasing. The use of expired medications has been proposed as a potential measure to maintain access and prevent critical situations arising from shortages, specifically in emergency situations and in the context of medication preparedness. The expiry date of a medicinal product is established by the manufacturer based on regulatory requirements and stability studies. Any use of a medicine past its stated expiry date is undertaken at the responsibility of the user. Antidotes is a type of medication where the extent of use is difficult to predict. Additionally, the need for antidote treatment is highly urgent and dependent on local availability. Thus, these medications are often stockpiled until expiry date and then discarded, but in situations with medication shortages, use after the expiry date may be enforced. However, few data exist on the stability of antidotes after expiry date, and such use pose both a potential solution to medication shortage, but also a health hazard if the quality of the API is diminished.

Method: Expired medications across several therapeutic categories were collected from acute wards in different Norwegian health trusts. HPLC was used to quantitate the active ingredients compared to pharmaceutical standards. The HPLC methods for each substance were based on those described in the European Pharmacopoeia.

Results: Three expired medications were selected for analysis: methylene blue, hydroxycobalamin and pralidoxime. The medications were from 2-2,5 years after expiry date. The packaging was unopened and stored according to the manufactures suggested conditions. HPLC analysis demonstrated varying degree of degradation between the various substances.

Conclusion: This work presents an approach to illuminate the complex problem of sustained medication access in a world of unstable production and logistics. The findings indicate, that a consideration of substance stability and storage conditions, is pivotal when eliciting advice on using expired antidots – in order to support balanced clinical decision making. To elucidate this complex challenge further, more studies are needed.

Analysis of drug interactions between injectable anticancer drugs and patients' standard treatments: assessment of effectiveness six months after implementation in the hospital

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Patients in oncology are often polymedicated. Limiting drug iatrogeny is therefore a priority. In order to secure their care, the preparation unit of injectable anticancer drugs (IADs) of a French hospital carrying out 10,000 annual preparations has set up an analysis of potential drug interactions (DIs) between IADs and usual treatments, during pharmaceutical validation. This practice is not widely adopted in France. From bibliographic data, prioritisation criteria were defined: glomerular filtration rate (GFR) <50 mL/min, anti-HIV antiretrovirals, high-dose methotrexate, busulfan, carmustine, irinotecan, docetaxel. One month after starting this activity, this analysis was extended to all patients receiving a first administration of IADs within a protocol (C1J1). This work aimed to evaluate the relevance of the analysis of potential DIs between the prescribed IADs and patients' usual treatments after 6 months of implementation.

Assessments of potential DIs were carried out by a pharmacist and a hospital pharmacy resident between September 9, 2025 and March 9, 2026. The tools "Thesaurus des interactions médicamenteuses" from the French Medicines Agency, "Cancer drug interactions" and

"Thériaque" were used. The prioritisation criteria underlying the analysis were recorded for each patient, along with the relevant department, the medical conditions involved, the presence of drug interactions (contraindications, combinations not recommended, precautions for use) and the course of action to be taken where applicable. These data were centralised and analysed with Excel®.

Over a six-month period, 235 DIs analyses were carried out for 203 patients. On average, 1.9 analyses were performed daily (min=0, max=8, median=2). Among the 6 client departments of the preparation unit of IADs, the main analyses concerned the day hospital (n=119, 51%) and haematology (n=87, 37%). They were predominantly conducted for C1J1 (n=170, 72%) with an average of 1.3 analyses per day (min=0, max=6, median=1) and for GFR <50 mL/min (n=44, 19%). In 35 cases, C1J1 was associated with another criterion, notably a GFR <50 mL/min (n=13) and busulfan prescriptions (n=10). The other 6 criteria were involved between 0 and 9 times. In total, 6.4% of DIs (n=15) were noted comprising 10 combinations not recommended and 5 precautions for use. Pharmaceutical interventions have been carried out and mapped.

The low number of DIs found and the absence of contraindications can be explained by a medical assessment carried out prior to prescribing. As relevant interactions have been noted, it appears necessary to maintain this activity, which fits well into everyday pharmaceutical practice. It might be worthwhile to carry out an assessment of the time involved. In light of the results, an optimisation of the selection of prioritisation criteria was proposed. Only C1J1, GFR <50 mL/min and high-dose methotrexate were retained. The pharmaceutical analysis of potential DIs only considered information available in the patient record. It would be ideal to be able to carry out medication reconciliations in day hospital.

Addressing the gaps in the interprofessional education to interprofessional practice journey

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Background: Health sciences programs globally have introduced interprofessional education (IPE) for several years. As with many educational outcomes, academia seems to be living in its own bubble as students are exposed to the ideals of the respective educational outcome including IPE. However, anecdotal evidence from health sciences students and the literature shows how the bubble is burst for students when they are on rotations as they observe lack of interprofessional collaboration among members of the healthcare team across practice settings. While as health

professions educators we may not be able to do much about the existing dynamics and politics of the current healthcare team to improve interprofessional practice, there is much we can and should do as part of educating future practitioners and in our respective medical centers and outpatient clinics.

Method: The IPE program at LAU consists of three core courses to address the competencies of interprofessional collaborative care. In addition, students are exposed to key concepts including intraprofessional collaborative care, psychological safety and intersectionality training. Further, role model interprofessional practice teams are invited to present to the students in each of the core courses and grand rounds are presented to practitioners at the medical center to highlight the value of interprofessional collaborative practice.

Results: Perceptions of first year and third year medicine, nursing, nutrition and pharmacy students related to the importance of intraprofessional education, intraprofessional collaborative care, psychological safety, civility, hierarchy in healthcare, intersectionality and their comfort level to speak up and to create a psychologically safe work environment will be presented. Practitioners' perceptions also on the above will be presented.

Conclusion: Introducing concepts of intraprofessional education and collaborative practice, psychological safety, civility, a culture of no hierarchy in healthcare, intersectionality and introducing role model interprofessional team for healthcare students and other related disciplines is essential to empower students in their training years to speak up and to create a psychologically safe environment in their future practice, contributing to preventing bursting the bubble of future students and practitioners.

Compliance audit of high alert medication management based on hospital accreditation standards to support medication safety at Dr. Cipto Mangunkusumo Hospital

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Background: High Alert Medications (HAM) are drugs that bear a heightened risk of causing significant patient harm when they are used in error. Hospital accreditation standards require strict control of HAM to determine which medications require special safeguards to reduce the risk of errors. The hospital has some strategies such as standardizing the ordering, storage, preparation, and administration of these products, staff awareness to ensure medication safety. Pharmacy Satellite, as medication distribution units within hospital wards, play a critical role in maintaining compliance

with HAM management standards to support medication safety. The Objectives of the study are to evaluate compliance of High Alert Medication management based on hospital accreditation standards and to prevent medication errors.

Method: This study used a descriptive observational design with a compliance audit approach conducted throughout 2025. Data were collected through direct observation in the wards (197) that manage HAM and pharmacy satellites (33) using a checklist form derived from hospital accreditation elements related to HAM management. The audit was focused on concentrated electrolytes, labeling practices that do not obscure drug names, the availability of warning posters for electrolyte dilution, appropriate HAM storage, appropriate refrigerator storage, and management of multi-dose vials. The assessment of multi-dose vials included the presence of opening date and expiration date stickers, proper sealing of opened vials using parafilm, and complete patient identification labeling.

Results: The audit results identified several findings in the management of high-alert medications in the wards and pharmacy satellite units. There was no high-alert medication list (4 findings), improper management of concentrated electrolytes such as stickers covering the electrolyte name (2 findings), incorrect storage (6 findings), absence of opening-date and expiration-date labels (8 findings), vials not sealed with parafilm (1 finding), incomplete patient identification (1 finding), incorrect storage in refrigerators (2 findings), and absence of a concentrated electrolyte dilution poster (2 findings). These results indicate that most elements of HAM management were in accordance with hospital accreditation standards; however, several aspects still require improved consistency in practice.

Conclusion: The management of High Alert Medications in the ward and pharmacy satellites still needs to be improved. Regular and systematic audits are essential to improve adherence, enhance consistency, and support medication safety.

Specialization pathways and potential benefits for pharmacists: Findings from the National Pharmacist Workforce Study in the United States

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Background: The National Pharmacist Workforce Study (NPWS) is a systematic, nationwide survey of licensed pharmacists in the United States that is conducted every five years. The NPWS describes and trends pharmacists' demographics, education, training, employment, work characteristics, and perceptions of work-life. Specialization in pharmacy is not clearly or universally defined, but often refers to specific practice areas that require additional knowledge, skills, and competencies beyond general pharmacist licensure. In the United States, specialization in pharmacy typically includes additional post-graduate (i.e., after pharmacy degree) education, training and/or board certification. Using data from the 2024 NPWS, this study aimed to: (1) characterize United States pharmacists with and without specialization and (2) explore potential benefits of specialization for pharmacists, including differences in compensation (e.g. salary, hourly wage), job characteristics (e.g. scheduling, hours worked, work from home, workload), and work-life outcomes (e.g. meaningful work, job autonomy, health, and well-being).

Method: The 2024 NPWS utilized a cross-sectional, descriptive survey design. An online Qualtrics survey was sent using a four-contact approach to a random sample of 198,000 licensed pharmacists drawn by the National Association of Boards of Pharmacy (NABP) Foundation, which resulted in 5,668 usable responses based on those who provided their employment status. A subset of responses from actively practicing pharmacists working in hospital and ambulatory care settings was used for this analysis. Specialization was defined as completing at least one of the following: fellowship, PGY1 residency, PGY2 residency, PGY1/PGY2 residency, board certification. Data analyses were conducted using SPSS Statistical Software and consisted primarily of descriptive statistics.

Results: The study sample consisted of 1,088 responses from actively practicing pharmacists, including 420 with specialization (38.6%) and 668 without (61.4%). By practice setting, there were 40.7% (302/742) of hospital pharmacists and 51.1% (113/221) of ambulatory care pharmacists with specialization. The most commonly reported form of specialization was board certification (72.9%), followed by completion of PGY1 residency (71%). There were no

statistically significant differences between respondents with and without specialization in terms of gender, race, or marital status. Age was statistically significant ($P < 0.001$) with 64.1% of pharmacists with specialization reporting ages of 40 years or younger. For pharmacists with specialization, there were statistically significant differences in job characteristics, including higher weekly hours worked and workload ratings, as well as differences in work-life outcomes, including higher hourly wage, autonomy at work, and overall life satisfaction.

Conclusion: Findings from the 2024 NPWS show that approximately 40% of pharmacist respondents in hospital and ambulatory care settings were classified as having specialization. The results suggest that investments by pharmacists to become specialized appear to offer meaningful professional and personal benefits for pharmacists (e.g., higher compensation, higher life satisfaction), while also introducing additional job demands (e.g., increased workload, longer work hours).

Pharmacist consultation at a breast specialty clinic in person

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Background: The breast cancer treatment guidelines indicate that administering hormone therapy (HT) for 10 years to patients with hormone receptor-positive invasive ductal carcinoma (HR-PIDC) reduces recurrence and mortality rates. Therefore, HT for HR-PIDC requires long-term administration. However, some patients experience a decline in quality of life due to side effects. At Sapporo Satomi Breast Clinic (our clinic), since its opening (April 2025), female pharmacists have conducted consultations with patients who request to meet in the private room. We report on a retrospective study of pharmacist consultations for patients undergoing HT following breast cancer surgery.

Method: 1. The subjects were breast cancer patients referred to our hospital from other medical institutions during the 9-month period from April 2025 to December 2025 (up to 10 years post-surgery). 2. The survey items were as follows: the presence or absence of estrogen receptors (ER), progesterone receptors (PgR), whether HT drugs were prescribed, drug names, the number of patients who requested to have a pharmacist consultation and the nature of their consultation, the number of patients for whom prescription proposals were made, and whether symptoms improved after taking the medication. We compared the Tamoxifen (TAM) group with the Aromatase Inhibitors (AI) group. 3. Statistical analysis employed the Mann-Whitney U test for

comparing continuous variables, Fisher's exact test for comparing nominal variables, and the chi-square test. A bilateral risk rate of less than 5% ($P < 0.05$) was considered statistically significant.

Results: 181 patients after breast cancer surgery were referred from other medical institutions during the nine months.

The positive rates of ER, PgR were 85.6%, 77.9%, respectively. There was a total of 154 patients: 140 undergoing HT, 11 who had completed HT after 5 years, and 3 who refused HT and were not taking it. The breakdown of HT and the number of patients requesting consultation were as follows: tamoxifen (TAM) 48 patients, of whom 21 (43.8%); aromatase inhibitor (AI) 92 patients, of whom 27 (29.3%) ($P=0.0954$). Of the 60 symptoms from the 48 people consulted. In the TAM group and AI group there were 3 and 13 cases of joint pain ($P=0.7477$), 8 and 2 cases of hot flashes ($P=0.0406$), 3 and 2 cases of sleep disorders ($P=0.8228$), 2 cases each of hair loss/thinning ($P=0.8395$), and others. Pharmacist made prescription suggestions to 7 patients for TAM group and 13 patients for AI group. After 1-3 months, patient symptoms showed improvement 5 patients in TAM group, 9 patients in AI group respectively ($P=1.0000$).

Discussion: The hot flashes showed a significant difference between two group. We view that it is depend on whether the patient had experienced menopausal disorders.

Conclusion: The pharmacist explained the mechanism of HT, which involves symptoms such as hot flashes and joint pain. It helped alleviate the patient's anxiety and supported the continuation of HT.

Xanthii fructus related toxicity on human: A systematic review

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Background: Xanthii Fructus, the mature fruit with involucre of Xanthium sibiricum Patr in ex Widder, is a traditional Chinese and Tibetan herbal medicine that has been used for more than 2,000 years, primarily for the treatment of nasal disorders. Despite its long history of therapeutic use, accumulating experimental and clinical evidence has raised concerns regarding its potential hepatotoxicity and nephrotoxicity. These toxic effects are largely attributed to carboxyatractyloside (CATR), a toxic diterpenoid glycoside found in the seedlings and mature fruits of Xanthium species. Given the increasing safety concerns surrounding this herbal medicine, this study aimed to systematically review the

available evidence and summarize current knowledge regarding its toxicological effects in humans.

Method: A comprehensive literature search was conducted in PubMed and Embase to identify relevant studies published in English up to March 15, 2026. The search strategy was developed based on a predefined PICO framework (Population, Intervention/Exposure, Comparison, and Outcomes). Studies investigating the toxicity or safety of Xanthii Fructus or Xanthium sibiricum in humans were considered eligible for inclusion. A combination of keywords and controlled vocabulary terms was used, including "Xanthium," "Xanthii Fructus," "carboxyatractyloside," "poisoning," "drug-related side effects," "chemical- and drug-induced liver injury," and "adverse reactions." A standardized data extraction form was used to systematically collect relevant information from the included studies. The extracted data were synthesized using descriptive and comparative approaches to summarize the current evidence on the toxicity and safety of Xanthii Fructus.

Results: A total of 64 and 260 records were identified from PubMed and Embase, respectively. After screening and eligibility assessment, five studies met the inclusion criteria. Among these, four studies reported adverse events associated with Xanthii Fructus (the fruit), while one study described toxicity related to Xanthium seedlings, locally known as Ghagra Shak. The four studies involving Xanthii Fructus were conducted in Turkey and China and reported a total of 15 poisoning cases (Turkey: $n = 13$; China: $n = 2$). All cases were associated with ingestion of unprocessed Xanthii Fructus. Among the 15 cases with available demographic and clinical information, the mean age was approximately 15 years. Severe hepatotoxicity was observed in all cases, renal toxicity occurred in six patients, and five fatalities were reported. The study involving Xanthium seedlings described a poisoning outbreak affecting 76 individuals in Bangladesh following consumption of the plant as a leafy vegetable.

Conclusion: The available evidence suggests that toxicity associated with Xanthium species is primarily related to the ingestion of unprocessed plant materials, particularly the fruits and seedlings. These toxic effects are likely attributable to carboxyatractyloside (CATR), a well-recognized hepatotoxic and nephrotoxic compound present in these plant parts. Although Xanthii Fructus has been used in traditional medicine for centuries, improper preparation or accidental ingestion of toxic plant components may pose significant health risks. Increased awareness of proper processing methods and safe clinical use is essential. Further research is needed to clarify the mechanisms of toxicity and to develop strategies to mitigate potential risks associated with Xanthium species.

Barriers and facilitators to job satisfaction: A qualitative study among pharmacy professionals working in tertiary hospitals in urban Ethiopia

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Background: A resilient and effective healthcare delivery system fundamentally depends on a workforce that is not only adequate in number but also empowered and professionally satisfied. In this regard, job satisfaction serves as a critical component that directly influences employee engagement, retention and the prevention of burnout. In the pharmacy sector, the quantitative trends with regards to workforce burnout and turnover are well reported. However, there remains a significant gap in in-depth qualitative evidence regarding job satisfaction among hospital pharmacists and influencing factors from the practitioners' perspective especially in low- and middle-income settings. This is particularly concerning as job dissatisfaction is particularly linked to diminished job performance and critical clinical errors including inaccurate dispensing and inadequate patient counselling. These in turn undermine quality of care and also erode pharmacists-patient relationship. This study therefore sought to explore hospital pharmacy professionals' job satisfaction and influencing factors.

Method: A descriptive qualitative study design was employed using individual interviews with purposively selected participants, ensuring a diverse representation of age, gender and years of professional experience. The study settings were two tertiary hospitals in Addis Ababa, Ethiopia, which provided highly specialized services to a large number of patients. The collected data was then subjected to a thematic analysis approach following among others an iterative familiarization process, coding and identifying a thematic framework while employing the job demand resource conceptual framework.

Results: Seventeen hospital pharmacists working for the two study hospitals and five key informants who were administrators in the study hospitals and a policy maker from the federal health ministry were the study participants. The findings that emerged from this study reported the influence of job dissatisfaction on the physical and mental wellbeing, burnouts, poor job performance and job turnover of the hospital pharmacist study participants. Different factors were identified for these, namely perceived job demand, perceived job resources, and personal resources. Job demands such as poor facility infrastructure, lack of medicines and medical supplies, lack of professional development, high workload, non-supportive managers, lack of job description, unfair benefit and rewards, and lack of physicians' acceptance were found to negatively influence job satisfaction. On the other hand, perceived job and personal resources such as

relationships with colleagues and teamwork, friendly relationship with pharmacy manager, the presence of different specialty area, passion for the field and implementation of computerized dispensing were found to positively influence job satisfaction.

Conclusion: The findings indicate that while the hospital pharmacy professionals demonstrate a sense of professional duty, systemic barriers negatively affect their job satisfaction. These issues need due consideration as they influence not only the professionals' wellbeing but also their job performance and in turn the quality of patient care and ensuing health outcomes. Therefore, pharmacy and hospital managers as well as policy makers should work with hospital pharmacists to address these factors so that their job satisfaction and performance is improved.

Evaluation and exploration of the clinical use of oral silymarin for liver-related diseases: A 2023–2025 study

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Background: Recent reports indicate that nearly 7 million people in Taiwan suffer from fatty liver disease, with a prevalence of Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) at approximately 33%. Silymarin, a flavonolignan complex extracted from milk thistle seeds, is widely used as an adjuvant therapy for chronic liver disease, cirrhosis, and fatty liver. This study aims to evaluate the real-world clinical utilization of oral Silymarin for liver-related diseases at a tertiary medical center in central Taiwan.

Method: A retrospective study was conducted from January 2023 to December 2025 at a 2,202-bed medical center. Data regarding the use of Silymarin (150mg/capsule) were analyzed. Statistical significance was assessed using the Chi-square test to identify trends and differences across the three years. A P-value < 0.05 was considered statistically significant.

Results: During the study period, a total of 63,524 patients were prescribed 2,991,130 capsules of Silymarin. The mean age of users was 54.71 ± 16.58 years (range: 1–105 years), with 37,996 males (59.81%) and 25,528 females (40.19%). The top three primary diagnoses were: 1.C22.0 Liver cell carcinoma (5.32%) 2.K76.9 Liver disease, unspecified (4.86%) 3.K74.6 Other and unspecified cirrhosis of liver (4.26%) Notably, the proportion of patients diagnosed with K76.0

(Fatty liver, not elsewhere classified) increased significantly from 0.24% in 2023 to 0.46% in 2025 ($P = 0.0007$). While the total volume of prescriptions increased, the average dosage per patient-visit showed a slight but statistically significant decrease from 47.86 units in 2023 to 46.74 units in 2025 ($P = 0.0437$).

Conclusion: Research indicates that Silymarin is primarily utilized for managing hepatocellular carcinoma and hepatitis-related conditions at a medical center in central Taiwan. From 2023 to 2025, while the prevalence of the top three primary diagnoses significantly declined ($P < 0.01$), there was a marked increase in K76.0 (fatty liver) cases ($P < 0.001$). This upward trend reflects the escalating clinical burden of MASLD in Taiwan. Additionally, a significant reduction in the average dosage per patient-visit was observed ($P < 0.05$), accompanied by a subtle demographic shift toward female users. Future research should prioritize investigating the long-term therapeutic efficacy of Silymarin in MASLD populations to further refine clinical practice guidelines.

Implementation of an artificial intelligence-based clinical decision support system to reduce antibiotic prescribing errors in a Taiwan academic medical centre: A five-year longitudinal study

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Background: Antimicrobial resistance and prescribing errors represent significant challenges to global patient safety. Clinical decision support systems (CDSS) leveraging artificial intelligence (AI) offer transformative potential in automating and optimizing antibiotic therapy. This study evaluates the impact of an AI-based CDSS, the Intelligent Antimicrobial System (iAMS), on reducing medication errors in antibiotic prescribing within an academic medical centre in Taiwan from 2021 to 2025.

Method: A retrospective longitudinal analysis was conducted on all patient systemic antibacterial (J01) prescriptions between 1 January 2021 and 31 December 2025. Following the implementation of the iAMS, prescribing error data were collected and categorised. Error rates were normalised to parts per million (ppm) to account for annual fluctuations in total prescription volume (exceeding 18 million orders per year). Statistical significance was assessed using the Chi-square test to identify trends and differences across the five-

year period, with a P -value < 0.05 considered statistically significant.

Results: The implementation of the iAMS was associated with a 65.22% reduction in the absolute number of antibiotic prescribing errors, decreasing from 184 cases in 2021 to 64 cases in 2025. The normalised error rate fell significantly from 9.85 ppm to 2.99 ppm ($P < 0.001$). The most substantial improvements were observed in dosage errors, which declined from 2.89 ppm to 0.65 ppm ($P < 0.001$), and frequency errors, which dropped from 2.52 ppm to 0.61 ppm ($P < 0.001$). Additionally, errors involving contraindications were significantly reduced from 1.93 ppm to 0.79 ppm ($P = 0.0247$). Other indicators, such as inappropriate drug combinations and duplicate prescriptions, remained at consistently low levels throughout the study without significant annual variation ($P > 0.05$).

Conclusion: The integration of an AI-based CDSS into hospital prescribing workflows significantly enhances medication safety for systemic antibacterials. By drastically reducing high-risk errors such as incorrect dosing and frequency, the iAMS demonstrates the efficacy of digital interventions in mitigating human error. These findings support the continued development and refinement of AI-driven systems to sustain high standards of antimicrobial stewardship and patient outcomes in complex clinical environments.

Clarifying the allergy record: Findings to enhance de-labeling efforts

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Background: Proper drug allergy documentation is essential for ensuring patient safety and optimising treatment decisions within hospital settings. Accurate recording of allergy status also plays a critical role in de-labeling initiatives, which aim to remove incorrect or outdated allergy labels that may unnecessarily restrict therapeutic options. A key challenge in this process is distinguishing true drug allergies from non allergic adverse reactions or medication intolerances, as mis-labeling can lead to suboptimal therapy, increased antimicrobial resistance, and higher healthcare costs. This review evaluated the quality and completeness of drug allergy documentation across an NHS Trust, examining recorded allergy descriptors, causative medications, and classification patterns to identify opportunities to improve documentation accuracy and support future de-labeling efforts.

Method: A de-identified data set of documented patient allergies was queried from the electronic prescribing and medicine administration (EPMA) system. The report pulled allergy documentation across five Barts Health NHS Trust hospitals, during two separate two-month periods in 2024 and 2025. The included data were allergy descriptor, causative medication, allergy severity and allergy category. A comparison was made between the entire data set for the Trust and the data recorded at St Bartholomew's Hospital (SBH) (a Barts Health Trust hospital). A total of 3797 reports were generated. NULL was described as a record that was missing the allergy descriptor. Descriptive statistics were used to categorize and evaluate the data.

Results: A total of 3449 (91%) reports were categorized as an allergy and of these reports, 698 (20%) were documented at SBH. There were 307 (8%) non-allergy related documentations (adverse effect, intolerance, side effect, or sensitivity). The most reported drug classes connected to an allergy report were penicillins (n=1334; 35.1%), NSAIDs (n=302; 7.9%), narcotics (n=219; 5.8%), aspirin (128; 3.4%); ACE inhibitors (n=105; 2.8%), and macrolides (n=103; 2.7%) across all five hospitals. The most reported allergy descriptors were rash (16.2%), swelling (3.2%), anaphylaxis (2.8%), itching (2.7%), and vomiting (2.7%). Allergy descriptors as described by the patient were categorized as mild (27.3%), moderate (52.4%) and severe (20%). Data was deemed NULL and thus inconclusive for 31% of records however, only 2% of NULL results were from the SBH documentation.

Conclusion: The composite data set reveals that many reported allergies were likely mis-labeled and could be categorized as a side effect or medication intolerance. Future activities to support de-labeling include: strengthening EPMA documentation standards, addressing/reducing NULL entries, focused data evaluation of penicillin allergy documentation, and education for providers and patients regarding allergies vs. intolerances. This data highlights an opportunity for SBH and the Barts Health Trust to utilize pharmacist-led allergy de-labeling protocols to enhance patient safety.

Clinical impact of pharmacist-led interventions at hospital discharge: A descriptive study from a care transitions service in Costa Rica

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Background: Hospital discharge is one of the most vulnerable moments in a patient's care journey. Incomplete medication reconciliation, ambiguous prescriptions, and inadequate post-discharge counselling are well-established drivers of preventable adverse drug events and avoidable hospital readmissions. Pharmacists are uniquely positioned to address these risks through structured clinical intervention; however, in Latin America, evidence quantifying the impact of pharmacist-led care transitions services remains scarce. To our knowledge, this is among the first studies to document and measure the full scope of pharmacist clinical interventions within a structured care transitions service in Central America, providing a replicable model for the region.

Method: A descriptive retrospective study was conducted at Clínica Bíblica Hospital, a private tertiary care hospital in San José, Costa Rica. All pharmacist interventions documented within the Care Transitions Services, primarily focused on the discharge service, between October 2025 and February 2026 were included, constituting a complete census of activity during the study period. Interventions were recorded prospectively using a standardized institutional registration system and subsequently classified by type, recommendation category, recipient, and relationship to the institutional antimicrobial stewardship program (ASP). The acceptance rate was calculated as the proportion of recommendations accepted among all resolved interventions. As a single-centre retrospective study, findings may not be generalizable to other hospital settings.

Results: Over the five-month study period, pharmacists conducted 262 clinical interventions across 234 patients, corresponding to an average of 51.4 interventions per month. Each intervention consisted of one or more pharmacist recommendations. The service demonstrated consistent growth, with the number of unique patients reached increasing from 16 in October 2025 to 59 in February 2026, representing a 269% increase and reflecting growing institutional integration. The patient population was predominantly female (55.1%), with most patients being adults aged 18–64 years (50.9%) or older adults aged ≥65 years (45.7%). Notably, 53 interventions (20.2%) involved patients receiving five or more concurrent medications, highlighting the clinical complexity managed by the service. A total of 150 recommendations were directly linked to the

ASP, representing 26.8% of all recommendations. Additionally, 61 interventions (23.3%) involved high-risk medications, including anticoagulants, insulins, immunosuppressants, and antiepileptics, where errors may lead to serious or potentially life-threatening harm. Education and information provision represented the most frequent intervention category (207; 79.0%), while therapy modifications were made in 59 cases. Interventions targeted patients (51.5%), physicians (21.0%), and caregivers (27.1%). Pharmacist recommendations were accepted in 95.4% of cases, partially accepted in 0.8%, and declined in 3.8%.

Conclusion: This study demonstrates that pharmacists provide meaningful clinical value within a structured hospital care transitions service. The service showed substantial growth in patient reach while managing complex cases involving high-risk medications and polypharmacy. The high acceptance rate of pharmacist recommendations underscores their clinical relevance and contribution to patient safety during care transitions. Future research should evaluate the impact of these services on readmissions, medication adherence, healthcare costs, and their scalability across hospital settings in Latin America.

Comprehensive medication management and medication adherence in biological therapies for chronic diseases: A three-year pharmacist-led experience in Costa Rica

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Background: Patients with chronic autoimmune, rheumatological, and dermatological conditions requiring biological and specialty therapies represent a high-complexity population in pharmaceutical care. Comprehensive Medication Management (CMM) programmes enable clinical pharmacists to systematically identify, prevent, and resolve drug-related problems whilst monitoring medication adherence — a critical determinant of therapeutic outcomes. Despite the growing global use of high-cost biological agents, evidence on adherence patterns within pharmacist-led CMM programmes in Latin America remains limited. This work characterises the pharmacotherapeutic and adherence profile of patients enrolled in the ATENFAR CMM programme at a tertiary private hospital in Costa Rica.

Method: A descriptive, cross-sectional analysis was conducted on 112 patients enrolled in the CMM programme at Hospital Clínica Bíblica, Costa Rica, over three years (2023–2025), with an average of 145 active patients per year. The cohort comprised 60% women and 40% men, consistent with the known female predominance in autoimmune diseases. Fourteen chronic pathologies were included. Medication adherence was assessed using the validated eight-item Morisky Medication Adherence Scale (MMAS-8), categorised as high, medium, or low. Medium adherence was further classified as intentional or non-intentional. Data were stratified by diagnosis, drug class, and route of administration using non-proprietary drug names.

Results: The most prevalent conditions were rheumatoid arthritis (n=31; 27.7%), chronic kidney disease (n=13; 11.6%), systemic lupus erythematosus (n=12; 10.7%), and psoriatic arthritis (n=11; 9.8%). The most frequently managed agents were secukinumab (n=19), tocilizumab (n=14), anifrolumab (n=12), tofacitinib (n=12), and adalimumab (n=11). MMAS-8 assessment revealed high adherence in 31.3% of patients (n=35), medium adherence in 66.9% (n=75), and low adherence in 1.8% (n=2). Critically, 72.2% of all medium adherence cases were intentional, indicating that the predominant barrier across the cohort is a conscious patient decision rather than forgetfulness — a clinically targetable pattern through pharmacist-led education. Route-stratified analysis revealed a clear adherence hierarchy. Intravenous therapies, administered under direct clinical supervision, achieved high adherence in 71.4% of patients (25/35), compared with 21.2% for subcutaneous self-administered therapies (11/52) and only 12.0% for oral agents (3/25). Low adherence occurred exclusively in oral agents (8.0%), with both cases reflecting intentional non-compliance. Drug-class analysis further reinforced this pattern: Janus kinase (JAK) inhibitors (tofacitinib, n=12) recorded 0% high adherence, with 91.7% of patients showing intentional medium adherence, representing the highest-risk subgroup for targeted intervention. Anti-tumour necrosis factor agents (adalimumab and etanercept, n=12) similarly showed predominantly intentional medium adherence (66.7%), whilst anti-interleukin-6 therapy (tocilizumab, n=14) achieved the strongest adherence profile among mixed-route agents (57.1% high).

Conclusion: The ATENFAR CMM programme successfully supported 112 patients across 14 chronic conditions over three years. The finding that 72.2% of non-adherence is intentional — concentrated in oral agents and JAK inhibitors — identifies a clearly addressable gap through structured patient education and intensified follow-up. The marked adherence hierarchy across administration routes (intravenous 71.4% > subcutaneous 21.2% > oral 12.0% high adherence) provides a framework for risk-stratifying pharmaceutical interventions. These findings support the expansion of pharmacist-led CMM programmes in Latin America as a strategy to optimise outcomes and ensure the rational use of high-cost biological therapies.

Environmental commitment in hospital pharmacies in Latin America: Results of a multinational survey

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Background: Healthcare systems contribute substantially to greenhouse gas emissions and environmental pollution. Hospital pharmacies are strategically positioned to promote sustainable practices through procurement policies, waste management, and therapeutic optimization. However, data on environmental engagement in Latin American hospital pharmacy practice remain limited. The purpose of this project is to assess environmental awareness, sustainability practices, and institutional policies among hospital pharmacy professionals in Latin America.

Method: A cross-sectional descriptive survey was conducted among hospital pharmacy professionals. The questionnaire assessed recycling practices, environmentally responsible procurement, supplier selection criteria, awareness of the environmental impact of anesthetic gases (e.g., desflurane), implementation of protocols to reduce medicinal gas consumption, promotion of low-carbon inhaler alternatives, and environmental education initiatives. Data were analyzed using descriptive statistics.

Results: A total of 108 professionals from Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Nicaragua, Peru, and Uruguay participated. Recycling practices were reported by 65.7% (n=71), being carton, paper and plastic the most recycled materials. Environmental criteria in supplier selection were applied in 31.5% (n=34) of institutions, and 13.9% (n=15) had rejected a supplier due to environmental concerns. Awareness of desflurane's environmental impact was reported by 62% (n=67), yet only 15.8% (n=17) indicated reduced use of inhaled anesthetics for environmental reasons, being the replacement for IV anaesthesia the most reported alternative (n=13). Protocols to reduce medicinal gas consumption were reported by 9.3% (n=10), and promotion of dry powder inhalers over metered-dose inhalers by 9.3% (n=10). Environmental training initiatives were reported by 47.2% (n=51) in average, but according to the subsystem, 61.8% in private institutions and 38% in the public sector. There is a statistically significant difference ($p = 0.019$) in recycling practices between public and private hospitals: 82.4% (28/34) of private hospitals recycle vs 55.5% (35/63) of public hospitals. According to the size of the institution, small facilities recycle 68% (30/44), medium facilities 70% (14/20), big hospitals 62.5% (20/32), and 45.5% of the outpatient centres recycle (5/11).

Conclusion: Although awareness and recycling practices are moderately present, integration of sustainability into procurement and high-impact pharmaceutical practices

remains limited. The dimension of Medical Gases and Inhaler Protocols (MDI to DPI) represents the area of least preventive development in hospital environmental management. Sustainability is not yet a decisive factor in the selection of healthcare products in the region. Strengthening environmental education and institutional policies may enhance the environmental contribution of hospital pharmacies in Latin America.

Optimizing knowledge management with artificial intelligence (AI) virtual assistants: A low-cost, high-impact solution

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Background: In the hospital pharmacy environment, the fragmentation of critical information—stability protocols, high-risk medications, Look Alike Sound Alike (LASA) drug lists, and administration guidelines—represents a significant barrier that increases the risk of operational errors and delays decision-making. This project presents the development and implementation of a personalized virtual assistant designed to centralize the technical documentation of the Pharmacy Service at Mater Dei Hospital in Buenos Aires, Argentina, prioritizing patient safety and operational efficiency.

Method: The NotebookLM® platform (and subsequently ChatGPT®) was used to create a centralized model for internal use by the Pharmacy. This model was trained with operational documents previously validated by pharmaceutical professionals, including: Stability protocols for 127 oncology drugs. Intravenous administration guidelines for 213 medications. Lists of 94 high-risk medications, 45 LASA drugs, and 87 active ingredients requiring filters. Physical location of 756 supplies and health insurance agreements for 534 products. To mitigate AI hallucinations, the system was configured with logical reasoning rules and natural language processing to respond exclusively based on the loaded data source, ensuring that the response is specific and strictly professional. The model's use was evaluated through a survey completed by pharmacy staff.

Results: The tool was implemented in November 2025, achieving a 91.7% adoption rate among staff (technical and professional). All respondents reported time savings. 100% of respondents reported greater confidence when responding to external inquiries. 81.8% of respondents believe the tool contributes to reducing errors. 36.4% consider the tool easy to use, while 63.6% consider it very easy to use, and 90.9% used it to locate supplies in the Pharmacy Department. 100% of respondents considered the model's response was correct. When asked about the possibility of adding new documents

to the resource library, responses included: information on drug interactions, access to the hospital's clinical practice guidelines, uses and synonyms for disposable materials/medical products, and a catalog of medical products with photos, generic names, and identification codes in the management information system. Furthermore, the success of the Pharmacy Department model has led to its replication in other institutional areas.

Conclusion: The implementation of AI-based virtual assistants for pharmacy management is a highly effective, cost-efficient, and scalable strategy. By using accessible and free tools like NotebookLM®, access to cutting-edge technology is democratized for institutions in low resource environments, transforming knowledge management into a pillar of security. This model not only optimizes workflow but also positions pharmacists as leaders in the digital transformation of healthcare.

The future of digital monitoring for chemotherapy patients through the SIAGA system

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Background: Effective monitoring of chemotherapy patients is essential to ensure treatment safety, improve adherence, and enable the early detection of treatment-related adverse events. Conventional monitoring systems that rely on manual documentation and in-person consultations often lead to delayed symptom reporting and fragmented patient records. Digital health technologies, particularly mobile health applications, have emerged as promising tools to support symptom monitoring and patient engagement in oncology care. Previous studies have demonstrated that mobile applications for cancer patients can improve treatment adherence, facilitate remote symptom monitoring, and enhance communication between patients and healthcare professionals (Yilmaz et al., 2021). However, many existing digital tools primarily focus on symptom tracking and lack structured chemotherapy cycle reminders or integrated pharmaceutical care components. Therefore, the SIAGA (Digital Chemotherapy Information and Monitoring System) was developed to provide an integrated digital monitoring platform with enhanced pharmacist involvement in chemotherapy patient care.

Method: This study implemented the SIAGA digital monitoring system to support structured chemotherapy patient monitoring. A total of 281 adult patients aged 18–65 years who were receiving oral or intravenous chemotherapy were included in the study. The SIAGA platform enables

patients to report symptoms, adverse effects, and treatment-related concerns remotely through a digital interface. A key novelty of SIAGA lies in the integration of structured chemotherapy cycle reminders and direct pharmacist consultation within the monitoring platform. Automated notifications are sent five days before chemotherapy, on the day of chemotherapy, and one day after chemotherapy to support treatment preparation and post-chemotherapy monitoring. Patients can also communicate directly with pharmacists regarding medication use and the management of chemotherapy-related side effects. Patient adherence and satisfaction were evaluated before and after the implementation of the SIAGA system.

Results: The implementation of SIAGA demonstrated improvements in patient participation and monitoring outcomes. Patient adherence to chemotherapy monitoring increased from 76.2% before implementation to 92.8% after the implementation of the digital system. Patient satisfaction with chemotherapy monitoring services increased from 80.5% to 94.3%, reflecting improved accessibility and responsiveness of healthcare services. The integrated reminder system and pharmacist-led communication contributed to improved patient engagement and earlier identification of treatment-related problems. To date, the SIAGA system has been implemented in routine clinical practice and has been utilised by more than 1,100 chemotherapy patients, demonstrating its feasibility and scalability in real-world oncology care settings.

Conclusion: The SIAGA digital monitoring system represents an innovative approach to chemotherapy patient monitoring by integrating structured treatment reminders, remote symptom reporting, and pharmacist–patient communication within a single digital platform. This pharmacist-led monitoring model improved patient adherence and patient satisfaction. SIAGA demonstrates strong potential to enhance patient safety, strengthen oncology pharmaceutical care, and support the future development of integrated digital health services for cancer patients.

Exporting skills, importing pride: A Canada–Senegal mentorship in hospital clinical pharmacy

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Background: Non-university hospitals play a significant role in healthcare delivery in Quebec (Canada), but their contribution often remains less visible compared to large academic medical centers. However, these institutions are often rooted in deep humanistic values. Santa Cabrini Hospital was founded by a religious congregation that supported the post Second World War Italian immigrant

community in Montreal and has preserved a core identity of openness and service to others. It was in this spirit that an international mentoring initiative emerged, in collaboration with the FIP (International Pharmaceutical Federation) Pharmabridge program. The purpose of this initiative was to support a Senegalese pharmacist seeking to implement an inpatient service of clinical pharmacy, while highlighting the capacity of a Quebec non-university hospital to extend its influence through the sharing of knowledge and expertise.

Method: A virtual mentoring program was established. Meetings provided a space to discuss about practice models, the clinical approach framework, and to identify priorities and objectives. The initiative combined mentoring (the transmission of experience) with coaching (reflection and empowerment). The project was integrated into existing resources allocated to institutional projects without any additional costs.

Results: For the Senegalese pharmacist, the mentoring program provided an initial structure and guidance to launch the development of an inpatient clinical pharmacy service. For the Montreal hospital pharmacy team, the project rekindled a sense of mission, strengthened professional pride, and demonstrated that non-university hospitals can achieve positive international impact. This initiative highlighted how the sharing of skills, when guided by humanism, can become a powerful driver of engagement and professional attractiveness.

Conclusion: This mentoring experience illustrates how a simple altruistic approach generates meaningful impact in two different countries. Non-university hospitals possess extensive human and professional expertise that deserves recognition and can contribute to the advancement of clinical pharmacy through international influence.

Pharmacist-guided optimization of antidiabetic regimens with SGLT2 inhibitors after incident proteinuria in long-term care residents

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Background: Recent clinical guidelines, including those from the American Diabetes Association (ADA), recommend prioritizing sodium–glucose cotransporter-2 inhibitors (SGLT2i) for patients with diabetes and albuminuria or mild renal impairment due to their renal protective effects and ability to slow chronic kidney disease (CKD) progression. Nursing home residents are predominantly older adults with multiple comorbidities, making equitable access to kidney-protective strategies particularly important. This study describes pharmacist-guided optimization of antidiabetic

regimens following the detection of albuminuria in a long-term care setting.

Method: When albuminuria was identified during routine laboratory monitoring, pharmacists evaluated residents' glucose-lowering therapy according to current ADA recommendations, with particular focus on renal protection. Interventions included prescription review, dosing assessment, evaluation of renal function and comorbidities, and recommendations to add or switch to an SGLT2 inhibitor when appropriate. Eligible patients met guideline-recommended CKD criteria, including an albumin-to-creatinine ratio (ACR) >30 mg/g and renal function suitable for SGLT2i use. All pharmacist recommendations and physician acceptance were documented within routine interdisciplinary practice.

Results: In December 2025, 88 residents were reviewed at a nursing home affiliated with a regional hospital in Taipei, Taiwan. Among them, 23 had diabetes mellitus; one patient on hemodialysis was excluded. The remaining patients were predominantly male (68.2%) with a mean age of 74.1 ± 13.2 years and a mean HbA1c of $6.5 \pm 0.6\%$. Based on KDIGO classification, 15 patients had CKD: 7 (31.8%) stage 1 with microalbuminuria, 5 (22.7%) stage 3A, and 3 (13.6%) stage 3B. Two patients had already been receiving an SGLT2 inhibitor prior to albuminuria detection or CKD diagnosis. Seven patients (46.7%) received pharmacist recommendations to initiate or switch to an SGLT2 inhibitor. Among these, three demonstrated substantial reductions in ACR after treatment initiation, with mean values decreasing from 684.2 mg/g to 249.9 mg/g. Six patients had not yet received SGLT2i therapy and were identified as potential candidates for future intervention.

Conclusion: Pharmacist-led, guideline-based optimization of antidiabetic therapy in nursing home residents with diabetes and CKD is feasible in real-world practice. Observed reductions in albuminuria following SGLT2i initiation suggest potential clinical benefit. These findings highlight the role of pharmacists in facilitating evidence-based implementation, enhancing renal protection, and strengthening team-based chronic disease management in long-term care settings.

Artificial intelligence in pharmacy education: Boosting efficiency and reducing burden

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Background: Clinical pharmacists play a key role in multidisciplinary healthcare teams while also serving as clinical educators. Balancing extensive clinical workloads with teaching responsibilities has become increasingly challenging. In recent years, artificial intelligence (AI) has been introduced as a supportive tool in medical education; however, evidence regarding its practical implementation in pharmacy education remains limited. This study integrated AI into pharmacy training across three domains: (1) the development of teaching materials, including presentations, visuals, cases, and instructional videos; (2) examination question generation; and (3) assignment grading with feedback. This study aimed to evaluate the impact of AI-assisted educational support on teaching efficiency and user acceptance within pharmacy training programs.

Method: This pilot quality improvement study employed a single-subject, repeated-measures pre-post design in a medical center pharmacy education setting. AI-assisted interventions were applied to teaching material development, examination question generation, and evaluation with feedback. Data were collected from October 2025 to January 2026, with repeated measurements obtained before and after AI implementation. Time expenditure was analyzed using descriptive statistics. The Wilcoxon signed-rank test was applied as an exploratory supplementary analysis to assess within-task changes before and after AI implementation. Changes in preparation time before and after AI implementation were visualized using paired course-level plots. User satisfaction was analyzed through thematic analysis. As all measurements were derived from a single participant, statistical inference was limited to the individual level.

Results: AI-assisted teaching material preparation reduced the median preparation time from 265 minutes (interquartile range [IQR]: 141) to 230 minutes (IQR: 141) ($n=3$, $W=0$, $p=0.25$). For AI-assisted examination question generation, median preparation time decreased from 29 minutes (IQR: 19) to 13 minutes (IQR: 15) ($n=4$, $W=0$, $p=0.125$). In evaluation and feedback provision, median preparation time significantly decreased from 13 minutes (IQR: 3) to 6 minutes (IQR: 2) ($n=9$, $W=0$, $p=0.004$). Paired course-level plots consistently demonstrated reductions in preparation time following AI implementation, although the magnitude of improvement varied across different teaching tasks. Thematic analysis identified three major benefits: reduced

teaching workload, improved educational consistency, and enhanced learner engagement and self-directed learning.

Conclusion: Although reductions in preparation time for teaching material development and examination question generation did not reach statistical significance, consistent trends toward time savings were observed. In contrast, AI-assisted evaluation and feedback provision demonstrated a statistically significant reduction in preparation time. These findings suggest that AI-supported instructional workflows may enhance teaching efficiency and help alleviate instructors' workload, particularly in clinical training settings where educators must balance intensive clinical duties with educational responsibilities. Given the single-subject design and limited sample size, further studies involving multiple educators and larger datasets are warranted to confirm these findings and improve generalizability.

Utilisation patterns of self-paid anti-influenza antiviral agents and clinical implications in a tertiary medical centre in Taiwan

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Background: In Taiwan, influenza viruses circulate year-round, with major seasonal outbreaks peaking during autumn and winter. Publicly funded antiviral agents (e.g., oseltamivir and zanamivir) are currently restricted to specific populations designated by health authorities. In October 2025, public coverage was expanded to all school-aged students and healthcare professionals to mitigate transmission risks associated with the start of the academic year. Nevertheless, many patients with influenza-like illness (ILI) remain ineligible for public reimbursement, highlighting a significant clinical reliance on self-paid antivirals to meet therapeutic needs and bridge gaps in public healthcare coverage. This study aimed to analyse utilisation patterns of self-paid anti-influenza antiviral agents and evaluate their clinical implications and dosing appropriateness in a tertiary medical centre setting.

Method: This retrospective observational study reviewed electronic medical records of self-paid antiviral prescriptions (baloxavir marboxil, peramivir, and oseltamivir) issued in outpatient and emergency departments between July and December 2025 at a tertiary medical centre in Taiwan. Utilisation trends were analysed by month, age group, and formulation. Dosing appropriateness was assessed according to Taiwan influenza treatment guidelines, with particular consideration of body weight and renal function.

Results: A total of 2,920 patients were included. Four antiviral formulations were prescribed, encompassing cap-dependent endonuclease inhibitors and neuraminidase inhibitors (NAIs):

baloxavir marboxil (50.9%, n=1,487), peramivir (33.2%, n=969), oseltamivir capsules (13.7%, n=401), and oseltamivir suspension (2.2%, n=63). Among patients receiving baloxavir marboxil, 44.7% were aged 12 years or younger; within this paediatric population, 8.3% weighed under 20 kg and 36.4% weighed 20 kg or above. For peramivir, 34.1% of prescriptions were issued to patients aged 18 years or younger. A single 600 mg high dose was administered to 1.4% of adults with severe influenza, and renal dose adjustment was required in 1.1% of peramivir-treated patients. Among oseltamivir capsule prescriptions, 9.9% were for paediatric patients weighing under 40 kg, while the suspension formulation was used exclusively in paediatric patients.

Conclusion: Antiviral utilisation peaked in September and October, with self-paid prescription trends closely mirroring national monthly influenza-like illness activity, reflecting how school-based clustering after the academic year drives antiviral demand. Despite publicly funded treatment being limited to specific criteria, self-paid anti-influenza antiviral agents remain integral to influenza management, highlighting the importance of maintaining adequate stock in hospital settings to meet patient needs. Both baloxavir marboxil and peramivir are single-dose regimens. Baloxavir marboxil was the most frequently prescribed, likely due to oral convenience and potential to improve adherence, whereas peramivir, administered intravenously, ensures complete bioavailability and is preferred for patients with severe disease, high-risk conditions, or swallowing difficulties. Differences in antiviral selection reflect patient-specific clinical needs, underscoring the importance of precision dosing. Pharmacists play a critical role in safeguarding medication safety and public health through careful assessment of dosing and patient risk factors, contributing to effective influenza management and optimal resource allocation during seasonal surges.

Designing a risk-stratified medication order verification framework using 2-year pharmacist intervention data in an acute tertiary hospital in Singapore

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Background: Healthcare systems face escalating medication order volumes driven by an ageing population and workforce constraints, placing increasing pressure on traditional prospective pharmacist verification workflows. Medication related problems (MRPs) risk-stratified 'verify-by-exception' frameworks, including autoverification or retrospective review for lower risk orders, may optimize workforce allocation while maintaining safety. However, there is a

paucity of real-world, pharmacist-adjudicated medication data to guide implementation.

Objective: To derive a medication-specific overall risk score based on MRP frequency and severity, using two years of pharmacist intervention data. Risk stratification of medication orders is anticipated to form the evidence base supporting autoverification and/or retrospective review during next-generation electronic medication record (NGEMR) implementation.

Method: We conducted a retrospective study of all pharmacist medication interventions between 01 December 2019 and 31 November 2021 in Changi General Hospital, an acute tertiary hospital in Singapore. Medication intervention notes were extracted from the institution's electronic health records. They indicate near-miss medication errors that were intercepted before reaching the patient; a proportion could be MRPs. A panel of four clinical pharmacists reached a consensus on a framework for MRP classification. Two independent clinical pharmacists who received task-specific training adjudicated if a medication intervention indicated an MRP. Inter-rater reliability was assessed using Cohen's Kappa. MRPs were categorized by the medication(s) involved and potential severity. A medication-specific overall risk score was calculated as MRP frequency (1: 1–2 times/year; 2: 3–5; 3: 6–20; 4: >20) multiplied by potential severity (1: minor; 2: moderate; 3: major; 4: critical). Medications were stratified into high (overall score ≥4), moderate (1–3), and low-risk (0) categories. We estimated the proportion of orders suitable for autoverification or retrospective review.

Results: There were 73,688 medication intervention notes across all hospital visits over two years. After excluding 49.1% that were not MRPs and 2.6% with indeterminate status, 35,636 (48.4%) notes from 23,948 visits (17,878 patients) were adjudicated to be MRPs. There was strong agreement in MRP classification (agreement 92.5%; Kappa 0.85) and potential severity score (agreement 94.7%; weighted Kappa 0.87) between the two pharmacists. Among 35,636 MRPs, the median age was 71 years (IQR 60–81) and 55.8% were male. Sixty-two percent were Chinese and 86.8% in the inpatient setting. Among 1,132 unique medications associated with MRPs, 57.2% and 15.9% were in the lowest and highest frequency categories, respectively. Most medications had higher severity scores (1: 9.4%; 2: 34.5%; 3: 54.5%; 4: 1.6%). Across 1,456 medications in the institution's drug formulary, 448 (30.8%) medications were classified as high-risk, 684 (47.0%) moderate-risk, and 324 low-risk (22.3%; not in this study). Rifampicin (12.1), rilpivirine (11.7), clarithromycin (11.1), and eplusea (11.0) had the highest risk scores. Low-risk medications may be eligible for autoverification and moderate-risk medications for retrospective review.

Conclusion: Real-world pharmacist intervention data can inform a risk-stratified medication order verification framework prior to NGEMR implementation. Medication-specific risk category thresholds can be modified based on institutional risk tolerance. This positions pharmacists as system designers in digital transformation, balancing patient

safety with sustainable workload management. Prospective validation and post-implementation safety monitoring are required.

AI-based image recognition to reduce LASA-related return-to-stock errors in automated packaging systems

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Background: Medication errors are among the most frequently reported patient safety incidents and are closely associated with adverse clinical outcomes. Among these, look-alike and sound-alike medications (LASA) are widely recognised as a major contributing factor. LASA errors may occur at different stages of the medication-use process, including prescribing, dispensing and administration, potentially leading to incorrect medication use, overdosing or underdosing. Automated tablet packaging systems are widely implemented in hospital pharmacies to improve dispensing efficiency and workflow consistency. However, in automated environments, the process of returning loose tablets to stock still relies largely on manual visual identification by pharmacists. This step represents a relatively low-frequency but high-risk task and has received limited systematic evaluation. When tablets share similar appearances or markings, pharmacists must repeatedly compare them before returning them to stock, increasing workload and the risk of LASA-related errors.

Method: This study investigated LASA-related risks in the return-to-stock workflow of the automated packaging machine and evaluated the feasibility of using artificial intelligence (AI)-based tablet image recognition as a supporting tool. Systematic literature review: PubMed, Embase, Google Scholar and the Cochrane Library were searched for studies related to LASA medication errors, automated dispensing systems and tablet image recognition technologies (up to February 2025). National data review: Public annual reports from the Taiwan Patient Safety Reporting System (2020–2024) were analysed to identify medication incident patterns and stages of occurrence. Workflow analysis and technology evaluation: The return-to-stock and prescription modification workflows of the automated packaging unit at Mackay Memorial Hospital, Taiwan, were reviewed. An AI-based loose tablet image recognition system was developed with a technology partner and evaluated in the pharmacy setting.

Results: Literature findings and national patient safety data indicate that medication incidents represent the largest category of reported adverse events in healthcare institutions, with human factors frequently identified as a major contributor. Although no single intervention can

completely eliminate LASA errors, technological support such as automation and information systems may help reduce risks and improve medication safety. At Mackay Memorial Hospital, more than 6,000 prescriptions are processed daily, with approximately 120 involving prescription modifications requiring medication quantity adjustments. Some medications are returned to the automated packaging machine as loose tablets. Because many tablets have similar appearances or names, pharmacists must rely on repeated visual comparison before returning them to stock, creating substantial workload and potential fatigue-related risks. In a preliminary evaluation, manual identification of 200 loose tablets required an average of 140 seconds, whereas the AI system completed identification in approximately two seconds. The AI system incorporates dual-side tablet recognition and achieved an identification accuracy of approximately 98%, significantly reducing verification time and the risk of incorrect tablet placement.

Conclusion: Integrating AI-based tablet image recognition into automated packaging workflows may reduce LASA-related risks during the return-to-stock process. The system supports pharmacists in identifying loose tablets more efficiently, reduces workload and improves operational reliability. This technology-assisted approach represents a feasible strategy for strengthening medication safety in automated pharmacy environments.

The clinical effect of steroids for hearing preservation in cochlear implantation: Conclusions based on three cochlear implant systems and two administration regimes

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Background: According to the current clinical indications for cochlear implantation (CI), which have been progressively expanded, candidates for the procedure are those with partial deafness (PDT, partial deafness treatment), children with congenital profound hearing loss, single-sided deafness patients, and those over 65 years of age, as well as those with acquired bilateral sensory hearing loss. Some years ago, it would be very challenging, or even impossible, to preserve residual hearing after CI surgery. Recent advances have been on the design of the electrodes, atraumatic surgical techniques, monitoring of cochlear function during implantation, and use of corticoids and other anti-

inflammatory drugs, all of which help preserve residual hearing.

Method: The main aim of this study was to assess the clinical effect of steroids (dexamethasone and prednisone) on hearing preservation in patients who underwent cochlear implantation with different cochlear implant systems (Oticon®, Advanced Bionics®, Med-El®). 147 adult patients met the inclusion criteria and were enrolled to the study and divided into three groups depending on the brand of cochlear implant they received and participated in all follow-up visits regularly. They were also randomly divided into three subgroups depending on the steroid administration regime: (1) intravenous dexamethasone (0.1 mg/kg body weight twice a day for three days); (2) combined intravenous and oral steroids (dexamethasone 0.1 mg/kg body weight twice a day plus prednisone 1 mg/kg weight once a day); and (3) no steroids (control group). The results were measured by pure tone audiometry (PTA) at three time points: (i) before implantation, (ii) at processor activation, and (iii) 12 months after activation. A hearing preservation (HP) figure was also calculated by comparing the preoperative results and the results after 12 months. Further measures collected were electrode impedance and hearing threshold in the non-operated ear.

Results: The highest HP measures (partial and complete) were obtained in the subgroups who were given steroids. Of the 102 patients given steroids, HP was partial or complete in 63 of them (62%). In comparison, partial or complete HP was achieved in only 15 patients out of 45 (33%) who were not given steroids. There were differences between the three cochlear implant groups, with the Med-El and Advanced Bionics groups performing better than the Oticon group (45% and 43% of the former two groups achieved partial or complete HP compared to 20% in the latter). Hearing thresholds in the non-operated ear were stable over 12 months. Generally, impedance was slightly lower in the 12 month follow-up in comparison with the activation period, with the exception of the Oticon group.

Conclusion: Pharmacological treatment with steroids in patients undergoing cochlear implantation helps to preserve residual hearing.

prescribes a TKI—specifically imatinib, osimertinib, or sorafenib—pharmacists are notified to remind the doctor to order regular blood tests, including ALT, AST, and total bilirubin. This study aims to evaluate how pharmacist intervention improves the liver function monitoring rate for patients receiving these TKI therapies.

Method: This study included patients treated with imatinib, osimertinib, or sorafenib at a district hospital from October to December 2025. We first identified patients who had not received liver function monitoring for over three months. For these patients, pharmacists actively intervened by reminding their doctors to order essential blood tests. Three months later, we collected follow-up data to evaluate the improvement in the monitoring rate. All data were analyzed using statistical software to compare the monitoring frequency before and after the pharmacist intervention.

Results: A total of 46 patients were included in this study, consisting of 14 receiving imatinib, 26 receiving osimertinib, and 6 receiving sorafenib. At baseline, the number of patients without liver function monitoring was 8 (57.1%) for imatinib, 11 (42.3%) for osimertinib, and 1 (16.7%) for sorafenib. Three months after the pharmacist intervention, the monitoring rates showed noticeable improvement. Specifically, 4 out of 8 patients (50%) in the imatinib group and 6 out of 11 patients (54.5%) in the osimertinib group completed the required blood tests. Overall, the unmonitored rate for the entire group decreased from 43.5% at baseline to 21.7% after the intervention. While the single unmonitored sorafenib patient showed no change, the reminder system effectively increased monitoring for the majority of patients.

Conclusion: Hepatotoxicity is a serious concern for patients treated with TKIs. Regular liver function monitoring every three months is essential for the early detection of abnormalities. Our study shows that a pharmacist-led intervention system can significantly improve monitoring rates. While some individual cases still require closer follow-up, the system effectively increases overall compliance. In conclusion, integrating pharmacist intervention into clinical workflows is a practical and effective strategy to enhance patient safety in cancer therapy.

Improving liver function monitoring in cancer patients receiving TKI therapy via pharmacist intervention: An experience in a district hospital

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Background: Tyrosine kinase inhibitors (TKIs) are essential for cancer treatment, but liver toxicity is a common concern. To improve patient safety, our hospital developed a reminder system to help doctors monitor liver function. When a doctor

The hospital pharmacist as the AI architect: Redefining paediatric medication safety

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Background: Hospital pharmacists play a critical role in ensuring medication safety in paediatric settings, where complex weight-based dosing, high-risk therapies, and vulnerable patient populations require continuous clinical oversight. In Greece, paediatric hospitals face challenges related to fragmented information systems, limited interoperability, and increasing demands for safe and efficient medication management. Emerging digital technologies, including artificial intelligence (AI), interoperable cloud computing, and secure data infrastructures, provide opportunities to strengthen pharmacist-led clinical decision-making, optimize medication-use pathway, from procurement and supply chain management to dispensing and clinical monitoring in order to enhance patient safety.

Objective: To develop and evaluate a pharmacist-led, AI-supported and interoperable medication management model designed to enhance patient safety, optimise pharmaceutical supply chain processes, and strengthen clinical decision-making and feedback mechanisms in paediatric hospitals.

Method: A pharmacist-led quality improvement initiative is being conducted across the two biggest tertiary paediatric hospitals in Greece to strengthen medication safety through digital innovation and clinical oversight. Current medication-use processes include the use of automated dispensing cabinets to support secure storage, traceability, and dispensing control, as well as established pharmacy systems for the preparation and verification of total parenteral nutrition. These systems are monitored by pharmacists through continuous audit, error reporting, and workflow optimization. The initiative aims to progressively incorporate AI into existing medication management systems to enhance pharmacist-led clinical decision-making. In parallel, hospitals are assessing and evaluating digital systems for oncology medication management, including chemotherapy prescribing and verification processes, with pharmacist oversight to ensure safe implementation and quality assurance. Pharmacists also coordinate antimicrobial stewardship activities and monitor high-risk medication processes. In addition, AI applications are being assessed for pharmaceutical supply chain management, including demand forecasting, inventory optimisation, monitoring of medicine availability, and traceability of high-risk medications.

Results: Pharmacist leadership was fundamental in ensuring the clinical relevance, safety, and effective integration of AI technologies into medication management processes. Pharmacist oversight of total parenteral nutrition processes improved standardisation, reducing preparation time by 80% and dispensing deviations by 92%. Pharmacist oversight of automated dispensing and chemotherapy verification strengthened quality assurance and reduced process variability by eliminating transcription and calculation errors. Pharmacist-led real-time antimicrobial stewardship using Days of Therapy (DOT) method demonstrated improved audit and feedback cycles and more timely clinical interventions. The implementation of structured feedback systems increased staff engagement and professional empowerment, while secure data management practices ensured system reliability and trust.

Conclusion: Hospital pharmacists are key drivers of digital transformation in paediatric healthcare, extending their role beyond traditional dispensing to leadership in AI-supported clinical decision-making and pharmaceutical supply chain management. The integration of interoperable systems and secure AI technologies enhances medication safety, optimises medicine availability, and supports measurable improvements in patient outcomes and safety culture. Strengthening pharmacist-led digital innovation represents a scalable strategy for advancing medication safety in paediatric hospital practice.

Establishing a global pharmacy workforce intelligence system: design and initial implementation of the international evaluation of labour force (INTEL) survey

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Background: Health systems worldwide are experiencing significant workforce pressures, including increasing service demand, workforce shortages, geographic maldistribution, and growing concerns regarding workforce wellbeing and sustainability. Pharmacists are among the most accessible healthcare professionals globally and play a critical role in ensuring safe and effective medication use. However, comprehensive and comparable international data describing the pharmacy workforce remain limited. Existing global workforce reports primarily rely on aggregated national data and often lack individual-level information on employment characteristics, scope of practice, and workforce wellbeing. Data describing pharmacy technicians and assistants—an increasingly important component of the medication-use workforce—are particularly scarce. To address these gaps, the Global Pharmacy Workforce Survey was developed through the Pharmacy International Evaluation of Labour

Force (INTEL) project. The objective is to establish a coordinated, international workforce survey capable of generating comparable data describing demographics, education, employment, professional roles, and well-being of pharmacists and pharmacy technicians worldwide. This initiative aims to support evidence-based workforce planning, policy development, and investment decisions across health systems.

Method: The INTEL Global Pharmacy Workforce Survey uses a cross-sectional, online design administered via Qualtrics. Pharmacists and pharmacy technicians from all World Health Organization (WHO) regions are eligible to participate, regardless of practice setting or professional role. Participants are recruited through global dissemination, including professional networks, international collaborators, professional organisations, regulatory bodies, and academic institutions. Interested individuals complete a participation interest form and subsequently receive a survey invitation via email. The survey instrument is informed by validated items from the United States National Pharmacist Workforce Study and adapted for global applicability. Core domains include: (1) demographics and education; (2) employment characteristics and work activities; (3) scope of professional practice; and (4) health, wellbeing, and professional sustainability. Standardised measures of professional fulfilment and burnout are incorporated. The survey is designed for annual administration over an initial five-year period to enable longitudinal analyses.

Results: The INTEL project successfully developed a globally applicable workforce survey instrument through the adaptation of validated workforce study items and the incorporation of internationally relevant domains. The final instrument includes comprehensive measures of workforce demographics, employment characteristics, scope of practice, and well-being, with standardised constructs enabling cross-country comparison. A global recruitment infrastructure was established, including dissemination through professional organisations, academic institutions, and international networks, supporting participation across all six WHO regions. Survey processes, including a participation interest form and structured email distribution strategy, were implemented to facilitate broad international engagement. Initial implementation is underway, with early participation spanning multiple regions and practice settings. The survey design enables comparative analyses of workforce characteristics, professional roles, and well-being across countries, as well as longitudinal monitoring of workforce trends over time.

Conclusion: The INTEL Global Pharmacy Workforce Survey represents a novel international effort to generate standardised, comparable workforce intelligence for the pharmacy profession. By integrating validated measures with a globally adaptable survey design, the project establishes a foundation for ongoing workforce surveillance. The findings are expected to inform policymakers, educators, and health system leaders, supporting strategic workforce planning and strengthening the global pharmacy workforce.

Development and Global Consensus of Professional Standards for Hospital Pharmacy Practice

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Background: Globally relevant standards are critical to advancing hospital pharmacy practice while accommodating variation in healthcare systems and resource availability. Building on the Basel Statements, FIP's best practice framework for hospital pharmacy, this project aimed to develop the Professional Standards for Hospital Pharmacy. These standards define the minimum essential components of medicines use systems required across all hospital settings no matter the setting or resources available, while also providing a structured pathway towards best practice. By identifying what must be in place before optimal practice can be achieved, the standards aim to improve clarity, prioritisation, and implementation across countries. The objective was to establish a globally informed, consensus-based framework that is practical, adaptable, and applicable across diverse healthcare environments.

Method: A multi-phase, mixed-methods approach was utilised. Phase 1 involved identification of functional components across Basel Statement themes using literature, existing national standards, expert input, regulatory frameworks, and prior research. These components represented discrete elements required to support safe and effective medicines use systems. In Phase 2, functional components were synthesised into draft standards aligned with Basel Statement domains. Phase 3 included a global workshop at the 2025 Congress, where participants reviewed and refined draft standards and contributed to a structured Delphi process assessing agreement, clarity, and applicability. Participants represented diverse practice settings and geographic regions. Quantitative Delphi data and qualitative feedback from workshop discussions were collected. Subsequent phases include iterative refinement and finalisation of the standards through continued expert engagement, with final outputs to be presented at the 2026 Congress.

Results: Phase 1 identified 147 functional components across all Basel Statement domains, of which 126 (85.7%) were retained based on ≥80% consensus. Retention rates by domain ranged from 81.3% to 92.9%, demonstrating strong agreement on essential elements of hospital pharmacy practice. Phase 2 resulted in the development of 43 draft standards derived from these components. Phase 3 engaged 94 participants from 22 countries, representing all six World Health Organization regions, ensuring broad global representation. Workshop feedback provided detailed, practice-informed insights that informed refinement of terminology, structure, and contextual adaptability. Delphi

findings demonstrated consistently high levels of agreement across proposed standards, supporting their relevance and clarity across settings. Final results will include the fully refined standards and detailed Delphi consensus outcomes, to be presented at the 2026 Congress.

Conclusion: The Professional Standards for Hospital Pharmacy provide a globally developed, consensus-based framework defining the minimum essential components of safe and effective medicines use systems no matter the setting or resources. By bridging foundational requirements with aspirational best practice, these standards offer a practical and scalable tool for countries to assess current capabilities, prioritise development efforts, and guide policy, education, and practice transformation. The strong global agreement observed underscores the shared vision for hospital pharmacy practice. Presentation of the final standards and consensus outcomes will support harmonisation of expectations and accelerate progress towards optimal medicines use worldwide.

Impact of a value co-creation-based pharmaceutical care model in long-term care facilities: A hospital-community pharmacy collaboration

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Background: As populations age rapidly, long-term care (LTC) residents frequently face multiple chronic conditions and polypharmacy, significantly elevating the risk of medication-related problems (MRPs) and adverse drug events. Effective pharmaceutical care in these settings necessitates seamless, coordinated collaboration among healthcare providers across diverse clinical environments. This study aimed to establish and implement a collaborative pharmaceutical care model grounded in a value co-creation framework. The model integrates a central hospital, partnered LTC facilities, and community pharmacies to foster interprofessional synergy. By leveraging cross-institutional collaboration, the model sought to enhance medication safety, optimize pharmacotherapy quality, and bridge communication gaps between primary and secondary care providers. Furthermore, the study evaluated the clinical and operational impacts of this integrated care model within the LTC ecosystem.

Method: The participating LTC facilities and community pharmacies were independent institutions collaborating with the hospital under this program. From 2023 to 2025, 21 LTC

facilities (total capacity: 1,400 beds) were enrolled. All facilities collaborated with a central hospital that provided monthly physician visits. Additionally, nine community pharmacies were recruited as strategic pharmaceutical care partners. The model utilized three core strategies: (1) Digital Integration: A cloud-based medical and prescription linkage system was developed for real-time sharing of clinical data among hospitals, LTCs, and pharmacies, minimizing information asymmetry. (2) Standardized Management: Hospital pharmacists conducted each year on-site visits to perform environmental safety assessments and medication storage audits using a 56-point standardized evaluation scale. (3) Direct Intervention: Community pharmacists conducted integrated medication reviews and provided recommendations by comparing residents' medication profiles before and after intervention.

Results: Through coordinated collaboration between the hospital, community pharmacies, and LTC facilities, a patient-centered pharmaceutical care model was successfully implemented. The real-time medical and prescription information linkage system was officially launched in December 2023, facilitating timely communication and improving medication management processes. Following pharmacist-led interventions and systematic medication reviews, the mean number of prescription orders per resident per month demonstrated a statistically significant and sustained decline. Specifically, the mean number decreased from 1.69 in 2023 to 1.27 in 2024, and further reached 1.16 by 2025 ($p < 0.05$), indicating a reduction in potentially inappropriate medications and improved prescribing efficiency. Furthermore, medication safety performance at the facility level showed marked improvement; the average medication safety score rose from 47.5 to 53.0 (out of 56), reflecting enhanced institutional management.

Conclusion: The implementation of a digitally supported, community-based, interprofessional pharmaceutical care model demonstrated substantial positive impacts on medication management and cross-setting communication. By facilitating real-time data exchange and proactive pharmacist interventions, this value co-creation framework effectively optimized pharmacotherapy for LTC residents. These findings suggest that a collaborative hospital-community-LTC model serves as a scalable, sustainable, and highly effective approach for delivering integrated pharmaceutical care in aging societies, particularly for healthcare systems facing high-intensity long-term care demands.

Beyond the missed dose: Dashboard supported evaluation of medication safety priorities

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Background: Medication safety within healthcare systems is essential to identifying, mitigating, and preventing harm. To advance this goal, healthcare organisations increasingly rely on systematic monitoring tools. The Hospital utilises a medication-safety dashboard to track missed or delayed medication doses for all hospitalised patients. This study aimed to identify and describe missed medication doses at the Hospital across the priority drug classifications for medication safety improvement.

Method: Data from the QlikSense® dashboard were evaluated from August 2023 to April 2025, based on the date when a medication was first prescribed. A total of 78,435 missed medication doses were identified. The dataset was refined to exclude all 'prn' medications (as needed/not scheduled) and to isolate patient-refused doses of medications on the Hospital Critical Medications List. A secondary analysis was conducted to identify missed medications across the priority medication safety areas within the facility: insulins, narcotics, and anticoagulants. Descriptive statistics were used for analysis.

Results: A total of 5,768 (7.4%) critical medication doses were identified as patient-refused. The top three medications refused by patients were enoxaparin (1,864), morphine (681), and oxycodone (597). Across the medication-safety priorities, there were 354 (6%) refused insulin doses, 1,922 (33%) refused anticoagulant doses, and 1,202 (21%) refused narcotic doses. Most refusals occurred in respiratory and oncology wards.

Conclusion: These findings indicate that more than 7% of all missed doses resulted from patient refusal of prescribed, scheduled medications. This analysis underscores the need to evaluate the patient-refusal reporting system, improve communication protocols among hospital staff when a critical medication is refused, and strengthen hospital-wide education strategies to reduce refusal rates. Future medication safety research at the Hospital will pair this dataset with a focused review of documented medication safety incidents to inform protocol improvements across the priority drug classifications.

Real-world effectiveness of risankizumab in patients with moderate-to-severe Crohn's disease

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Background: Interleukin-23 (IL-23) is a heterodimeric proinflammatory cytokine comprising p40 and p19 subunits. Risankizumab, a humanized IgG1 monoclonal antibody, targeting the p19 subunit of IL-23, has demonstrated efficacy for Crohn's disease in pivotal phase III trials. However, the real-world evidence on Asian Crohn's disease patients with risankizumab treatment is limited.

Objective: Our study aimed to assess the real-world effectiveness of risankizumab among Taiwanese patients with Crohn's disease.

Method: This retrospective observational study included patients with moderate-to-severe Crohn's disease (Crohn's Disease Activity Index, CDAI $\geq$ 220) newly treated with risankizumab in five hospitals from June 2024 to February 2026. Patients enrolled in ongoing clinical trials with risankizumab were excluded. The primary endpoints were clinical remission and clinical response assessed at weeks 12 and 36. The definition of clinical remission was CDAI < 150 while clinical response was $\geq$ 100 points reduction from baseline CDAI. Secondary endpoint was treatment duration in weeks.

Results: We included a total of 71 patients (33.8% female; median age 43.5 years [IQR 30–55]). Baseline characteristics included smoking (37%), alcohol use (21.1%), and betel nut chewing (21.1%). Disease location was distributed as ileal, ileocolonic, and colonic involvement in 47.1%, 24.3%, and 25.7% of patients, respectively. Among these patients, 18.3% developed perianal fistula. The mean baseline CDAI score was 381.7 (IQR 334–417.6), primarily from 220 to 450 (with 2.8% > 450). 43.7% of patients were biologic-naïve, and 56.3% were biologic-experienced (ustekinumab 26.8%, adalimumab 40.9%). At week 36, 15.5% (n=11) of patients achieved clinical remission while 88.7% (n=63) showed clinical response. The mean difference in CDAI from baseline was -217.4 ± 54.6 , ranging from -112.4 to -365 . Remission rates in biologic-experienced patients were not statistically lower ($P > 0.05$) compared with naïve patients. The median treatment duration was 37.4 weeks (IQR 27–51).

Conclusion: In this short-term follow-up study, most patients achieved clinical response, with a marked decrease in CDAI, suggesting that a longer follow-up study is needed to confirm the long-term clinical remission rate.

Clinical appropriateness as a cost-containment strategy: The MediCoP experience at CHUM

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Background: The Centre Hospitalier de l'Université de Montréal (CHUM) is a tertiary-care academic hospital located in Montreal, Canada, with 772 beds and an annual medication budget of approximately \$107 millions. In the context of increasing pressure on drug expenditures, the MediCoP Committee (MÉDicament, COût et Pertinence; Medication, Cost and Appropriateness) was established within the CHUM Department of Pharmacy in spring 2025. The aim of the committee is to optimize the use of medication resources while maintaining the quality, safety, and appropriateness of care. This study describes the structure, operations, barriers, and financial impact observed during the first year of the MediCoP Committee.

Method: In spring 2025, pharmacists, pharmacy technicians, and pharmacy technician assistants were consulted to identify opportunities to improve the efficiency of medication resource utilization. This consultation generated 100 ideas or issues, which were consolidated into 82 potential projects. These projects were organized using the collaborative project management software Asana, according to implementation feasibility and anticipated cost savings, inspired by the Eisenhower matrix model. Projects were prioritized and evaluated using a structured approach and monitored through committee meetings held every 2 to 4 weeks. Project leaders were assigned responsibility for the development and implementation of each initiative. Clinical appropriateness was systematically assessed before implementation of each initiative to ensure that patient safety and quality of care were maintained.

Results: At the end of the fiscal year, among the 82 identified projects, 18 (22%) were completed or in the process of being operationalized, 17 (21%) were ongoing, 16 (20%) had not yet begun, and 31 (38%) were not retained. Estimated recurring savings for the fiscal year totaled \$1,028,855, primarily driven by inventory management initiatives (~50%) and oncology-related projects (~43%). Completion of the 18 projects required 250 hours of pharmacist project time and 15 hours of administrative process specialist time, representing a total cost of \$21,917. Committee meetings required an additional 128 hours of pharmacist time and 8 hours of pharmacy technician time, for a total cost of \$11,101. Overall, this resulted in a net financial benefit of \$995,837 and a return on investment of 3,016% based on estimated recurring savings. The main barriers encountered included challenges in project

prioritization, limited pharmacist project time, difficulty quantifying indirect costs, and the negotiation leverage held by physicians. No negative clinical impact was documented for completed projects. Beyond financial savings, the initiatives also generated organizational and environmental benefits, including reduced medication waste, streamlined processes, and improved budget predictability.

Conclusion: The first year of the MediCoP Committee demonstrates that structured clinical and financial medication governance can generate substantial and sustainable savings without compromising patient care. Building these results, the committee aims to secure concrete support from CHUM's executive leadership to expand initiatives focused on optimizing medication resource management. These efforts could contribute to broader adoption of similar models across Quebec and position CHUM as a leader in medication governance.

Integrating Evidence-Based Art (EBA) and 3D simulation in healthcare design: A dual-layered framework for enhancing patient well-being

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Background: Contemporary healthcare design increasingly seeks to alleviate patient distress through targeted environmental interventions. A critical challenge remains in transforming clinical spaces, such as hospital pharmacy waiting areas, from high-stress environments into supportive healing zones. This research investigates the intersection of Evidence-Based Art (EBA)—defined as the use of artistic interventions supported by credible data to improve health outcomes—and three-dimensional (3D) simulation. The primary objective was to develop a user-centred design framework for hospital pharmacy waiting areas that enhances psychological outcomes and mitigates the anxiety often associated with medical treatment environments.

Method: This study utilised a mixed-methods design to evaluate the impact of environmental aesthetics on user-centred experiences within the Dali Jen-Ai Hospital pharmacy waiting area in Taiwan. The investigator leveraged a multidisciplinary background in pharmacy, neuroscience, and arts and design to develop a 3D simulation of an art-integrated clinical environment. To assess the effectiveness of the design as a "positive distraction"—an environmental feature that elicits positive feelings and holds attention without taxing the individual—on-site semi-structured interviews were conducted with 70 participants, comprising both patients and medical companions. The measurement protocol evaluated the participants' ability to temporarily detach from their illness and identified preferences regarding

specific design elements. Data management involved the evaluation of emotional and cognitive responses to the 3D-simulated environment. These qualitative and quantitative data were analysed to identify core aesthetic preferences and determine the overall efficacy of the artistic distraction.

Results: The findings demonstrate a significant correlation between integrated art and psychological relief. Approximately 94 per cent of participants (66 out of 70) reported that the art-decorated environment served as an effective positive distraction, allowing them to temporarily detach from their illness or the treatment process. Qualitative data analysis highlighted a tripartite emotional response characterised by feelings of calmness, curiosity, and comfort. Participants expressed a strong preference for environments that balanced visual interest with a sense of order. Furthermore, the 3D simulation proved to be an effective proxy for physical environments, as participants could clearly articulate specific preferences for other functional designs, the profound impact of cultural art, and curated spaces that directly mitigate environmental stress.

Conclusion: Based on these findings, the study proposes a Dual-Layered Design Framework for healthcare environments. The first layer, the "Foundation", utilises overall "Calm" stimuli to establish environmental stability, suppressing anxiety and noise to meet the universal demand for tranquillity. The second layer, the "Catalyst", employs "Curious" stimuli to promote cognitive engagement through high-preference features such as calligraphy and curated reading areas. This research validates the use of 3D simulation as a predictive tool for healthcare design and underscores the necessity of balancing environmental tranquillity with intellectual engagement. By implementing this framework, designers can optimise the patient experience, proving that the integration of evidence-based aesthetics is essential for holistic healthcare delivery.

Validation of a Basel Statements-Based Tool to Assess Hospital Pharmacy Preparedness Among Students in Türkiye

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Background: As global healthcare shifts toward a comprehensive One Health model, the hospital pharmacist's transition from product provider to clinical decision-maker necessitates a rigorous evaluation of whether current

pharmacy education aligns with the international excellence standards of the FIP Basel Statements.

Objective: To develop and validate a robust Knowledge–Attitude–Practice (KAP) instrument based on the FIP Basel Statements and utilise it to evaluate the professional readiness of pharmacy students in Türkiye.

Method: A cross-sectional study was conducted between June and July 2025, involving 247 pharmacy students from 21 Turkish universities. The instrument was developed through systematic item generation and a rigorous three-round Delphi validation process. The final questionnaire comprised 79 items (26 knowledge, 28 attitude, 25 practice) mapped across the seven Basel domains. Psychometric properties were established using Exploratory and Confirmatory Factor Analysis (EFA/CFA), with reliability confirmed via Kuder–Richardson Formula 20 (KR-20) and Cronbach's alpha (α).

Results: Participants were mostly female (76.1%), with a mean age of 23.3 years; 15.4% had prior awareness of the Basel Statement. The questionnaire showed strong validity and reliability (KR-20 = 0.840; α = 0.879–0.980). Knowledge was moderate (17.66 ± 4.92 ; 67.9%), highest in administration and procurement, and lowest in preparation and delivery. Attitudes were moderate (97.24 ± 14.34 ; 73.1%), strongest in preparation and delivery, weakest in governance and prescribing influence. Practices were moderately engaged (98.51 ± 24.20 ; 78.8%), with the highest engagement in procurement and the lowest in human resources and training.

Conclusion: While pharmacy students in Türkiye possess a positive disposition toward hospital pharmacy, there is a clear "preparedness gap" in strategic clinical areas such as governance and prescribing influence. To realise the "One Pharmacy" vision, it is imperative to integrate FIP Basel-aligned competencies into the core pharmacy curriculum. This study provides a validated tool for educators worldwide to audit and align local pharmacy education with international excellence.

Medicines availability during global geopolitical disruptions: A quaternary care hospital's supply chain response in Pakistan

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Background: Several recent geopolitical conflicts, (such as Pakistan-India, Russia–Ukraine war and Middle East conflict involving US, Israel and Iran etc.), have caused significant disruptions to not only the global pharmaceutical supply chains, but also to Pakistan. These disruptions lead to

interruptions in manufacturing, cross border transportation routes, and raw material availability to a minimum. This increases the risk of both medicine shortages worldwide and also, price hike of available medicines. Healthcare facilities that operate under budget, and must ensure seamless patient care, are particularly vulnerable to such disruptions.

Objective: To describe the strategies adopted by a quaternary care hospital in Pakistan to maintain continuity of pharmaceutical supply and ensure uninterrupted patient care during periods of global geopolitical instability.

Method: A descriptive analysis was conducted in a quaternary care, teaching hospital pharmacy and warehouse operations during the period of heightened geopolitical tensions (2024–2026 till date). Institutional procurement records, inventory management practices, and shortage mitigation strategies were reviewed. Interventions implemented by the pharmacy supply chain team were categorized into critical supplies identification, procurement diversification, inventory optimization, safety stocks, suppliers' coordination, clinical stewardship, and interdepartmental coordination.

Results: Multiple proactive strategies enabled the hospital to maintain medication availability despite global disruptions. These included: 1.Product Prioritization: Prioritizing essential medicines and surgical supplies with the help of stakeholders. Leveraging expertise of interdisciplinary committees like Pharmacy & Therapeutics Committee 2.Supply Chain Tracing: this helps to spot key dependencies on international imports and interprovincial transports of the critical products 3.Proactive situation analysis with suppliers, identifying alternate suppliers and procurement channels where necessary 4.Preference to local & available: products from local source were identified to reduce import dependencies. Moreover, manufacturers with ample stock of raw materials were marked in the priority list (in case multiple options exist for single product) 5.Developing contingency stock levels with approval of hospital management 6.Assigning focused teams to enhance inventory vigilance at multiple levels (pharmacy, warehouse and procurement). All teams frequently and regularly met and exchanged information 7.Leveraging artificial intelligence (AI) to generate predictive reports that enabled real-time tracking of stock levels, orders in transit, pending stocks, mechanism for early detection of critical shortages and days-on-hand etc. 8.Clinical interventions: Rationalizing the use through criteria-based usage monitoring, therapeutic interchange protocols and rationing the supplies were implemented for vulnerable drug categories. •Close coordination with manufacturers, regulatory authorities and other healthcare organizations in the country •Improved communication between pharmacy, warehouse, procurement, and clinical teams. These measures prevented major stock-outs of essential medications and surgical supplies, and helped in seamless continuity of patient care across inpatient, outpatient, emergency and critical care services.

Conclusion: Hospital pharmacy and supply chain department serves as the backbone of continued hospital operations during geopolitical crises that threaten pharmaceutical supply chains. Proactive procurement planning, supply chain optimization, product prioritization and multidisciplinary collaboration can significantly improve institutional resilience. The experience of our hospital highlights practical approaches that may be adopted by healthcare systems in low- and middle-income countries to mitigate medication shortages during global disruptions.

Pharmacist-led interventions for bacteraemia and antimicrobial-resistant bloodstream infections: a systematic scoping review

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Background: Bloodstream infections (BSIs) are severe infections usually diagnosed and managed within hospital settings. Pharmacy professionals are uniquely positioned within healthcare systems to influence antibiotic prescribing, educate patients, and implement stewardship interventions, making them vital in reducing antimicrobial resistance (AMR) and improving outcomes. This scoping review aimed to synthesise evidence of pharmacist led stewardship interventions for BSIs.

Method: The scoping review builds on a systematic search conducted across five online databases (Ovid Embase, Ovid MEDLINE, CINAHL, Scopus, Cochrane Central Register of Controlled Trials) in December 2024 to identify papers for BSIs and AMR BSIs. Search terms combined MeSH and free-text terms for antibiotic resistance, BSI risk factors, and health equity. No geographical or language restrictions were applied. Eligible studies included assessment of BSIs and listed pharmacy or pharmacist interventions in title or abstract. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Scoping Review (PRISMA-ScR) abstract guidance was followed.

Results: From 7 586 articles, 17 articles were identified. Most of the studies (spanning 2017–2024), were conducted in the USA (n=7) and Japan (n=6), with one study each in Canada, Italy, and Spain. Study designs were predominantly retrospective pre–post (n=10), then cohort studies (n=4), observational(n=2) and matched cohort (n=1). Intervention types were categorised into five: Rapid Diagnostic Testing (RDT) + pharmacist models(n=5), prospective audit and

feedback (PAF) based interventions (n=4), BSI/Staphylococcus aureus bacteraemia (SAB) bundles with pharmacist involvement(n=3), pharmacist directed therapeutic management such as vancomycin dosing or carbapenem deescalation (n=2), multifaceted ICU/system level AMS(n=2), and automation supported pharmacist workflows(n=2). There were reported substantial reductions in process measures such as time to targeted therapy (e.g., 22→2 h, 40→11 h, or 59.6→29.0 h), marked increases in bundle adherence (e.g., 69%→92%, 79% vs 23%), also significant improvements in stewardship behaviours including deescalation, earlier step-down to oral therapy (6.0 day vs 8.0 days), culture before therapy, DOT/DDD reduction, and reductions in antipseudomonal antibiotic use (e.g. -42%). PAF and education models were particularly strong contributors to these antimicrobial use improvements. Clinical outcome improvements were also reported. Pharmacist planned vancomycin dosing improved survival (82% vs 53%), MRSA stewardship bundles reduced 30-day mortality (41.8%→21.6%) and in hospital mortality (58.1%→27.5%), and pharmacist recommended carbapenem deescalation lowered mortality (7.4%vs29.3%) and LOS (-5days). Tele-ID plus pharmacist oversight improved SAB bundle adherence (79% vs 23%) and reduced readmissions (9% vs 17%). Pharmacist intervention in Italy's ICU was associated with a significant reduction in carbapenem resistant K. pneumoniae (94%→6%). No measurable clinical improvement was reported in a study that implemented an antimicrobial scoring system.

Discussion: Overall, the studies from the scoping review demonstrate that pharmacist- led or integrated stewardship, particularly when combined with RDT, PAF, care bundles, or targeted dosing drive measurable improvements in antimicrobial optimisation, patient survival and resistance outcomes. The findings of this study can contribute to the evidence base for developing pharmacy clinical services for sepsis and BSIs within hospital settings. In addition, these findings suggest that pharmacist-led stewardship operates not only as a quality improvement mechanism but as a clinical intervention influencing time-critical treatment pathways to improve patient outcomes.

Towards 2031: The evolution of a pharmacy workforce strategy

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Background: Workforce pressures continue to intensify across Australian hospital pharmacy services, with demand for hospital pharmacists increasing by 50 per cent between 2013 and 2021. This growth, alongside rising service complexity, expanded scopes of practice and heightened expectations for wellbeing and psychological safety, has created sustained challenges in recruitment, retention and

capability development within Monash Health's Pharmacy Program.

Objective: To develop and evaluate a comprehensive Pharmacy Workforce Strategy that strengthens workforce sustainability through improved recruitment, structured development pathways, enhanced leadership capability, and evidence-informed wellbeing initiatives.

Method: There have been three iterations of the Monash Health Pharmacy Workforce Strategy: 2020, 2023 and 2026. Development of this work has drawn on mixed-method data sources, including workforce demographics, vacancy and turnover trends, program outcomes and organisational engagement feedback. National and state workforce strategies and pharmacy-specific forecasts informed strategic alignment. Post-implementation reviews of major initiatives—educator programs, technician leadership, recruitment processes and reclassification systems—were undertaken to assess impact. Themes were synthesised into priority domains and linked to measurable actions.

Results: Targeted workforce interventions have produced quantifiable improvements. Clinical educator programs delivered more than 3,650 learning assessments and supported over 380 pharmacists, while aseptic training time was reduced from 16 to 4 weeks with a corresponding elimination of repetitive strain injuries. Dedicated workforce leadership roles reduced pharmacist vacancy rates from 18 per cent to 5 per cent within 12 months and increased applicant demand by 114 per cent. Introduction of Pharmacy Technician Team Leaders improved reporting structures and training consistency, while recruitment redesign, combined with proactive communication and social media campaigns, reduced time-to-hire by 75 per cent. Innovations such as pharmacy technician-led Best Possible Medication History training, stewardship programs and expanded pharmacy technician capabilities have demonstrated strong early outcomes for service quality, operational efficiency and workforce development.

Conclusion: A coordinated, evidence-based workforce strategy can materially strengthen recruitment, retention, leadership capability and wellbeing in a complex and growing hospital pharmacy service. Sustained investment in structured training pathways, credentialing systems, technician career development and psychological safety will remain central to workforce resilience. Future work will focus on advanced practice development for pharmacists and technicians, data-driven workforce modelling, and broader integration of digital and automated technologies to support safe and efficient service delivery. Continued evaluation will be required to understand long-term impacts on career progression, retention of training program alumni and emerging models of care. The strategy provides a scalable foundation for future workforce planning across Monash Health and may inform pharmacy workforce redesign across the profession.

Early suprathreshold tacrolimus exposure and infection risk after lung transplantation: Implications for therapeutic drug monitoring and pharmacist-led risk stratification

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Background: Early lower respiratory tract infection (LRTI) remains a major determinant of early morbidity and mortality after lung transplantation. The first postoperative week represents a particularly vulnerable window during which infection risk may be influenced by baseline physiological reserve, intensity of organ support and degree of immunosuppression. Tacrolimus, a cornerstone calcineurin inhibitor in lung transplantation, requires therapeutic drug monitoring (TDM) to balance rejection prevention against over-immunosuppression. Although suprathreshold tacrolimus exposure is biologically plausible as a contributor to infection, its quantitative exposure–response relationship with early postoperative LRTI has not been clearly characterised. This study aimed to develop and internally validate a clinically applicable prediction model for early (≤ 7 days) LRTI after lung transplantation, with specific focus on quantifying the infection risk associated with suprathreshold tacrolimus exposure and exploring its implications for TDM-guided optimisation.

Method: A single-centre retrospective cohort study was conducted including 106 adult lung transplant recipients between 2017 and 2025. Early LRTI was defined according to American Thoracic Society/Infectious Diseases Society of America criteria within 7 postoperative days. Forty perioperative candidate variables were screened using Least Absolute Shrinkage and Selection Operator (LASSO) regression to minimise multicollinearity and overfitting. Selected predictors were entered into multivariable Firth penalised logistic regression to reduce small-sample bias and improve model stability. Suprathreshold tacrolimus exposure was modelled using a hybrid variable (tacrolimus_excess), defined as 0 for concentrations ≤ 15 ng/mL and (Tacrolimus – 15) for levels > 15 ng/mL. This approach enabled explicit quantification of incremental infection risk per 1 ng/mL above the safety threshold, rather than treating tacrolimus as a simple linear continuous variable. Model discrimination was assessed by the area under the receiver operating characteristic curve (AUC). Calibration, decision-curve analysis and 1,000-bootstrap internal validation were performed to evaluate robustness and potential clinical utility.

Results: Early LRTI occurred in 55 of 106 recipients (51.9%) and was significantly associated with increased mortality (hazard ratio 3.86, $P < 0.001$). LASSO retained four independent predictors: preoperative oxygenation index, duration of extracorporeal membrane oxygenation (ECMO),

duration of invasive mechanical ventilation and tacrolimus_excess. In the final Firth model, each 1 ng/mL increase in tacrolimus above 15 ng/mL corresponded to a 12.2% higher odds of early infection (odds ratio 1.122; 95% confidence interval 0.990–1.294; $P = 0.072$), demonstrating a clinically meaningful exposure–risk trend. The model showed good discrimination (AUC 0.821; 95% confidence interval 0.741–0.902), which was maintained after bootstrap validation (AUC 0.832). Calibration demonstrated acceptable agreement between predicted and observed risks, and decision-curve analysis indicated net clinical benefit across relevant probability thresholds.

Conclusion: Early postoperative LRTI is frequent and strongly associated with mortality after lung transplantation. A quantitative exposure–risk trend was observed between suprathreshold tacrolimus concentrations and early infection, supporting the biological plausibility of over-immunosuppression-related vulnerability. These findings underscore the critical role of early TDM and pharmacist-led dose optimisation during the first postoperative week to minimise infection risk while preserving immunosuppressive efficacy. Integration of exposure-informed risk modelling into routine transplant pharmacy practice may enhance precision immunosuppression and improve early post-transplant outcomes.

Development and dissemination of a multi-agent psychotropic in-syringe compatibility chart for acute agitation

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Background: In the management of acute agitation, pharmacological interventions are essential when non-pharmacological strategies have been exhausted. Parenteral administration, most frequently by intramuscular injection, is required when patients refuse oral medication or when the immediate safety of patients and clinical staff is at risk. In cases of marked agitation, the administration of two or three psychotropic agents is often necessary. To minimise the

number of traumatic injections, enhance patient comfort, and improve clinician safety during administration, combining psychotropic agents into a single syringe represents a valuable clinical practice. However, available evidence regarding in-syringe compatibility is often scarce, fragmented, or contradictory, which limits rapid, evidence-based decision-making in emergency situations. To address this gap, a syringe compatibility chart of psychotropic medicines was developed by two clinical pharmacists specialised in psychiatry and members of the Regroupement de pharmaciens experts en psychiatrie of the Association des pharmaciens des établissements de santé du Québec (A.P.E.S.), a professional group of clinical pharmacists experts in psychiatric pharmacy.

Method: The development of the compatibility chart followed a three-step process. First, a literature synthesis was undertaken using gold-standard references, including Trissel's Handbook on Injectable Drugs and the King Guide to Parental Admixtures, to develop a preliminary version of the chart. Review of grey literature sources and existing data from compatibility charts from the institutions of members of the Regroupement de pharmaciens experts en psychiatrie was also conducted. Second, to create new compatibility data, a research project was performed by a clinical psychiatric pharmacist. Third, findings were consolidated into a revised version of the chart, with data inconsistencies resolved through standardised decision rules by prioritising conservative safety margins. The revised chart was appraised by an expert panel of psychiatric pharmacists to ensure clinical relevance. The definitive version of the chart was shared within the institutions of members of the group of clinical psychiatric pharmacists, followed by a survey to assess uptake and usability.

Results: The definitive version of the compatibility chart included 79 combinations of 13 psychotropic medicines, including benzodiazepines, antipsychotics, and anticholinergic agents commonly used in the management of acute agitation in a concise, ready-to-use format. To ensure clinical applicability as psychiatry practice evolves, mixtures currently deemed clinically irrelevant were also tested and documented for potential inclusion in updated versions of the chart. Following dissemination of the compatibility chart, 79% of pharmacists members of the Regroupement de pharmaciens experts en psychiatrie (11/14 respondents) reported utilising the chart within their institution. The development process highlighted significant challenges, including paucity of peer-reviewed compatibility data, lack of resources dedicated to research on pharmaceutical stability, required levels of clinical judgment to reconcile heterogeneous data into a usable format, and administrative barriers limiting the sharing of clinical tools across institutional committees.

Conclusion: This initiative successfully bridged the gap between theoretical stability data and bedside psychiatric practice. The development of the compatibility chart has supported safer care for patients in cases of acute agitation in Quebec. Further dissemination, such as in primary care and

in emergency departments, would allow for greater usability beyond psychiatric settings.

The efficacy and safety of micronutrient supplementation in adults during the acute phase of critical illness: A retrospective cohort study

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Background: Critically ill patients often suffer metabolic disturbances and micronutrient deficiencies that worsen oxidative stress and immune dysfunction. Despite guideline recommendations, micronutrient supplementation is underutilized due to assessment challenges during acute illness. This study evaluates the impact of early intravenous micronutrient supplementation on clinical outcomes using real-world electronic health data.

Method: A retrospective cohort study was conducted at the National Taiwan University Hsinchu Branch between July 2024 and November 2025. Adult intensive care unit (ICU) patients who received parenteral nutrition (PN) for ≥ 24 hours were included and categorized according to whether intravenous micronutrient supplementation was initiated within 72 hours of ICU admission. Demographic, baseline clinical, and laboratory data were collected. The primary outcomes were in-hospital mortality and new infectious complications. Secondary outcomes included ICU and hospital length of stay (LOS), changes in inflammatory markers, such as C-reactive protein (CRP) and serum lactate, lactate clearance, organ support requirements, and incidence of refeeding syndrome. Statistical analyses involved t-tests, chi-square tests, and regression models, with statistical significance defined at $P < 0.05$.

Results: Among 692 critically ill patients, 230 were excluded, 213 received early micronutrient supplementation, while 249 did not. Baseline characteristics were largely comparable except for diagnosis distribution. No significant difference was observed in all-cause hospital mortality. However, the treatment group significantly reduced infectious complications, with logistic regression confirming protective effects (OR 2.67, 95% CI 1.83–3.90, $p < 0.001$). Secondary outcomes showed no differences in LOS, vasopressor use, oxygen therapy, continuous renal replacement therapy (CRRT) requirement, PN duration, or refeeding syndrome. The treatment group exhibited delayed enteral nutrition (EN) initiation (control 8.90 ± 8.88 days vs treatment 11.00 ± 10.73 days; $p = 0.02$) but demonstrated significant improvements in inflammatory and metabolic parameters. The linear regression model were performed and demonstrated significantly reductions in C-reactive protein (CRP) ($B = -10.91$

mg/dL, 95% CI -13.16 to -8.65, $p < 0.001$), serum lactate levels ($B = -1.49$ mmol/L, 95% CI -2.58 to -0.40, $p = 0.007$), and time to lactate normalization ($B = -0.90$ days, 95% CI -1.64 to -0.16, $p = 0.017$). In subgroup analysis, a total of 212 patients were included, of whom 137 received standard micronutrient supplementation, and 75 received micronutrients with additional zinc supplementation, which demonstrated further benefits. For instance, the group received additional Zn reduced mortality rate (control 32/137, 23.2% vs treatment 3/75, 4.0%; $p < 0.001$), infectious complications (control 62/137, 44.9% vs treatment 21/75, 28.0%; $p = 0.02$), shorter ICU LOD (control 13.72 ± 13.46 vs treatment 8.37 ± 10.87 days; $p = 0.004$) and hospital LOS (control 29.44 ± 20.14 vs. treatment 22.41 ± 17.57 days, $p = 0.01$), lower vasoactive-inotropic scores (control 14.80 ± 25.34 vs. treatment 3.73 ± 14.83 $\mu\text{g/kg/min}$, $p = 0.001$), decreased CRRT use (control 31/137, 22.5% vs treatment 6/75, 8.0%; $p = 0.01$), shorter cardiovascular support duration (control 5.52 ± 11.20 vs. treatment 2.32 ± 8.10 days, $p = 0.03$), and faster lactate clearance (control 2.96 ± 2.32 vs. treatment 1.74 ± 1.70 days, $p < 0.001$).

Conclusion: Early intravenous micronutrient supplementation within 72 hours of ICU admission reduces infectious complications and improves inflammatory and metabolic recovery. Combined multivitamin and trace element therapy shows synergistic benefits, while additional zinc further enhances survival and reduces organ support needs, encouraging comprehensive critical care nutrition strategies.

Pharmacist-Led Diabetes Medication Therapy Adherence Clinic (DMTAC) for Asian Pediatric Type 1 Diabetes: Impact on Treatment Outcomes

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Background: The major form of diabetes in Malaysian children and adolescents is Type 1 Diabetes (T1D) (71.8%). The Diabetes Medication Therapy Adherence Clinic (DMTAC) service by pharmacists has been available for Type 2 Diabetes (T2D) patients in Ministry of Health hospitals and primary care clinics since 2006, and was first initiated for T1D patients in Putrajaya Hospital in 2024. In this study, we investigated the effect of a pharmacist-led DMTAC service on treatment outcomes in pediatric patients with T1D.

Method: This prospective randomised controlled study (October 2024 – February 2026) was conducted at Putrajaya Hospital, which is a tertiary endocrine hospital in Malaysia. Twenty patients from the pediatric endocrine clinic were

randomised to the pharmacist DMTAC clinic (Intervention) and 20 to the control, and were followed for 6 months. Inclusion criteria: age 7–18 years, diagnosis of T1D, on insulin therapy, and HbA1c $> 7.0\%$. Exclusion criteria: on insulin pump therapy, corticosteroids, antipsychotics, or tacrolimus. Intervention-group subjects were seen by the diabetes pharmacist in DMTAC in addition to routine care at three visits (baseline, 3 months, and 6 months) for assessment of medication adherence, insulin injection technique, and hypoglycemia, with education and recommendations provided. Control-group subjects attended routine pediatric endocrinologist follow-ups and refilled medications at the pharmacy. Sociodemographic data were obtained by interview; clinical and laboratory data were extracted from electronic medical records.

Results: Nineteen subjects in the intervention group and 20 in the control group completed follow-up and were included in the final analysis. Mean age of the subjects was 11.5 ± 3.0 years, and they comprised 19 (48.7%) males and 20 (51.7%) females. The ethnic distribution was as follows: Malay 74.4%, Chinese 17.9% and Indian 7.7%. Median diabetes duration was 3.0 [3.0–6.0] years. The intervention arm showed improved glycemic control by the end of follow-up, while the control arm's glycemic control worsened (Baseline: $9.7 \pm 1.4\%$ [Intervention] vs $9.9 \pm 1.9\%$ [Control]; Post follow-up: $9.3 \pm 1.4\%$ [Intervention] vs $10.3 \pm 2.0\%$ [Control], $p > 0.05$). This may be attributed to a significant improvement in medication possession ratio in the intervention group (Baseline: $79.9 \pm 28.8\%$ [Intervention] vs $83.8 \pm 25.2\%$ [Control]; Post follow-up: $94.2 \pm 15.8\%$ [Intervention] vs $86.3 \pm 25.0\%$ [Control], $p < 0.05$). Frequency of hypoglycemic episodes also significantly decreased in the Intervention arm compared with Control (Baseline: 1.3 ± 1.7 [Intervention] vs 0.3 ± 0.8 [Control]; Post follow-up: 0.4 ± 1.0 [Intervention] vs 0.2 ± 0.4 [Control], $p < 0.05$).

Conclusion: The pharmacist-led DMTAC service has shown positive effects on medication adherence, hypoglycemia incidence, and glycemic control in Asian pediatric T1D patients. Pharmacists can be valuable members of the multidisciplinary diabetes team alongside clinicians, dietitians and diabetes educator nurses to improve overall diabetes treatment outcomes. These findings support expanding pharmacist-led DMTAC services to T1D patients nationwide.

International Perspective of Pharmacist Role in Transplant

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Background: Pharmacotherapy for solid organ transplant (SOT) recipients is complex and requires specialized knowledge and close therapeutic monitoring. While pharmacists are formally recognized as essential members of transplant teams in the United States, the extent to which they are integrated into SOT services globally remains unclear.

Objective: To identify the global presence of transplant pharmacists and describe their roles, training, barriers, and practice patterns.

Method: Two electronic surveys were developed. Survey 1 targeted SOT institutions and asked whether a transplant pharmacist was part of the clinical team; if not, respondents selected were asked for the reason. Institutions reporting a transplant pharmacist were asked to forward Survey 2 to those individuals. Survey 2 collected demographics, practice characteristics, involvement across transplant phases, perceived barriers, and interest in an international network. Surveys were translated into 39 languages. A three phase distribution strategy maximized global reach. Phase 1 was systematically emailed to 1,726 SOT institutions across 108 countries, with reminders after one month. Phase 2 expanded distribution using snowball sampling through professional networks, transplant societies, and international contacts. Phase 3 used targeted outreach to clinicians and authors in underrepresented countries. Responses from all phases were pooled, and descriptive statistics were used for analysis.

Results: Of 194 World Health Organization-listed countries, 136 (69.4%) perform SOT, and Survey 1 responses were received from 122 (89.7%) of these countries. Among responding countries, 36.1% (44/122) reported having transplant pharmacists, 10% (12/122) reported center dependent variation, and 54.1% (66/122) reported no transplant pharmacist involvement. Common reasons for absence included lack of clinical pharmacist roles, insufficient specialized training, and lack of institutional funding. Survey 2 received responses from 183 pharmacists in 33 non US countries and 74 pharmacists in the USA, for a total of 257 respondents. Among non US respondents, most had been licensed for 6–10 years (25.3%) or 11–15 years (25.3%), lacked specialized transplant training (86.7%), and practiced primarily in inpatient settings (85.8%). Despite limited training, nearly all felt confident in their ability to provide transplant care (93.4%) and perceived strong demand for transplant pharmacists (92.1%). The most frequently

reported barrier was limited time for direct patient care due to competing responsibilities (55.5%), followed by high workload (41.8%) and lack of transplant specific training (27.4%). US pharmacists differed substantially: 76.4% reported formal transplant training, most dedicated $\geq 75\%$ of their clinical time to transplant care (91.7%) and reported higher involvement across all transplant phases. Pharmacists internationally supported a wide range of organ transplant types, most commonly kidney (73.2%), liver (50.2%), lung (31.5%), and heart (31.1%). Interest in developing an international transplant pharmacy network was high across regions.

Conclusion: Transplant pharmacists play a significant role in SOT care worldwide, although their presence, training, and level of clinical integration vary considerably. Persistent barriers, including high workload, insufficient training opportunities, and limited institutional support, highlight the need for strengthened global infrastructure. Strong participation across all three phases demonstrates clear global interest in international collaboration and supports the development of an international transplant pharmacy network.

Global prevalence and factors associated with modified-release opioid use following orthopaedic surgery: Multinational retrospective cohort study

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Background: Professional advisory and regulatory bodies around the world discourage the use of modified-release opioids for acute postoperative pain. Orthopaedic surgeries such as total hip arthroplasty (THA) and total knee arthroplasty (TKA) are frequently linked with significant postoperative pain and opioid exposure. However, the global prevalence of modified-release opioids following orthopaedic surgeries is unclear, and the clinical ambiguity regarding which factors impact their use remains.

Method: This is a retrospective cohort study conducted in 106 participating hospitals across 23 countries, using the PAIN

OUT data registry. Eligible patients were those aged ≥ 18 years who underwent orthopaedic surgeries and were inpatients on the ward for a minimum of six hours postoperatively. Descriptive statistics were conducted to gather patient and opioid characteristics. Multivariable logistic regression analysis was conducted to identify the contributors to modified-release opioid use for postoperative pain following orthopaedic surgeries.

Results: During the 10-year study period, 9665 patients underwent orthopaedic surgeries. Of 9665 patients, 6722 patients were treated with postoperative opioids in the recovery room and/or ward, where 1507 patients (22.4%) received modified-release opioids. In the modified-release opioid cohort, the mean (standard deviation) age was 63.4 (14.5) years, with 56.4% (850/1507) of the patients being female, and 43.3% (652/1507) male. The European region was the country region with the highest prevalence of postoperative modified-release opioid use (76.6%, 1155/1507), followed by the Western Pacific region (20.3%, 306/1507). Among the modified-release opioid group, the main orthopaedic surgeries operated included total hip arthroplasty (THA) and total knee arthroplasty (TKA), followed by open reduction and internal fixation (ORIF), and other orthopaedic surgeries. Opioid use before admission was higher in the modified-release opioid group (19.7%, 972/1507), compared to the immediate-release opioid only group (18.3%, 1229/5215) following orthopaedic procedures. Multivariable logistic regression identified that the type of orthopaedic surgery and the country regions in which patients underwent their surgeries were strongly correlated with the use of modified-release opioids after surgery. TKA reported the highest association with the use of modified-release opioids after surgery (adjusted OR 5.598, 95% CI 1.230–25.480; $p=0.026$), followed by THA (adjusted OR 4.610, 95% CI 1.017–20.909; $p=0.026$). Patients who underwent orthopaedic surgeries in the European region had significantly higher odds of receiving modified-release opioids (adjusted OR 1.192, 95% CI 1.014–1.401; $p=0.033$) after surgery when compared with the Western Pacific region. The use of opioids before admission was also strongly associated with the postoperative modified-release opioid use, with more than a two-fold increase (adjusted OR 2.191, 95% CI 1.857–2.584; $p<0.001$).

Conclusion: The study identified an overall prevalence of 22.4% for the use of modified-release opioids following orthopaedic surgeries across the participating countries worldwide. In addition, our findings identified THA and TKA, the use of opioids before admission, and receiving surgeries in European countries are strongly associated with the use of modified-release opioid for postoperative pain.

How much vancomycin exposure is too much? AUC₂₄ and the risk of acute kidney injury within 48 hours after therapeutic drug monitoring

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Background: Vancomycin therapeutic drug monitoring (TDM) has increasingly shifted from trough-based assessment to area under the concentration–time curve over 24 hours (AUC₂₄)-guided dosing in order to optimise antibacterial efficacy while limiting nephrotoxicity. Although an AUC₂₄ target range of 400–600 mg·h/L is widely recommended, the short-term relationship between vancomycin exposure and acute kidney injury (AKI) after TDM remains incompletely characterised in routine clinical practice. In particular, it remains uncertain whether the association between vancomycin AUC₂₄ and early AKI is linear across the observed exposure range and whether this relationship is modified by important clinical factors such as intensive care unit (ICU) admission, concomitant nephrotoxins, or chronic kidney disease. The present study was conducted to evaluate the association between vancomycin AUC₂₄ and AKI within 48 hours after TDM in a real-world hospital cohort.

Method: A retrospective cohort study was conducted in hospitalised patients who underwent vancomycin TDM. The primary exposure was Bayesian-estimated vancomycin AUC₂₄, analysed both as a continuous variable per 100 mg·h/L increase and as a categorical variable using clinically relevant exposure groups. The primary outcome was AKI within 48 hours after TDM, defined using serum creatinine-based Kidney Disease: Improving Global Outcomes (KDIGO) criteria. Logistic regression models were fitted using an unadjusted model, a minimally adjusted prespecified model, and a fully adjusted exploratory model. The minimally adjusted model included age, sex, baseline serum creatinine, ICU admission, piperacillin/tazobactam co-administration, aminoglycoside co-administration, and time from first vancomycin dose to TDM. Restricted cubic spline analysis was used to examine potential nonlinearity, and prespecified interaction analyses assessed effect modification by ICU admission, piperacillin/tazobactam co-administration, aminoglycoside co-administration, and chronic kidney disease.

Results: Among 672 eligible episodes included in the primary analysis, 58 (8.6%) developed AKI within 48 hours after TDM. Higher vancomycin AUC₂₄ was consistently associated with greater odds of AKI across all continuous-exposure models. For each 100 mg·h/L increase in AUC₂₄, the odds ratio (OR) for AKI was 1.13 (95% confidence interval [CI] 1.04–1.24; $p=0.007$) in the unadjusted model, 1.18 (95% CI 1.06–1.30; $p=0.002$) in the minimally adjusted model, and 1.19 (95% CI 1.06–1.33; $p=0.003$) in the fully adjusted exploratory model. By contrast, categorical comparisons using AUC₂₄ 400–600 mg·h/L as the reference group were not statistically

significant. Restricted cubic spline analysis demonstrated a significant overall association between AUC24 and 48-hour AKI ($p < 0.001$), with no strong evidence of nonlinearity ($p = 0.272$). Interaction analyses showed no significant effect modification by ICU admission, piperacillin/tazobactam co-administration, aminoglycoside co-administration, or chronic kidney disease.

Conclusion: In this real-world cohort, higher vancomycin AUC24 was independently associated with an increased risk of early AKI after TDM, and the exposure–toxicity relationship appeared approximately linear over the observed range. These findings support careful exposure optimisation and highlight the importance of clinical pharmacy-led AUC24-guided vancomycin monitoring to minimise nephrotoxicity while maintaining individualised therapy.

Comparing Public AMR Surveillance Outputs in Canada and the WHO African Region: Implications for Pharmacist-Led Stewardship

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Background: Antimicrobial resistance (AMR) is a global health emergency requiring coordinated surveillance and stewardship action. Pharmacists are increasingly recognised as essential stewardship actors; however, their effectiveness depends on timely, actionable surveillance data. Canada operates mature, multi-sectoral surveillance infrastructure, whilst WHO African Region countries rely on fragmented national systems. How these divergent outputs equip pharmacists to lead stewardship remains unclear. This study compared publicly available AMR surveillance outputs in Canada and the WHO African Region to assess implications for pharmacist-led stewardship.

Method: A secondary data analysis was conducted using publicly available surveillance datasets. Canadian sources comprised the Canadian Antimicrobial Resistance Surveillance System (CARSS) 2024 Key Findings, the Canadian Integrated Programme for Antimicrobial Resistance Surveillance (CIPARS), and Public Health Agency of Canada reports. WHO African Region sources included the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) AMR 2022 and Antibiotic Use 2022 reports, and the Tracking AMR Country Self-Assessment Survey (TrACSS) 2024 dataset ($n = 48$ countries). Outputs were assessed across three dimensions: pathogen and antibiotic coverage, resistance rates for WHO priority pathogens, and stewardship actionability, scored using an 8-criterion weighted rubric.

Results: Canada's CARSS covers more than ten priority pathogens with five-year trend data (2018–2022); key indicators like carbapenemase-producing Enterobacterales

(CPE) and multidrug-resistant invasive pneumococcal disease are worsening. GLASS AMR 2022 tracked eight pathogens across approximately 35 of 47 WHO African Region member states, revealing substantially higher resistance burdens: *Acinetobacter baumannii* carbapenem resistance reached 69–73% and third-generation cephalosporin-resistant *Klebsiella pneumoniae* bloodstream infections exceeded 59–65% globally. Neither vancomycin-resistant *Enterococcus* (VRE), *Pseudomonas aeruginosa*, nor *C. difficile* are GLASS targets, a notable gap relative to Canadian surveillance. TrACSS 2024 confirmed integrated AMR surveillance exists in only 27 of 48 WHO African Region countries (56%); AMR data inform policy in only 25 of 48 (52%). Stewardship actionability scoring revealed distinct gap profiles. Canada's data infrastructure is stronger, but stewardship programmes are partial, AWARe remains unadopted in the national essential medicines list, and community pharmacy data are absent. In the WHO African Region, 35% of countries have no stewardship policy, only 19% have adopted AWARe with active monitoring, and infection prevention and control is fully implemented in only 15%. Critically, pharmacist-specific indicators are absent from TrACSS - the primary global AMR governance monitoring instrument - confirming the structural exclusion of pharmacists from AMR governance in both regions.

Conclusion: Both surveillance systems present gaps constraining pharmacist-led stewardship, but these manifest differently. Canada's mature infrastructure has not translated into community pharmacy stewardship practice. In the WHO African Region, foundational governance deficiencies predominate. Only 43% of countries use AMU data for policy, and resistance burdens substantially exceed Canadian levels. Pharmacist-specific indicators are absent from TrACSS, confirming their structural exclusion from global AMR governance. Context-specific strategies are required: enhanced data-to-practice frameworks for Canada and accelerated surveillance investment with explicit pharmacist integration in African Region.

Medical practitioners' knowledge, prescribing practices, and compliance with attention-deficit/hyperactivity disorder treatment guidelines in Limpopo, South Africa

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Background: Attention-Deficit/Hyperactivity Disorder (ADHD) is a common neurodevelopmental condition with significant academic, social, and behavioral consequences. Methylphenidate is the most frequently prescribed pharmacological treatment, however, concerns remain

regarding diagnostic accuracy, prescribing practices, and adherence to Standard Treatment Guidelines (STGs) in South Africa, particularly in resource-limited settings such as the Limpopo province. This study addresses gaps in knowledge and practice that may compromise safe and effective ADHD care.

Objective: The study aimed to explore medical practitioners' knowledge of ADHD diagnosis and management, examine prescribing practices for methylphenidate, and assess compliance with national STGs at selected hospitals in Limpopo Province.

Method: A descriptive, qualitative, cross-sectional study was conducted with nine medical practitioners across selected hospitals. Data were collected through structured interviews assessing diagnostic knowledge, management strategies, prescribing patterns, dosage and monitoring practices, and adherence to STGs. NVivo software was used for thematic analysis. Ethical clearance was obtained from the Turfloop Research Ethics Committee, and permission was granted by the Limpopo Department of Health.

Results: Findings revealed substantial gaps in diagnostic knowledge, with practitioners relying heavily on caregiver and teacher reports rather than comprehensive DSM-5 criteria. Prescribing practices varied, with inconsistent titration, limited monitoring of adverse effects, and frequent deviations from recommended dosing protocols. Compliance with STGs was poor, hindered by systemic barriers such as legislative restrictions on Schedule 6 medicines, shortages of psychiatrists, and limited access to psychosocial interventions. Knowledge gaps and misuse concerns were evident, raising questions about safe and effective ADHD care in the region.

Conclusion: ADHD management in Limpopo is challenged by inadequate medical practitioner knowledge, inconsistent prescribing practices, and poor compliance with STGs. Targeted interventions are urgently needed to strengthen diagnostic accuracy, prescribing safety, and adherence to treatment protocols. Future work should focus on system level reforms and integration of psychosocial support to improve ADHD care in resource constrained areas.

Empirical Antibiotic Therapy in Pediatric Intensive Care: Between Guideline Adherence and Stewardship Challenges

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Background: Empirical antibiotic therapy is frequently initiated in pediatric intensive care units (PICUs) due to the high risk of severe bacterial infections and the need for immediate treatment before microbiological confirmation. While early administration of broad-spectrum antibiotics is essential to reduce morbidity and mortality, inappropriate use may contribute to antimicrobial resistance, drug toxicity, and unnecessary exposure to reserve antibiotics. Evaluating the accuracy of empirical antibiotic prescriptions is therefore essential to optimize antimicrobial stewardship in critical care settings. This study aimed to assess the accuracy of empirical antibiotic therapy in a pediatric intensive care unit and to evaluate its conformity with current international clinical recommendations.

Method: A prospective observational study was conducted in the Pediatric Intensive Care Unit of Abderrahim Harouchi Children's Hospital, Casablanca, between March and September 2025. Pediatric patients receiving empirical antibiotic therapy were included. Prescriptions were evaluated for guideline adherence according to international recommendations and classified as compliant, partially compliant, non-compliant, or non-pertinent.

Results: A total of 100 pediatric patients were included, with a mean age of 3 years and 9 months (range: 2 days–15 years). The population was predominantly male (60%). Respiratory distress was the leading cause of admission (34%), followed by burn injuries (18%) and status epilepticus (17%). Among suspected infectious episodes, pulmonary infections were the most frequent (41%), followed by meningitis (18%), urinary tract infections (16%), and cutaneous infections (13%). Combination antibiotic therapy was commonly prescribed (82%), mainly dual therapy (62%). β -lactams represented the most frequently used antibiotic class (41.2%), particularly third-generation cephalosporins and carbapenems. Overall, 59% of empirical antibiotic prescriptions were fully compliant with guideline recommendations, while 25% were partially compliant, 10% were non-compliant, and 6% were considered non-pertinent. The most frequent inadequacy was unnecessary broad-spectrum coverage (49%), followed by incorrect dosage or administration modality (15%) and absence of clear indication for antibiotic therapy (15%).

Conclusion: Empirical antibiotic therapy in this PICU showed a moderate level of adherence to international recommendations. Although the majority of prescriptions were appropriate, a significant proportion demonstrated unnecessary spectrum broadening and deviations from recommended practices. Strengthening antimicrobial stewardship strategies, including systematic reassessment of therapy at 48–72 hours and improved microbiological documentation, is essential to optimize antibiotic use and limit the emergence of antimicrobial resistance in pediatric critical care settings.

Safety of intravenous therapy in the home: A scoping review

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Background: Intravenous therapy has long been considered error-prone with high potential for harm. Compared to other routes, errors were found to be five times more likely in intravenous administration. This is due to the high-risk nature of many intravenous therapies and the complexity in their administration and monitoring. Providing intravenous therapy in the home introduces additional risks related to the home as a clinical environment. Despite recognised patient-centred and organisational benefits of transferring intravenous therapy from acute settings to patients' homes, understanding safety implications in the uncontrolled domestic environment is limited. Furthermore, little is known about how patients, families, and clinicians maintain safety in this highly variable and often isolated setting.

Objective: This review aims to explore the hazards and risks associated with home intravenous therapy. The sociotechnical systems concept is used as a framework to understand the interplay between these hazards, associated risks, and their impact on patient safety.

Method: This scoping review was prospectively registered with the Open Science Framework and followed JBI guidance. A Patients and Public Involvement Steering Group informed the review questions and search terms. Inclusion criteria followed the Population (home healthcare patients), Concept (hazards, risks, safety) and Context (advanced clinical care, intravenous therapy) framework. Five databases were searched (MEDLINE, CINAHL, PsycINFO, CENTRAL, and the ISRCTN registry). Eligible articles included trials, observational studies, qualitative studies, reviews, case series, conference abstracts and guidelines. No date restrictions were applied. Results were reported in accordance with PRISMA-ScR.

Results: 7,087 citations were retrieved. Following de-duplication, title and abstract screening and full-text review, 38 studies were included. Findings were synthesised using thematic analysis. Hazards were identified across all aspects of the home intravenous therapy sociotechnical systems, including people (characteristics, competency, preparedness, and protocol deviations/violations), artefacts (missing or unsuitable equipment for the home), technology (infusion devices not designed for lay users), tasks (interactions with daily living activities that impede care performance), workspace and environment (distractions, hygiene, temperature, infrastructure and emergency access), and organisation (lack of defined programme structures, inadequate care coordination between providers). The associated risks of home intravenous therapy were broadly categorised into: complications directly-related to intravenous therapy which may be exacerbated in the home; harm arising from improper administration or suboptimal performance of intravenous care tasks; interruptions to therapy due to logistical issues; hazardous exposure from inappropriate handling and disposal of pharmaceuticals; omission of care due to challenges navigating care in the community; and physical injuries from the use and storage of medical equipment in the household.

Conclusion: Findings from this review show that inherent hazards of intravenous therapy are amplified in the home setting, while 'medicalisation' of patients' home introduces additional risks. Successful transfer of intravenous therapy from controlled clinical settings to the home requires robust patient selection and home assessment. Service design should include training for patients and caregivers, clinical oversight for home healthcare professionals, and provision for out-of-hours support service. These measures will help to ensure all stakeholders are adequately prepared and safety-netted to deliver home intravenous therapy.

The safety of proton pump inhibitors: An overview of systematic reviews and meta-analyses

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Background: Numerous adverse drug reactions (ADRs) to proton pump inhibitors (PPIs) have been reported in recent decades. However the evidence across the studies remains inconsistent and heterogeneous.

Objective: We conduct an overview of systematic reviews/meta-analyses (SR/MAs) to provide a contemporary review of the evidence for the safety of PPIs in patients using them for treating or prophylaxis, to summarize the outcomes data, assess the methodological quality, rate the certainty of the evidence.

Method: We conduct a Overview of reviews following the Preferred Reporting Items for Overviews of Reviews (PRIOR) guidelines. We identified SR/MAs regarding PPIs safety through a search of multiple databases, including the China National Knowledge Infrastructure (CNKI), Chinese Science and Technology Journal Database (VIP), and Wanfang Database (WanFang) on December 6, 2025, as well as Embase, PubMed, and the Cochrane Library database on December 7, 2025. The participants were human populations who had been administrated PPIs; the intervention groups utilized PPIs-based regimens, and the control group received different PPIs regimens, no-PPIs, H2-receptor antagonists (H2RA), potassium-competitive acid blockers (P-CAB) or placebo; the outcomes mainly included the specific ADRs associated with PPIs use. We used the A Measurement Tool to Assess Systematic Reviews-2 (AMSTAR-2) to assess the methodological quality of the included SR/MAs, and employed the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework to evaluate the quality of evidence for the reported outcomes.

Results: A total of 940 studies were retrieved from various databases according to the search strategies. After eliminating duplicates and screening process, 36 SR/MAs were finally included. Overall, there was a slight overlap (CCA of 0.91%) in 483 primary studies included in the 36 SR/MAs. The AMSTAR-2 evaluation results showed that 34 SR/MAs are of low quality, the other two were of critically low quality. The GRADE evaluation results indicated that the certainty of evidence for all outcomes were low or very low. The use of PPIs might be associated with an increased risk of acute kidney injury (AKI) [RR=1.75, 95%CI (1.40-2.19)], chronic kidney disease (CKD)[RR=1.35, 95%CI (1.15-1.56)], gastric cancers (GC) [RR=1.67, 95%CI (1.39-2.00)], and community-acquired pneumonia (CAP) [OR=1.37, 95% CI (1.22-1.53)]. PPIs therapy was associated with a higher recurrence rate of CDI (24% vs 18%) and might increase CDI risk in renal transplant recipients [RR=2.33, 95%CI (1.07–5.07)]. The use of PPIs might heighten the risk of fractures in young patients (aged <29 years)[RR=1.20, 95%CI (1.12-1.29)]. PPIs therapy was also linked to hypomagnesemia in hemodialysis patients (1/36, 2.78%) and renal transplant recipients (1/36, 2.78%).

Conclusion: This overview evaluates the safety profile of PPIs, noting associated risks including renal impairment, gastric cancer, fractures, and infections. Most evidence comes from observational studies, resulting in low or very low certainty evidence that limits definitive causal conclusions. Clinicians and pharmacists may consider greater vigilance with PPIs use, these ADRs may not require de-escalation but de-implementation when inadequate (e.g. long-term use or special groups use). Future research should focus on high-quality prospective studies and investigate underlying mechanisms to better establish causality and quantify risks.

Medication-related 30-day readmissions among patients admitted to rural and remote hospitals: A cohort study

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Background: Medication errors are a significant and preventable cause of patient harm. Patients living in rural and remote areas face inequitable access to healthcare and fragmented continuity of care, increasing their vulnerability to medication-related harm. Despite this, the burden and drivers of medication-related harm in these settings remain poorly understood. Identifying factors associated with medication-related readmissions is essential to inform targeted strategies that improve medication safety.

Objective: To determine the proportion of adult patients who experienced a medication-related readmission within 30 days of discharge from rural and remote hospitals, and to identify medication-related factors associated with these readmissions.

Method: The medical records of patients admitted to rural and remote hospitals between June 1, 2022 and August 31, 2023, were reviewed. Readmissions within 30 days were assessed as medication-related using the AT-HARM10 tool. Univariable and multivariable logistic regression models were

used to identify medication-related factors associated with 30-day medication-related readmissions.

Results: Of the 2220 patients admitted during the study period, 6% (n=133) experienced a 30-day readmission, of which 22.5% (n=30) were medication-related. Overall, 1.4% of all admitted patients experienced a 30-day medication-related readmission. Multivariable logistic regression identified older age, insulin use and opioid or benzodiazepine use[GU1.1] on discharge as significant factors associated with medication-related readmission.

Conclusion: In rural and remote hospitals, approximately 1.4% of admitted patients experienced a 30-day medication-related readmission. Older age, the use of insulin and the use of opioids or benzodiazepines were associated with increased risk. Further research is needed to validate these findings and explore additional factors not captured in the current dataset.

Opioid-related drug-drug interactions and harm to hospitalised patients: A retrospective multi-centre cohort study

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Background: Opioid-related drug-drug interactions (DDIs) are common in hospitalised patients and can lead to serious harm, especially when opioids are combined with central nervous system depressants. Electronic medical records (EMRs) often trigger DDI alerts to warn clinicians of potential DDIs, but the effect of DDI alerts on clinically relevant opioid DDIs and related patient harm remains uncertain. This study evaluated whether EMR-integrated opioid DDI alerts reduce clinically relevant interactions and associated harms in routine hospital care.

Method: This retrospective cohort study was a secondary analysis of a multi-centre quasi-experimental controlled pre-post evaluation of EMR implementation across five Australian hospitals. Adult inpatients were randomly selected from all patients who stayed in study hospitals for a one-week period six months before and six months after EMR implementation. Inpatients were included if they had at least one prescribed and administered opioid and one concurrent medication.

Interruptive opioid DDI alerts were active only at intervention sites post-EMR. Potential DDIs were identified using Stockley's Interaction Checker; pharmacists adjudicated clinically relevant DDIs, and clinical pharmacologists assessed DDI-related harm and causality. Clustered logistic regression with generalised estimating equations, adjusting for demographic and clinical variables, estimated the effect of alerts involving opioids on three outcomes: clinically relevant opioid DDIs (primary), any potential opioid DDI, and opioid DDI-related harm.

Results: Of 1,144 patients prescribed an opioid, 847 (74.0%) had at least one potential opioid DDI and 548 (47.9%) had at least one clinically relevant DDI. EMR alerts were associated with no significant change in clinically relevant DDIs (adjusted odds ratio 1.06, 95% CI 0.72–1.55; p=0.75). There was a significant reduction in potential opioid DDIs (adjusted odds ratio 0.55, 95% CI 0.41–0.74; p<0.001). Of all patients, there were 11 patients with a total of 38 DDIs experienced harm (0.6% of potential and 1.1% of clinically relevant DDIs), with most DDIs involving pharmacodynamic interactions with concomitant CNS depressants.

Conclusion: EMR opioid DDI alerts reduced overall exposure to potential DDIs but did not decrease clinically relevant interactions or related harm. The low rate of harmful events highlights the limited clinical value of current alert systems and the burden of low-value warnings.