Pharmacy Education (2024) 24(7) 398 - 409
https://doi.org/10.46542/pe.2024.247.398409

CONFERENCE ABSTRACTS

FIP CAPE TOWN 2024

82nd FIP World Congress of Pharmacy and Pharmaceutical Sciences in Cape Town, South Africa, 1 to 4 September 2024

Regulatory sciences and quality

Artificial intelligence and cybersecurity in medical devices: Potential risks and regulatory responses

Samuel Egieyeh

University of the Western Cape, Cape Town, South Africa

Introduction: Medical devices and artificial intelligence systems rapidly transform healthcare provisions. At the same time, due to their nature, artificial intelligence (AI) in or as medical devices (MD) might get exposed to cyberattacks, leading to patient safety and security risks. Here, the authors present the potential risks, challenges, and current legislation related to cybersecurity and AI in medical devices.

Method: A critical review of the literature was conducted, and the summary was presented. Briefly, an integrated search strategy was adopted to cover an extensive automated search of different online databases using the keywords AI, medical devices, risks, and regulation. A manual review of the selected articles was done. The backward snowball technique was used to locate articles that were not identified through the previous search strategies.

Results: Several risk factors can contribute to data breaches in AI platforms. Medical devices that use AI often require internet connectivity to function; this creates opportunities for the connection signals to be intercepted by cyberattacks, which introduce malware and harmful software to disrupt system functions and compromise data integrity. In addition, AI algorithms can also be vulnerable to data poisoning and manipulation of the AI training data. In response to the identified risk, the European Commission (EC) proposed the Artificial Intelligence Act in April 2021 to satisfy the regulatory void of AI. The Act identified and categorised into four levels of AI risk: unacceptable risk, high risk, limited risk and minimal risk. Healthcare AI applications (including medical devices) would generally fall into the high-risk category. In the USA, Title 21 of the Code of Federal Regulations governs the marketing of AI medical devices and requires that AI medical devices go through pre-market and post-market reviews. In South Africa, while there are no specific guidance documents designed to specifically address AI medical devices, the South African Health Products Regulatory Authority (SAHPRA) does have a draft guideline for SaMD, which could also be applied to AI technologies.

Conclusion: AI can revolutionise medical science and offers many prospects for healthcare. However, cybersecurity is a threat to AI in medical devices. It is important to ensure that AI, in or as a medical device, is well-regulated and that the appropriate level of accountability is established. Moreover, the development of AI in medical devices and in-vitro diagnostics should be an inclusive and harmonised approach to imperative policy adoption and technological transformation.

Electrochemical detection of anti-leishmanial drug paromomycin using phosphorylated copper-beta cyclodextrin-based sensing platform

Darko Kwabena Adu[1], Zondi Nate[2], John Alake[1], Blessing Wisdom Ike[1], Lungelo Miya[1], Ruchika Chauhan[1], Rajshekhar Karpoormath[1]

[1]Department of Pharmaceutical Chemistry, College of Health Sciences, University of KwaZulu-Natal, Westville Campus, Durban, South Africa

[2]Department of Chemistry, Cape Peninsula University of Technology, Belleville, South Africa

Introduction: Leishmaniasis is a neglected tropical disease which is caused by Leishmania species. Leishmaniasis is one of the diseases that has not been researched much. Chemotherapy is the only form of treatment available to treat leishmaniasis. Currently, few drugs are available for the treatment of leishmaniasis. Hence, quality control of the drugs has become important due to the prevalence of counterfeit drugs. This study is therefore aimed at developing an electrochemical method for the detection of paromomycin using phosphorylated copper-β cyclodextrin nanocomposite. Paromomycin is an aminoglycoside used in treating leishmaniasis.

Method: In this study, the solvothermal method was used to synthesise a nanocomposite of copper-cyclodextrin. This was followed by phosphorylation of the nanocomposite of copper-β cyclodextrin. The formation of the nanocomposites was confirmed by Fourier transform infrared spectroscopy and nuclear magnetic resonance. The morphology of the synthesised nanocomposites was confirmed by scanning electron microscopy and transmission electron microscopy. Energy-dispersive X-ray spectroscopy was used to confirm the elemental composition of the nanocomposite. A differential pulse voltammetric technique was employed to study the electrochemical detection of paromomycin using a glassy carbon electrode modified with a phosphorylated copper-β cyclodextrin nanocomposite. [Fe(CN)6]3−/4− solution was used as a redox couple for the detection of paromomycin.

Results: A detection limit of 0.5 µM with a linear range of 10 – 100 µM was obtained for paromomycin. Also, the developed sensor was used to detect paromomycin in the spiked urine samples, and a detection limit of 0.1 µM was obtained in a linear range of 5 – 60 µM. Moreover, the developed sensor showed excellent reproducibility and selectivity amidst interfering agents.

Conclusion: In conclusion, the fabricated sensor of phosphorylated copper-β cyclodextrin nanocomposite can be applied for quality control of paromomycin.

GLP implementation: DSI/NWU Preclinical Drug Development Platform (PCDDP) case study

Thulile Van Wyk

North-west University, Potchefstroom, South Africa

Background: The importance of GLP in a research institute engaged in preclinical drug development cannot be overstated, as it forms a foundational element that warrants the credibility, compliance, and ethical conduct of preclinical research activities. This contributes significantly to the successful advancement of potential drug candidates from preclinical to clinical development. PCDDP stands as the sole GLP-certified national facility in South Africa. As such, there are valuable lessons to be gleaned from its experience, which can serve as inspiration for other institutes or industries contemplating GLP certification. This underscores the benefits of GLP in preclinical studies and highlights the potential for broader adoption within the scientific community.

Purpose: This paper introduces a case study featuring the DSI/NWU Preclinical Drug Development Platform (PCDDP) research facility in South Africa, showcasing its successful implementation of GLP regulations. This case study will assess the level of GLP awareness and adoption in an academic research institution in South Africa. It will also identify barriers to implementation and propose strategies to enhance GLP integration into academic research. The presentation will address the challenges faced, strategies employed, and the overall impact on data quality and regulatory compliance. In addition, the role of regulatory agencies, such as the South African Health Products Regulatory Authority (SAHPRA), in overseeing and enforcing GLP compliance will be emphasised.

Method: A comprehensive literature review on GLP implementation in preclinical drug development settings will be conducted, focusing on the best practices, challenges, and success factors reported in similar case studies. Additionally, audit findings, regulatory requirements, guidelines, SOPs, and protocols related to GLP standards and their implementation within the PCDDP will be investigated. Quantitative data on key performance indicators related to GLP implementation, such as error rates, deviation frequencies, and compliance metrics, will be analysed. In addition, semi-structured interviews with key stakeholders involved in GLP implementation will be conducted. This includes quality assurance personnel, researchers, and regulatory inspectors. Questionnaires will also be used to gather feedback from PCDDP staff members regarding their awareness, understanding, and perceptions of GLP standards.

Results: The best practices, challenges, and success factors reported in similar articles were identified. Additionally, the preliminary data shows that achieving standardisation in laboratory procedures and documentation was challenging

due to diverse research needs and practices. Besides, the meticulous documentation demanded by GLP is being perceived as burdensome. Specific challenges, successes, lessons learned, and recommendations for improving GLP compliance and effectiveness will be shared.

Conclusion: In conclusion, this case study underscores the indispensable role of GLP in ensuring data integrity and reliability, enhanced reproducibility of studies, regulatory compliance, and ethical conduct of preclinical research activities, offering valuable insights for fostering GLP adoption and integration in academic research institutions.

Regulations of pesticides in cannabis

Audrey Muscat, Janis Vella Szijj, Anthony Serracino Inglott

Department of Pharmacy, University of Malta, Msida, Malta

Background: Accurate determination of pesticide residues in medicinal cannabis is increasingly recognised as a necessary contributor to the safety of medicinal cannabis products.

Purpose: To identify and compare regulations related to the allowed limits of pesticides in medicinal cannabis in different countries.

Method: Regulations for the use of pesticides in cannabis were identified using official government websites of different countries. The following parameters were compared: testing requirements, pesticides tested for, allowed limits and analytical techniques used.

Results: Nine countries with regulations on the use of pesticides in cannabis were identified. In Thailand, analysis is done in accordance with the Thai Pharmacopoeia, which sets residue limits for 70 pesticides. Malta, The Netherlands, Australia and New Zealand follow the European Pharmacopoeia guidelines, which require testing of 69 pesticides and their allowed limits. Denmark sets three criteria for pesticides to be approved for cannabis: pesticides must be approved in the European Union, active ingredients must be within maximum levels, and the Danish Agricultural Agency must approve them. In Morocco, in the cultivation of cannabis, authorised and licensed pesticides should only be used if use is justified. In the United States of America, 17 states were identified in which no pesticides are federally registered for use on cannabis. However, each state has its own guidelines and lists of approved pesticides. No countries in South America have defined regulations. In Canada, 96 pesticides are to be tested for, and for each, different limits of quantification are described, depending on whether the product is in dried cannabis, cannabis oil, or cannabis inflorescence.

Conclusion: The study helped identify differences and similarities between guidelines and regulations for the use of pesticides in cannabis. Harmonised regulations help improve the quality and safety of medicinal cannabis products.

Regulatory compliance: Diethylene and ethylene glycol challenges

Jude Nwokike, Allison Radwick, Chaitanya Koduri, Victor Pribluda

U.S. Pharmacopeia, Rockville, United States

Introduction: Diethylene glycol (DEG) and ethylene glycol (EG) contamination present significant challenges in the pharmaceutical industry, posing risks to patient safety and regulatory compliance. This study aims to recognise key factors contributing to DEG and EG contamination, examine the U.S. FDA's regulatory guidance on testing procedures for high-risk drug components contaminated with DEG and EG, and compare DEG/EG regulatory guidance documents and testing methodologies from different regions. Additionally, the study will explore requirements and recommended practices for stakeholders in the pharmaceutical supply chain to mitigate contamination risks effectively.

Method: The study employs a comprehensive review of literature, regulatory documents, and guidelines to identify factors contributing to DEG and EG contamination. Furthermore, it examines the U.S. FDA's regulatory guidance documents, focusing on testing procedures for high-risk drug components. Comparative analysis will be conducted to evaluate EG/DEG regulatory guidance documents from various regions, analysing variations in testing methodologies and regulatory requirements.

Results: Through the analysis, the study will provide insights into the root causes of DEG and EG contamination, challenges in testing procedures, and regulatory approaches across different regions. It will elucidate the U.S. FDA's testing protocols for identifying DEG and EG in high-risk drug components and highlight variations in regulatory guidance documents from different regions. Additionally, the study will outline requirements and recommended practices for manufacturers, repackagers, preparers, and distributors to ensure product safety and compliance.

Conclusion: By recognising key factors contributing to DEG and EG contamination, understanding the U.S. FDA's regulatory guidance, and comparing EG/DEG regulatory documents from different regions, stakeholders in the pharmaceutical industry can enhance their ability to mitigate contamination risks effectively. Adherence to rigorous testing protocols, implementation of recommended practices, and alignment with regulatory requirements will enable stakeholders to uphold product safety standards, ensure

regulatory compliance, and protect public health in the pharmaceutical sector.

Solubility determination and characterisation of steroids

Giulia Baluci[1], Everaldo Attard[2], Nicolette Sammut Bartolo[1], Anthony Serracino-Inglott[1]

[1]Department of Pharmacy, Faculty of Medicine and Surgery, University of Malta, MSIDA, Malta

[2]Rural Sciences and Food Systems, Institute of Earth Systems, University of Malta, MSIDA, Malta

Introduction: The pKa and logP of a compound affect its bioavailability and extent of action. The characterisation of properties of active pharmaceutical ingredients, such as solubility, aids in the development of analytical methods and formulations for finished dosage forms. To date, some of the physicochemical parameters of the steroids difluprednate and 6α9α-difluoroprednisolone are only characterised using computational methods.

Purpose: To experimentally determine the melting point and solubility of the selected steroids, difluprednate (DFPA) and 6α9α-difluoroprednisolone (DFP).

Method: The melting point of the selected steroids was investigated using a Griffin® melting point apparatus, and the result obtained was compared to the literature. An open-ended capillary was used to introduce the steroidal sample into the apparatus, and the temperature range over which the sample dissolved was recorded. The solubility of the steroids was assessed in different HPLC-grade solvents, namely water, methanol and acetonitrile. These solvents were selected since they are the most commonly used solvents in the analysis of active pharmaceutical ingredients. A set of stock solutions was prepared for each steroid in acetonitrile and methanol, respectively. The stock solutions were then sonicated using an IBX® Ultrasonic bath for 30 minutes and left overnight in the fridge. A set of dilutions was prepared by adding HPLC-grade water to methanol or acetonitrile at a ratio of 1:9, 3:7, 5:5, 7:3, and 9:1, respectively. The UV-spectroscopy SPECTROstar Nano (BMG LABTECH) was used to determine the solubility of the steroids. The stock solutions of each steroid were used to determine the wavelength which exhibits the best absorbance. The absorbance of the pure solvents was determined to eliminate interferences. A quartz cuvette was used for the analysis, and each sample was analysed in triplicates, and the average absorbance was calculated. Spectrograms were plotted in Excel, and the solubility was determined from the area under the peak.

Results: The melting point of difluprednate was found to be 188-189^{o}C, and that of 6α9α-difluoroprednisolone was found to be 210-220^{o}C. The wavelength which provided the best absorbance was 242nm. The maximum UV absorbance when analysing the diluted solutions of DFPA and DFP were 6.815 Au and 3.359 Au, respectively. These results indicate that the highest solubility of difluprednate was achieved when dissolved in a methanol and water mixture at a ratio of 1:9 with a solubility of 0.72mg/ml. The highest solubility of 6α9α-difluoroprednisolone was 1.92mg/ml. This solubility was observed when the steroid was dissolved in a mixture of acetonitrile and water at a ratio of 1:9 respectively.

Conclusion: The melting point of the analysed steroids was found to be in accordance with values found in the literature. The experimental determination of the solubility of the analysed steroids will contribute towards improved analytical method development.

Mapping of temperature and humidity fluctuations in an emergency medical setting of ambulance service: A prospective observational study in Qatar

Nour Alhuda Alaghawani[1], Abrar Mohamed[1], Ahmed Makhlouf[2], Habib Ben Kerkeni[2], Loua Al Shaikh[2], Guillaume Alinier[2], Alaaldin Alkilany[1], Ousama Rachid[1]

[1]College of Pharmacy, QU Health, Qatar University, Doha, Qatar

[2]Hamad Medical Corporation Ambulance Service, Doha, Qatar

Introduction: Paramedics working in emergency medical settings (EMS) are required to administer life-saving medications to patients routinely. Typically, these medications experience undocumented fluctuations in environmental conditions, including temperature and humidity (T/H), which may lead to the degradation of the drug and harm to the patient. In a country like Qatar, known for its high temperatures and relative humidity, the conditions to which the paramedic medications are exposed are yet to be documented and require careful assessment. This study aims to map the T/H in Hamad Medical Corporation Ambulance Service (HMCAS) vehicles, as well as identify the magnitude and reasons for excursions in the mean kinetic temperature (MKT).

Method: In this study, six HMCAS Charlie unit vehicles, each with three temperature and humidity data loggers, were used to assess the T/H fluctuations experienced by the ambulatory medications. Two of the data loggers were placed in two paramedic bags stored at the back of the unit, while the third data logger was mounted on the unit's metal net. T/H readings were recorded at 10-minute intervals over a year. Data was then extracted from the loggers, analysed using Python, and subjected to statistical analysis.

Results: T/H records reached up to 59.1 and 65.6°C for temperature and 98.4% and 99% in humidity for the bags and metal, respectively. The calculated MKT exceeded the USP recommendations of 30°C in both the bags and metal, and in some instances, it exceeded 50°C. Mann-Whitney U test comparing both bags reported little to no observed difference in the data of each unit; however, as expected, the metal net loggers reported greater temperature and MKT violations compared to the bags.

Conclusion: Overall, due to the large violations reported, optimum storage conditions for EMS vehicles need to be developed and implemented to ensure product stability and patient safety. Research on the effect of these excursions on medication integrity is still ongoing.

Environmentally benign synthesis of magnetic Fe3O4 nanoparticle-carbon black@copper-quercetin rods for sensitive, disposable electrochemical sensor mitoxantrone

John Alake[1], Darko Kwabena Adu[1], Blessing Wisdom Ike[1], Zondi Nate[2], Ruchika Chauhan[1], Sachin Mohite[1], Lungelo Miya[1], Rajshekhar Karpoormath[1]

[1]Department of Pharmaceutical Chemistry, College of Health Sciences, University of KwaZulu-Natal, Westville Campus, Durban, South Africa

[2]Chemistry Department, Faculty of Applied Sciences, Cape Peninsula University of Technology, Bellville, South Africa

Background: Mitoxantrone is a valuable cancer chemotherapy. The anthraquinone-based drug interacts with cancer cell DNA to exert a cytotoxic effect. Due to the increased toxicity of mitoxantrone associated with the increase in dosage, there is a need for monitoring techniques. Furthermore, there is a need for quality control techniques due to the proliferation of counterfeit drugs, which is a common problem for medicines used to treat prevalent and life-long diseases like cancer. Counterfeit drugs may complicate treatment outcomes, hence the need for rapid and sensitive detection and quantification techniques. Despite the availability of tools like HPLC, LCMS, FTIR, UV spectroscopy, and more, electrochemical techniques have attracted considerable interest over other analytical methods because of their cost-effectiveness, high sensitivity, real-time analysis, selectivity, simplicity, and minimal sample preparation requirement.

Purpose: This study aimed to synthesise Fe3O4 nanoparticles, carbon black (CB), and copper-quercetin (Cu-QCT) composite using an environmentally friendly approach and their application for a disposable electrochemical sensor for quality control and monitoring serum mitoxantrone.

Method: Magnetic Fe3O4 was synthesised by titrating an aqueous mixture of FeCl3 and FeCl2 solution with Camellia sinensis aqueous leaf extract under vigorous stirring until the solution turned black. The copper-quercetin complex was synthesised by titrating copper acetate solution with quercetin monohydrate solution at room temperature. Finally, redispersed solutions of Fe3O4, copper-quercetin complex, and carbon black (purchased) were mixed, sonicated for 10 minutes, and centrifuged to obtain Fe3O4-CB@Cu-QCT. Energy-dispersive X-ray spectroscopy, X-ray diffraction, NMR, and electron microscopy characterised the materials. 5 µl of 1 mg/mL Fe3O4-CB@Cu-QC was drop-casted onto a screen-printed carbon electrode (SPE) and used as the working electrode for the electrochemical analysis. Differential pulse voltammetry was conducted on CHI660E (CH instrument, USA) with a three-electrode set-up: Fe3O4-CB@Cu-QCT/SPE, platinum wire, and Ag/AgCl (1.00 M KCl) to detect and quantify the mitoxantrone in spiked serum.

Results: The microscopy Cu-QCT was rod-like, while the Fe3O4 and CB were nanoparticles. Fe3O4-CB@Cu-QCT/SPE showed improved conductivity and promoted faster electron transfer than the bare SPE. Fe3O4-CB@Cu-QCT/SPE produced an Rct 0.001 Ω compared to 223.7 Ω for bare SPE. Differential pulse voltammetry of 0.1 mM mitoxantrone in phosphate buffer (pH 6.5) produced peaks at three oxidation potentials: 0.340 V, 0.508 V and 0.688 V. There was a linear relation between the concentration and the oxidation current. The sensor was highly sensitive, with a detection limit of 49 pM at a linear range of 10 to 100 µM. The average recovery was 102 % (RSD=4.5 %). The sensor was reproducible and selective to mitoxantrone at the optimised parameters.

Conclusion: The Fe3O4-CB@Cu-QCT/SPE has the lowest detection limit compared to previously reported mitoxantrone sensors. The materials are obtained by simple green chemistry. Also, the authors found the three oxidation potentials for mitoxantrone instead of the reported two for the first time. The three oxidation potentials agreed with mitoxantrone's established complex three-step oxidation mechanism. The current technique may be useful for quality control and monitoring of serum mitoxantrone.

SPaRCS: Learnings from a project to strengthen pharmacovigilance and regulatory capacity in Southern Africa

Hazel Bradley[1], Michelle Viljoen[2], Star Khoza[2], Mukesh Dheda[3], Liberty Chirinda[4], Anna Shimbulu[5], Frieda Shigwedha[5], Siphesihle Nhlabatsi[6], Nomsa Shongwe[6]

[1]*School of Public Health, University of the Western Cape, Cape Town, South Africa*

[2]*School of Pharmacy, University of the Western Cape, Cape Town, South Africa*

[3]*Pharmacovigilance Centre for Public Health Programmes, National Dept. of Health, Pretoria, South Africa*

[4]*Medicines Control Authority of Zimbabwe, Harare, Zimbabwe*

[5]*Ministry of Health and Social Services, Windhoek, Namibia*

[6]*Ministry of Health, Mbabane, Eswatini*

Background: Access to safe, effective and quality medicines and vaccines is an important goal of universal health coverage. Robust regulatory systems and pharmacovigilance (PV) programmes for health products are recognised as essential components of health systems as they play critical roles in assuring the safety, efficacy and quality of health products through licensing, market authorisation, post-marketing surveillance and, finally, use or disposal. Whilst PV systems exist in most African countries, there are challenges in maintaining mature and active PV systems. This poster describes the achievements and learnings from a recent EDCTP-funded project in Southern Africa and the potential to leverage relationships to further strengthen PV and related activities in this region.

Purpose: Strengthening pharmacovigilance and regulatory capacities in four Southern African countries (SPaRCS) was a 3.5-year project which commenced in April 2020, led by the Schools of Public Health and Pharmacy at the University of the Western Cape, Cape Town, in collaboration with National Regulatory Authorities (NRAs) from Namibia, Eswatini and Zimbabwe and the National Department of Health from South Africa, with the aim of strengthening PV systems and clinical trials oversight in the four countries.

Method: SPaRCS used a participatory action learning and co-creation approach to develop the personal and institutional capacities of the NRAs. Key activities included: a mapping and review of PV systems across the four countries, mutual learning exchanges and thematic workshops on selected topics and the development of capacity building initiatives for health workers. The project was divided into three phases.

Results: Phase 1: Participatory mapping of PV systems across the four countries identified several areas of good practice, gaps and training needs. The mapping guided the focus of phases 2 and 3.

Phase 2: Two thematic areas, Strengthening PV Systems and Clinical Trials Oversight, were selected for mutual learning activities. A workshop and exchange visits were held for each thematic area - one took place in Namibia and the other in Zimbabwe, with approximately 15-20 participants from the four countries attending each workshop.

Phase 3: Capacity-building activities focused on developing and piloting a training package for community health workers on adverse drug reaction reporting.

Key learnings from the SPaRCS project included the following: There were good opportunities for shared learning and collaborative activities despite the varying levels of maturity of NRAs, PV systems, and clinical trial oversight amongst the four countries. SPaRCS project partners appreciated the four face-to-face meetings, established a 'community of practice' and expressed interest in future collaborations.

Conclusion: Strengthening PV and regulatory capacity in Southern Africa will require a multifaceted approach involving the establishment of robust systems, addressing infrastructure and training gaps, learning from successful initiatives in other countries and building formal collaborative platforms at the regional level.

A hybrid type II implementation study to evaluate the effectiveness of a hub and spoke model to deliver antimicrobial stewardship interventions in African countries

Ayesha Iqbal, Gizem Gulpinar, Helena Rosado, Maxencia Nabiryo, Frances Garraghan, Claire Brandish, Victoria Rutter

Commonwealth Pharmacists Association, London, United Kingdom (UK), London, United Kingdom

Introduction: As part of the Commonwealth Partnerships for Antimicrobial Stewardship (CwPAMS) 2.0, a hub and spoke model (HSM) was employed across eight health partnerships (HPs) in 6 African nations (Ghana, Kenya, Malawi, Sierra Leone, Tanzania, and Uganda) to deliver Antimicrobial Stewardship (AMS) interventions. The hubs serve as centralised organisations driving effective AMS initiatives, whereas spokes are smaller health centres collaborating to share resources, services, and training to execute impactful AMS initiatives. There is a total of eight hubs and 34 spokes. Implementation research shows evidence-based interventions don't always ensure adoption and sustainability due to contextual factors. Socio-ecological factors, intervention complexity, and organisational considerations can influence the uptake of interventions and consequently impact interventional outcomes. Therefore, it is essential to understand, evaluate, and strategise implementation plans in an emergent context. The authors designed a hybrid Type 2 implementation study to evaluate HSM's effectiveness in delivering AMS interventions across HPs in CwPAMS 2. This

study aimed to assess HSM's effectiveness in achieving planned AMS initiatives and outcomes in CwPAMS.

Method: A mixed method research design was adopted in this study, with data collection in 3 phases: pre-, mid and post-implementation from December 2022 to March 2025. Four mandatory indicators were selected to track the progress of the CwPAMS programme. Data collection tools, such as surveys, study forms, monitoring and evaluation forms and interview topic guides, have been designed for each phase based on implementation science frameworks and are administered to relevant stakeholders through virtual and in-person methods. Quantitative data is being analysed using descriptive statistics using Microsoft Excel and SPSS software (V 22.0), and a thematic analysis is conducted to analyse qualitative data using NVivo 14 ®.

Results: In the mid-term implementation phase, among the indicators outlined, the Pre-AMS assessment tools have been completed for all eight hubs and 34 spokes, while the AMS Action plans have been prepared for eight hubs. The spokes (n=34) are still developing AMS action plans. AMS committees have been developed in 8 hubs and nine spokes (3 are newly formed, and six were in existence but are being rejuvenated as part of CwPAMS2). PPS has been conducted in 2 hubs, one spoke, and 34 PPS are yet to be conducted. Major barriers reported to delivering CwPAMS hub and spoke activities are identifying leaders and site champions, inadequate staff training and lack of knowledge, resistance to change, lack of time and resources (laboratory diagnostics, chemicals, etc) and competing priorities.

Conclusion: Insights gained will guide tailoring interventions and optimising strategies to overcome contextual challenges, enhancing the adoption, uptake, integration, and sustainment of beneficial AMS interventions in real-world healthcare systems.

Transitioning to regulatory harmonisation for medicines: A comparison between Africa and Europe

Kirti Narsai, Aukje Mantel-Teeuwisse, Hubert Leufkens, Rianne van den Ham, Francine Brinkhuis

Utrecht University, Utrecht, Netherlands

Introduction: Harmonisation of medicines regulation has historically been cumbersome and complex in many regions of the world. Numerous work-sharing, reliance, and cross-country learning activities have been tried, each demonstrating varying levels of success. In Europe, the harmonisation of medicines regulation started more than 50 years ago, resulting in 1995 in the establishment of the European Medicines Agency (EMA) and the European Network. More recently, Africa has embarked on a similar process, starting with various regional and continental initiatives (e.g., the African Medicines Regulatory Harmonisation Initiative and the African Medicines Agency). The aim of this study was to compare the historical and policy developments in medicines regulation in Africa and Europe over the last decades.

Methods: Existing literature and reports on medicines regulation and harmonisation were reviewed. In addition, Digital Tables, i.e. online discussions and content analysis, were hosted between African and European regulatory and policy experts, with 21 participants (11 from Africa; 10 from Europe) from private and public sector, academia, industries, and NGOs. Questions focused on a few key areas: power balance/influence between stakeholders, regulatory philosophy, funding, product scope, and embedding in health systems.

Results: The analyses pointed to fundamental differences between Africa and the EU, e.g., product mix, economics, disease epidemiology, industry policy, and socio-cultural factors, but also key commonalities, including protecting public health, work-sharing and capacity building. For Africa, key drivers have been the challenge of managing public health threats such as AIDS and COVID-19 effectively, resulting in policy responses which emphasised the need for self-sufficiency through a harmonised regulatory system to improve access to essential medicines, industrial policy and local production. In Europe, key drivers for harmonisation have been less reactive and included the formation of the EU common market, the awareness of cultural differences in medicines, and the need for informed regulatory review capacity across the continent to assess innovative medicines.

Discussion and conclusion: Comparing the histories of Africa and Europe in the context of regulatory harmonisation for medicines provides an opportunity for useful insights into why and how certain developments, policy changes and harmonisation initiatives have been shaped. Africa has made impressive progress over the last decade; Europe is strengthening its current regulatory system with new legislation. The public health and innovation challenges ahead for both continents and the rest of the world are paramount and will need all the global regulatory capacity and synergies available.

Assessment of the registration status of antimicrobial drugs available in pharmacies in the Ho Municipality, Ghana

Emmanuel Orman[1], Bridget Dzidzinu Ankah[1,2], David Oteng[1,2], David Mccarthur[2], Araba Ata Hutton-Nyameaye[1], Isaac Folitse[2]

[1]*School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana*

[2]*Pharmacy Department, Ho Teaching Hospital, Ho, Ghana*

Introduction: The fight towards antimicrobial resistance (AMR) requires safeguarding the quality, safety, and efficacy of antimicrobial drugs (AMDs) due to their pivotal role in the management of infections. Community pharmacies in Ghana often serve as the first point of call for most patients, where most febrile conditions are empirically managed with AMDs. While the unregulated prescription of AMDs in these settings requires attention, their quality and safety are also of prime importance. The current study considers the assessment of the registration status of AMDs available in community pharmacies in the Ho Municipality.

Method: This was a cross-sectional study using a pre-validated visual assessment checklist to assess key quality attributes and information on the packages and labels of AMDs in 23 pharmacies in the Ho Municipality between November 2023 and February 2024. Ethical clearance was sought, and the inclusion of any pharmacy was confirmed by consent approval. The data was analysed using descriptive and inferential statistics from Statistical Package for Social Scientists (SPSS) for Windows (version 26.0, USA).

Results: In total, the packages and labels of 275 AMDs, comprising antibacterials (n=112/275, 41%), antiprotozoans (n=76/275, 28%), antifungals (n=61/275, 22%) and antivirals (n=26/275, 9%), were assessed. Most of the AMDs originated from Ghana (n=114/275, 41%), followed by India (n=70/275, 25%) and the United Kingdom (n=46/275, 17%). While most of the AMDs had information entirely written in English (n=269/275, 98%), few of them (n=6/275, 2%) were written in other languages, with five of these providing English translations and one having no such translation. Of concern, 67% (n=183/275) of the products lacked registration numbers of the Food and Drugs Authority of Ghana (FDA), raising doubts about their legitimate registration for use in Ghana. Several of these products displayed registration numbers from other countries (n=14/183), including Nigeria (n=11/14, 79%), Kenya (n=1/14, 7%), and Zambia (n=2/14, 14%). After cross-referencing with the FDA website's list of registered products, it was found that only 55% (n=150/273) possessed valid registrations at the time of the study. Among the 183 products lacking FDA registration numbers, 53% (n=97/183) were either not registered with the FDA or had registrations that had expired. Furthermore, among the AMDs with displayed FDA numbers (n=92/275, 33%), 30% (n=28/92) were found to lack valid registrations at the time of the study.

The proportions of the studied AMDs classes either lacking registration or possessing expired registrations (n=125) were as follows: antifungals (n=40/61, 66%), antivirals (n=15/26, 58%), antibacterials (n=45/112, 40%), and antiprotozoans (n=25/76, 33%). Notably, two distinct batches of an antifungal displayed different FDA numbers, while three products from the same manufacturer exhibited similar FDA numbers.

Conclusion: In summary, the study reveals the presence of AMDs with questionable registration status in pharmacies within the Ho municipality. This raises concerns about product authenticity. Consequently, it is recommended that the FDA intensify post-market surveillance on AMDs in the region and other parts of the country since poor-quality AMDs may contribute to AMR and pose other harmful effects.

Quality-assured oxytocin and misoprostol can prevent hemorrhage and save mothers' lives

Sachiko Ozawa[1], Ashley Yi-Fang Lee[1], Colleen Higgins[1], Petra Procter[2], Sara Rushwan[2], Metin Gülmezoglu[2], Lester Cheney[2]

[1]*University of North Carolina, UNC Eshelman School of Pharmacy, Chapel Hill, United States*

[2]*Concept Foundation, Geneva, Switzerland*

Introduction: Almost 800 women die every day from preventable causes related to pregnancy and childbirth, and 95% of these deaths take place in low- and middle-income countries (LMICs). One of the preventable causes of maternal deaths is poor medicine quality, where 1 in 10 essential medicines in LMICs are substandard or falsified. Of particular concern are uterotonic medications, which play a crucial role in reducing the risk of postpartum haemorrhage (PPH), a leading cause of maternal mortality. This study evaluates the health and economic benefits of ensuring the quality of uterotonics in sub-Saharan African countries.

Methods: The authors simulated the impact of improving the quality of uterotonics (oxytocin and misoprostol) to prevent PPH and maternal deaths in 3 countries: Ghana, Nigeria, and Senegal. A decision-tree model was developed to depict mothers' care-seeking behaviours, PPH rates, additional uterotonic treatments, blood transfusions, mortality, and costs. Model inputs came from countries' Demographic and Health Surveys, e-Motive trial data, and various literature. The authors ran scenarios with and without substandard uterotonics to estimate the health benefits and cost savings associated with using quality-assured uterotonics.

Results: On a per 100,000 population basis, improving the quality of uterotonics would be able to annually prevent over 940 PPH cases in Nigeria, 2,180 PPH cases in Ghana, and 870

PPH cases in Senegal. At a population level, improving uterotonic quality would lead to over 74,500 PPH cases averted in Nigeria, 20,000 PPH cases averted in Ghana, and 5,000 PPH cases averted in Senegal every year. Overall, ensuring oxytocin and misoprostol quality would result in nearly 1,600 fewer maternal deaths annually. Cost savings from improving the quality of uterotonics by preventing PPH, healthcare costs, and productivity losses due to maternal deaths are estimated at $89.3 million in Nigeria, $18.8 million in Ghana, and $1.3 million in Senegal annually.

Conclusion: Substandard uterotonics contribute to many mothers suffering from preventable bleeding and deaths. Improving the quality of oxytocin and misoprostol not only saves lives but also brings significant cost savings to families and healthcare systems. Ensuring the quality of medicines is essential in improving medicine access and would contribute towards countries' efforts to achieve Universal Health Coverage.

A framework for investigating signals in pharmaceutical regulatory quality assurance

Valentina Sammut[1], Anthony Serracino Inglott[2]

[1]Malta Medicines Authority, San Gwann, Malta

[2]University of Malta, Faculty of Medicines & Surgery, Department of Pharmacy, L-Imsida, Malta

Introduction: Pharmaceutical regulatory assurance is a pillar in the regulatory sciences that leads to the availability of safe, effective, and quality medicinal products. A structured approach to using signals as an instructive tool of process management in regulatory sciences is an innovative, relatively unexplored concept in the evolution of pharmaceutical regulatory sciences. This research explores a gap in the identification of disruptive signals from sources within the quality management system, categorisation of identified signals, and development of signal minimisation action plans at the heart of the regulatory, scientific field. Strategic lines of inquiry in the regulatory and scientific field can be unfolded. The objective is to formulate a novel investigative framework for identified signals within regulatory sciences quality management systems. The hypothesis is that signal categorisation serves to enhance a quality management system by strengthening the regulation to safeguard the availability of quality, safe and effective medicines.

Method: The study employs a retrospective analysis of internal audit reports, quality improvement, and deviation forms within a competent authority in the medicine regulatory department. The analysis focuses on identified signals associated with operational and regulatory aspects within pharmaceutical sciences. A structured framework for categorising signals is devised, drawing upon the principles outlined in Module IV of the Guideline on Good Pharmacovigilance Practice, focusing on Pharmacovigilance Audits. The assessment tool incorporates definitions for terms such as "critical," "major," "minor," and "others" and thresholds to facilitate the systematic classification of signals. In this context, 'critical' denotes a foundational deficiency within regulatory pharmaceutical procedures or methodologies, leading to adverse impacts on the regulatory framework and/or constituting a severe breach of relevant regulatory standards. 'Major' signifies a notable deficiency within regulatory pharmaceutical procedures or methodologies or a fundamental fault therein that undermines the regulatory process and/or breaches applicable regulatory standards, albeit without reaching a level of severity deemed critical. 'Minor' denotes a deficiency within regulatory pharmaceutical procedures or methodologies that is not anticipated to have adverse effects on the regulatory framework. 'Other' encompasses deficiencies or inadequacies in regulatory pharmaceutical processes or practices that do not fit within the aforementioned terms. These may include less consequential deviations from regulatory requirements or minor issues that do not present substantial risks to the regulatory integrity or compliance criteria. The competent Authority in question is patient-centric, and the relation of signal categorisation to patient safety needs to be elaborated upon.

Results: The analysis of the internal documentation revealed that no cases were of a critical and major nature. Predominantly, findings were categorised as minor or other. These findings hold significance in fostering a proactive approach to signal management within the regulatory framework of signals for quality assurance, contingent upon the established classification framework. These findings are anticipated to strengthen regulatory integrity and ensure adherence to established standards.

Conclusion: This research has yielded the development of a structured categorisation framework tool inspired by Module IV Pharmacovigilance Audits, as outlined in the Guideline on Good Pharmacovigilance Practice. The interaction between data, communication, and governance offers a systematic approach to organising identified signals and facilitating streamlined processes in signal classification.

Review and update of the UK professional standards for the reporting, learning, sharing, taking action and review of incidents error reporting

Laura Wilson, Regina Ahmed, Wing Tang

Royal Pharmaceutical Society, London, United Kingdom

Background: The General Pharmaceutical Council (GPhC) and the Pharmaceutical Society of Northern Ireland are the

regulatory bodies for pharmacy professionals in Great Britain (GB) and Northern Ireland (NI). The Royal Pharmaceutical Society (RPS) and Pharmacy Forum NI are the professional bodies for pharmacists in GB and NI, and the Association of Pharmacy Technicians UK for pharmacy technicians. Professional standards provide a framework to support pharmacy professionals in meeting the regulatory standards and describe quality pharmacy services or what 'good' looks like.

The error reporting professional standards describe good practice for reporting, learning sharing, taking action and review of incidents as part of a patient safety culture. Implementation improves patient safety and protects people who use pharmacy services.

Purpose: The GPhC standards require pharmacy professionals to help people 'maintain and improve their health, safety and wellbeing'. Standards for pharmacists' initial education and training state, 'Patient safety must come first'. Therefore, patient safety and well-being are essential considerations when delivering pharmacy services. With an evolving pharmacy landscape and expanding roles, a review of these standards is required.

Method: An expert steering group provided strategic oversight for the update. 27 patient safety experts from different sectors and settings were invited to join from across the UK. A 6-week public consultation informed the update. The steering group designed the questions, and it was disseminated through the RPS website and networks. Results were analysed using text and descriptive analysis. The group used a consensus process to review and update the standards.

Results: There were 48 responses to the consultation. The standards are well used in practice, with over 1500 unique users viewing the standards on the RPS website annually. Therefore, it is essential to update these standards to include the latest legislative, regulatory, and national updates, such as the NHS England patient safety incident response framework and the pharmacy (preparation and dispensing errors hospital and other pharmacy services) order 2022. Current terminology and topics were identified for inclusion, such as just culture, the duty of candour, human factors, safety II, and systems-based thinking. A new title was created, 'Patient safety professional standards responding to patient safety incidents,' to encompass all patient safety incidents, not just errors. A generic scope and expanded audience were adopted to include all pharmacy services, not just community pharmacies. It applies to anyone delivering pharmacy services, pharmacy professionals working in other healthcare settings, and anyone working within the pharmacy, regardless of professional background or setting. Clarity was requested around expectations and outcomes that demonstrate good professional practice, patient safety, systems of care and effective working practices, and examples of how the standards could be demonstrated in practice. New standards, descriptor outcomes and supporting statements were created to address these.

Pharmacy-initiated medication reconciliation and its impact on patient care

Kenny Yu[1], Arash Dabestani[2]

[1]*NYU Langone Hospitals, New York, United States*

[2]*LIU Pharmacy (Arnold & Marie Schwartz College of Pharmacy and Health Sciences), Brooklyn, United States*

Background: Patient medication profiles are extremely important in influencing the best possible care to drive quality outcomes and safety. Accurate and timely medication reconciliation is necessary. The issues are the timeliness of performing the medication reconciliation and the time it takes to complete one. Although significant, expending time and using a provider to perform this task takes away from other patient care activities. The pharmacy department at NYULH, in collaboration with providers, nurses and IT, implemented a workflow to station pharmacy personnel in the ED dedicated to collecting medication histories of patients prior to admission.

Method: New resources were added to the ED dedicated to collecting medication histories from patients who were admitted. The authors implemented a new process alongside pharmacy, nursing, providers and IT to provide an efficient workflow, improve communication and reduce duplication. The authors created a new profile in this EMR that allowed the Transitions of Care (ToC) Coordinators to document. The authors leveraged admission data to influence the scheduling. Qualitatively, the authors tracked the success rate of medication history acceptance by providers, the number of discrepancies these ToC coordinators identified, the types of discrepancies, the number of interventions the ToC coordinators identified and were able to reconcile, and the success rate. Quantitatively, the authors track the number of patients reached divided into the number of medication histories performed, the average number of medication histories per shift, the time per medication history, and the average number of medications per patient. IT created a flag in the patient profile within this EMR to show a provider that a medication history was collected and performed by the pharmacy department, including any communications about potential interventions.

Results: Since its inception, the authors have seen a 100% acceptance rate of providers utilising the medication histories of the pharmacies for their medication reconciliation. Based on the two ToC coordinators, the authors average 7.7 medication histories completed per shift, an average time of 35.5 minutes per medication history, and an average of 10.1 medications per patient. The authors capture approximately 25% of patient admissions with the two dedicated resources and use a scoring tool to identify patients at higher risk.

Conclusion: Thus far, the authors have seen a positive impact on the patients, the pharmacy, pharmacy interns (or students), providers and nurses. For the patients, this helps with the quality of care. The authors have afforded providers and nurses time to perform patient care tasks that are more in line with their scope of work. For the pharmacy department, the authors have expanded the scope of practice, participating more actively and collaboratively with the care team. The authors have provided a professional growth opportunity for these pharmacy technicians and are cultivating and promoting a learning environment for the pharmacy interns and students as they move towards becoming pharmacists with real-life experience in patient care.

An analysis of the regulatory process and challenges for medicine marketing authorisations in Namibia: A mixed-methods study

Vulika Nangombe, Loide Tomas, Saren Shifotoka

School of Pharmacy, Faculty of Health Sciences & Veterinary Medicine, University of Namibia, Windhoek, Namibia

Introduction: Numerous complex factors affecting access to medicines in low- and middle-income countries (LMICs) exist, including regulatory system shortfalls. These have negative public health consequences, such as preventing timely access to cost-effective, quality-assured, and safe pharmaceuticals. The Namibia Medicines Regulatory Council (NMRC) has implemented steps to address delays in medicine authorisation, such as reliance on outcomes for products prequalified by the World Health Organisation (WHO) and those approved by stringent regulatory authorities (SRA) or participating in the Southern African Development Community's (SADC) regional collaboration on medicines authorisation (Zazibona), as well as legal provisions for expedited reviews for priority products. However, the status of the marketing authorisation process is not known.

Purpose: This study aimed to review the Namibian medicine marketing authorisation process and its associated challenges.

Method: A mixed-method approach was used in this study. Multiple data sources were reviewed to quantify and describe the current registration process, including the electronic medicine pre-registration application database, Zazibona tracking sheet, and the medicines register for all products submitted or registered between 2010 and 2022. To explore challenges with the process, an online survey of NMRC medicines assessors, combined with in-depth semi-structured key informant interviews with the heads of NMRC and the registration subsection, respectively, were conducted. Quantitative data was triangulated between databases and analysed using descriptive statistics; qualitative data was analysed into themes.

Results: From 2010-2022, 2742 product applications were finalised and registered, of which 3.5% (n=96) were approved based on Zazibona recommendation and 1.5% (n=41) were WHO prequalified. On average, 210.9 applications were finalised for registration each year. During this period, 983 new applications were received (75.6 applications/year). Most new applications (82%, n=803) were submitted for review under the full assessment pathway. Of newly submitted applications, only 5.2% (n= 51) were allocated assessors for review, while for the rest, their status was not indicated. During this period, the number of assessors ranged from two to seven individuals who had additional responsibilities within NMRC. Timelines could not be determined by the data available. Key informants revealed major challenges in the process, which included manually managing data, managing dormant applications, and addressing considerable assessor workloads. Other factors include an outdated legal framework and limited funding.

Conclusion: While the study could not evaluate review timelines due to shortcomings in the currently available data, the investigation was able to identify and confirm large workloads for assessors. As a comparison, the former South African NRA finalised 3148 applications between 2011 and 2017, equivalent to 449.7/year by substantially more assessors. The population of South Africa is approximately 20 times the population of Namibia. Data also revealed that few of the applications were processed through the proposed efficiencies (WHO Pre-qualification and Zazibona recommendation), with most applications submitted through full assessment pathways. Process challenges were similar to other LMICs, including systems for managing and tracking information to allow NRA decision-making to be either lacking, inaccurate or difficult to retrieve. Continued work in this area can lead to improved tracking and greater efficiencies, which will lead to improved medication access in Namibia.

Transformations in the pharmaceutical regulatory system: Opportunities and challenges

Fahad S. Aldawsari

Saudi Food and Drug Authority (SFDA), Riyadh, Saudi Arabia

Introduction: A typical pharmaceutical regulatory system comprises conventional activities such as medicine registration, surveillance & pharmacovigilance and laboratory compliance testing. However, there have been recent safety issues in medicines that have influenced society, in which common regulatory activities were not effective enough in mitigating these risks. In addition, new technological and digital tools are gaining attention in stimulating the existing

regulatory system as well as establishing new regulatory opportunities.

Purpose: To investigate the new trends in medicines regulations among the world's leading regulatory systems in order to identify learning opportunities for pharmacists and also to provide academia with insights in order to update appropriate curriculums accordingly.

Methods: A thorough analysis of the announced strategic plans for regulatory systems in the countries of the United States, European Medicines Agency, Australia, Japan and Saudi Arabia was performed. In addition, scanning for the published research studies from those authorities was also attempted in order to identify research directions and potential areas for enhancing pharmacists' skills.

Results: Three key areas for the new era of medicine regulations were identified, namely digital health, partnership collaboration and regulatory-driven scientific research. Moreover, special focus was given to biopharmaceuticals within the context of these areas owing to the future of medicinal therapeutics, taking the COVID-19 pandemic as a drive for this wave.

Conclusions: The new generation of pharmacists are encouraged to broaden their knowledge on the use of scientific tools (e.g. artificial intelligence, data analysis, and biostatistics), and how to incorporate these concepts within the essence of the pharmaceutical sciences arena. Academia is encouraged to embed these areas of learning into their curriculum for better preparation of pharmacists to embark the challenges in regulatory ecosystem.

Application of experimental design and canonical analysis through the Eigen value problem to drug release of microencapsulated microparticles

Sandile Khamanga, Roderick B. Walker

Rhodes University, Makhanda (Grahamstown), South Africa

Background: Fitting data to a second-order polynomial for a system that contains some curvature is not well accommodated or interpreted. Canonical analysis can solve the problems by finding local optima for classical minimization and saddle point problems. In vitro dissolution is one of the most important elements of drug product development. Several models can be used to describe drug dissolution profiles where f (t) is a function of t (time) that is related to the amount of drug dissolved from a pharmaceutical dosage form. The quantitative interpretation of values generated in dissolution studies is facilitated using generic equations that mathematically translate dissolution curves as a function of certain parameters related to the dosage forms being tested. In some cases, the equations can be deduced by theoretical analysis of processes that a dosage form is subject to.

Purpose: The response surface methodology and canonical analysis through the Eigen value problem were employed to find the most suitable conditions for drug release of captopril (CPT) from microencapsulated microparticles.

Methods: In this study, the modelling of per cent drug release and optimization of per cent released was undertaken using canonical, mathematical and Lagrange methods or Lagrange multipliers and Eigenvalue problems. A total of 30 sets of experiments were developed to obtain second-order polynomial equations in terms of independent variables. The variables were the concentration of Eudragit® RS, Methocel® K15M, Methocel® K100M and homogenizing speed. The experiments were carried out according to a central composite design. An empiric quadratic equation that correlated drug release and the independent variables was proposed.

Results: The optimal conditions determined by the canonical analysis of the fitted model were X1= 0.43 g, X2= 2.04 g, X3 = 1.02 g and X4 = 3000 rpm. Subsequent formulation, carried out under optimal conditions, confirmed the release predicted by the adjusted model. The results of curve-fitting studies reveal that CPT release from the microparticles could be described by the Makoid-Banakar, Korsmeyer-Peppas, Kopcha and Higuchi models. These coefficients of determination were higher than 0.900 for all analyses, and the corresponding sum squared regression values were lower than those of the other models.

Conclusion: Central composite rotatable design and canonical analysis of the response surfaces proved to be useful tools for determining the release of CPT from the microparticles. Canonical analysis seems to be a proper choice for finding local optima for classical minimization and saddle point problems.