Non-virtual simulation training and patient simulation existing for pharmacy students: A scoping review

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Abstract

Background: Simulation training enhances non-technical skills and patient safety in pharmacy education, fostering healthcare knowledge and interprofessional collaboration. These training programmes are crucial for instructing pharmacy students in establishing therapeutic and interprofessional relationships with patients and healthcare providers. The objective of this scoping review was to examine not only the simulation training activities currently available to pharmacy students but also their effectiveness and then to identify areas in non-technical skills that still need to be taught. **Methods:** A scoping review focused on "*simulation training*" and "*pharmacy students*" was conducted, excluding virtual simulation. Initial searches in Scopus, MEDLINE and ERIC were performed on June 6, 2020, with a follow-up on February 25, 2022. Both English and French articles were considered, guided by PRISMA-ScR. **Results:** From 812 initial papers, 140 met inclusion criteria, revealing two simulation modalities: simulated patient and hybrid. Hybrid modality facilitated interprofessional simulation. Simulation training in patient communication, medication counselling and interprofessional education was seen to have the most impact on students. **Conclusion:** Simulation training was found to be an efficient method of teaching non-technical skills such as communication, medication counselling and interprofessional collaboration for patient-centred care and interprofessional exchanges in pharmacy education programmes.

Introduction

A number of different educational training programmes, such as simulation training, have been widely implemented in a number of areas of medical education to improve healthcare skills (McInerney *et al.*, 2022). Simulation training involves replacing or amplifying real experiences with guided ones that replicate likely interactions in the professional workplace in an interactive manner (Gaba, 2004). In fact, this form of training has become more and more widespread as it allows healthcare students to practice and hone their skills in a controlled and low-risk environment before engaging with actual patients (Barry Issenberg *et al.*, 2005; McGaghie *et al.*, 2010). Simulation training has been found to be particularly valuable in assessing skills, team training, enhancing confidence, decision-making (Boulet *et al.*, 2010) and developing relational skills. Patient communication and relational skills, also known as emotional intelligence (Soft Skills, empathy, etc.), play a crucial role in fostering patient-medical staff relationships, therapeutic adherence, and improving therapeutic outcomes. Previous studies have noted that the outcome of an interaction between a patient and a pharmacist depends on the pharmacist's ability to use the correct communication and counselling skills (Shah & Chewning, 2006; Mafinejad *et al.*, 2017). The

community pharmacist is an accessible healthcare provider whose advice is highly sought-after. In addition to providing appropriate medication and treatment advice, a pharmacist must be able to respond appropriately to patients' demands and promote healthcare. This means that he also needs to be capable of interacting effectively with all members of a multidisciplinary medical team.

The terminology of the simulation modalities used was based on Chiniara's taxonomy and conceptual framework (Chiniara *et al*., 2013). A number of different modalities were employed to define the characteristics of simulation, including computer-based simulation, procedural simulation, simulated clinical immersion (SCI) and simulated patient (SiP). Additionally, hybrid modality (HM) was used which refers to a simulated experience combining two or more simulation modalities (Chiniara *et al*., 2013).

Visualising the practical applications of simulation training in non-technical skill development is crucial, but these fields have not been exhaustively described to date. There is currently no comprehensive overview of the various applications of live person-person simulations that are currently used to educate pharmacy students.

In a community pharmacy, the pharmacist interacts in person with both patients and medical colleagues. For this reason, this study focused on non-virtual live person-person simulation training scenarios: a SiP interacting with a pharmacist (played by a pharmacy student) or an interprofessional role play (IPR) that integrated multiple simulation modalities for patient care provision (Chiniara *et al*., 2013). The HM incorporated a minimum of one simulation modality alongside the IPR, such as SiP, computer-based simulation, procedural simulation, or SCI. SiPs are either actors or actual patients who have assumed the role of a patient in a pre-determined situation.

A scoping review is the method of choice for identifying knowledge gaps in the literature (Munn *et al*., 2018). This scoping review mirrored other studies that have demonstrated the benefit of virtual training in pharmacy education (Beshir *et al*., 2022). The results provide an overview of existing non-virtual reality simulation training and patient simulation for pharmacy students and describe the different areas of

non-technical skills that are taught as part of pharmacy education. This currently includes patient communication, medication counselling and interprofessional education. In addition, their impact was examined and gaps in simulation training activities in these areas were identified.

By reviewing the existing literature on simulation training in pharmacy education, this review aimed to highlight the main areas of application in simulation training and come up with potential topics for future research. It was hoped that filling these gaps would improve current simulation training programmes for pharmacy students, equipping them with the skills they require to provide high-quality care for their patients.

Methods

Before starting the scoping review, the following databases were searched in June 2020 for existing scoping or systematic reviews on the topic: Cochrane Library, Prospero, Scopus (via Elsevier), MEDLINE (via Pubmed), ERIC (via Ovid), Epistemonikos, Campbell Library and JBI Evidence synthesis. None were found. Ethics approval was not required.

Design

This scoping review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al*., 2018). The PRISMA-ScR checklist was used to perform the analysis and the protocol has been registered on the Open Sciences Framework (Registration DOI 10.17605/OSF.IO/G5VPW).

Search strategy

Three bibliographic databases, MEDLINE (via Ovid), ERIC (via Ovid) and Scopus (via Elsevier), were searched for articles in both English and French on June 6, 2020. A second search was carried out on February 25, 2022. The search strategy was made up of two key concepts: (1) simulation training and (2) pharmacy students. The complete search strategy can be found in the supplementary material section (Figure 1).

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Ovid MEDLINE(R) ALL <1946 to March 25, 2022> - Search strategy
1 Students, Pharmacy/
2 Education, Pharmacy/
3 ((pharmacy or pharmaceutic*) adj3 (student* or education)).ti,ab,kf.
4 1 or 2 or 3
5 exp Simulation Training/
6 Role Playing/
7 (simulat* adj3 (training* or patient* or environment or education or high-fidelity or interprofession-al)).ti,ab,kf.
8 (role adj1 playing*).ti,ab,kf.
9 ((interact* or simulat*) adj3 learning).ti,ab,kf.
10 (standardi* adj1 patient*).ti,ab,kf.
11 5 or 6 or 7 or 8 or 9 or 10
12 4 and 11
SCOPUS (via Elsevier) – Search strategy
TITLE-ABS-KEY ( ( ( simulat* ) W/2 ( training OR patient OR environment OR education OR high-fidelity OR interprofessional ) ) OR ( ( role ) W/1 (
playing ) ) OR ( ( interact* OR simulat* ) W/2 ( learning ) ) OR ( ( standardi* ) W/1 ( patient ) ) ) AND TITLE-ABS-KEY ( ( pharmacy OR
pharmaceutic* ) W/2 ( student OR educa-tion ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "re" ) )
ERIC <1965 to January 2022> - Search strategy
1 pharmaceutical education/
2 ((pharmacy or pharmaceutic*) adj3 (student* or education)).mp.
3 1 or 2
4 Simulation/
5 Role Playing/
6 Simulated Environment/
7 (simulat* adj3 (training* or patient* or environment or education or high-fidelity or interprofession-al)).mp.
8 (role adj1 playing*).mp.
9 ((interact* or simulat*) adj3 learning).mp.
10 (standardi* adj1 patient*).mp.
11 4 or 5 or 6 or 7 or 8 or 9 or 10
12 3 and 11
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Figure 1: Supplementary material

Eligibility criteria

The eligibility criteria (inclusion and exclusion criteria) are presented in Table I. Articles published before 2000 were excluded. Incorrect intervention types encompassed literature reviews, descriptions of educational programmes, workshops, or patient cases without interaction, assessment, or examination were also rejected.

Table I: Eligibility criteria (inclusion and exclusion criteria) of references to be included in the scoping review

	Inclusion criteria	Exclusion criteria
Population	• Students in pharmacy programme • Interprofessional collaboration with pharmacy students and other disciplines	• Wrong population (professional pharmacists) • Students in pharmacy were playing a minor role.
Intervention	Simulation training	• Inappropriate settings/intervention: Simulation training focusing on the evaluation/assessment of the performance: certification assessments or examinations, objective structured clinical exam (OSCE) • Insufficient description of the simulation activity • Insufficient pharmacy student's participation in interprofessional collaboration • Post-graduate pharmacy activities
Concept	Face-to-face or in-person (by telephone or face-to-face) simulation training	• Virtual simulation training, online simulations
Context	French and English	• Pharmacy dispensary
Sources	Peer-reviewed original studies	• Records • Short commentaries • Conference abstracts • Book reviews • Letters to editors

Selection of studies and data extraction

Titles and abstracts were independently screened by two authors; Aurore Gaspar (AG) and Geneviève Philippe (GP), to exclude records that did not match the eligibility criteria. Marjorie Bardiau (MB) acted as the third peer to arbitrate in the event of a difference of opinion. The full text of each selected article was screened to determine whether it met the eligibility criteria. The data extraction of the selected papers was conducted using a pre-defined data sheet developed by the authors.

Results

Study selection

In total, 812 articles were identified from the database searches after duplicates had been removed. In fact, 397 of the original 812 screened, using the titles and abstracts, were considered eligible for full-text screening. Following full-text screening, 140 studies were selected for the scoping review. Figure 2 shows the PRISMA flow chart describing the process of selecting articles.
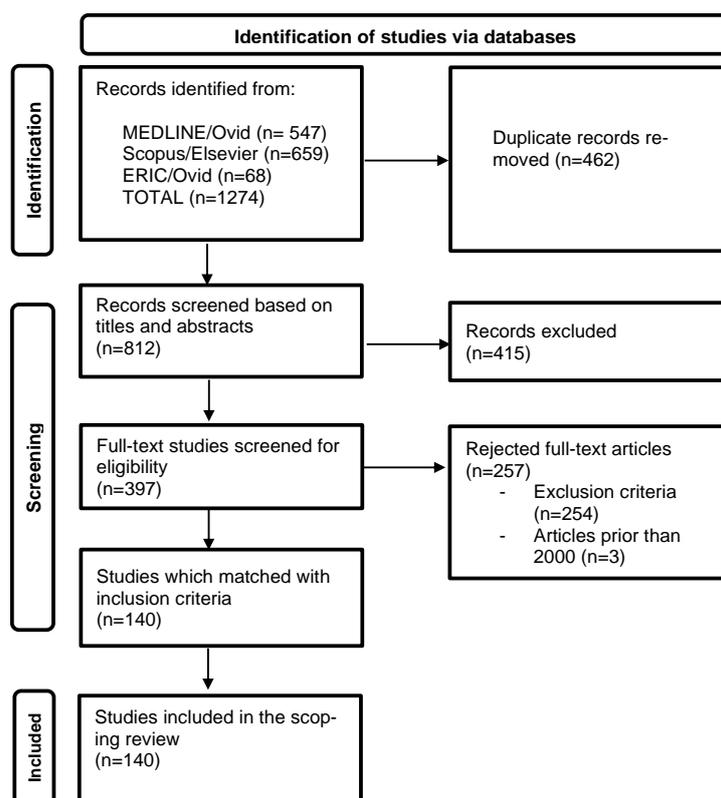

Figure 2: PRISMA flow diagram for the inclusion of articles on simulation training for students in pharmacy until February 2022

General characteristics of included studies

Appendix A shows the characteristics of accepted studies (extraction table).

The majority of the selected studies were single-site studies, with many having been conducted in the United States (n=107), Australia (n=12) and England (n=9). Other countries represented to a lesser degree were Canada, China, Ireland, Japan, Jordan, Korea, New Zealand, Qatar, Saudi Arabia, Scotland, Spain, and Turkey. The most common designs were pre-post surveys, post-activity assessments, and mixed-method studies. Other study designs, found to a lesser degree,

included comparative, observational, cohort, and correlation studies.

Simulation modalities

Two simulation modalities, SiP modality and HM, were used for in-person training scenarios.

SiP modality represented 62 articles of the 140 selected (44%). Pharmacy students took the role of a pharmacist and worked with a person assuming the role of a patient. The SiP modality can be further subdivided into standardised patients (SP) and simulated patients in a

role-play (RP). SPs followed a predefined script, while SiP, in a role-play, was given free rein to improvise a dialogue that met their patients' needs (Chiniara *et al.*, 2013). SPs and RPs each represented 50% of the SiP modality. In a small number of studies, SiP referred to real patients (Basheti, 2014; Boukouvalas *et al.*, 2018; Barrickman *et al.*, 2020; Wang *et al.*, 2020). Hybrid modality represented 56% of the selected studies (78 articles out of the total 140). Pharmacy students acted as pharmacists in an IPR that integrated multiple simulation modalities for patient care provision (Chiniara *et al.*, 2013). Simulation modalities which accompanied IPR were SPs, RPs, human simulators (high-fidelity or low-fidelity mannequins) (Jung *et al.*, 2020) (Marken *et al.*, 2010), SCI (Chiniara *et al.*, 2013)

or a patient case. Therefore, the patient was not necessarily someone playing a role, but there was interaction between two (or more) healthcare professionals.

Impact of simulation training on pharmacy student's non-technical skills

Simulation training has been shown to have a positive impact on the education of pharmacy students in 3 main areas: (1) patient communication (PC), (2) medication counselling (MC) and (3) interprofessional education (IPE) skills.

Table II shows the impact of simulation training on non-technical skills.

Table II: Simulation training's impact on non-technical skills

Reference	Simulation training's impact			Type of impact (+, -, 0)	Description of impact measured
	PC	MC	IPE		
Acquavita, 2021			P	+	IPE using SBIRT, knowledge, perceived competence, frequency of care
Baalmann, 2022			P	+	IPE confidence in error disclosure, telehealth technology
Bajis, 2021		P		+	knowledge and confidence in asthma first aid performance and counselling
Bajis, 2019		P		+	medication reconciliation skills, self-perceived confidence, and satisfaction
Barker, 2018	P			+	self-reported generic communication competencies, confidence
Barrickman, 2020		P		+	MTM, patient care skills in acute care setting
Bartlett, 2020			P	+	IPE (IP communication, role-related knowledge and skills, confidence, and satisfaction)
Basheti, 2014		P		+	MC in verbal and clinical device technique education
Begley, 2013		P		+	MTM (medication-related problems, drug utilisation reviews, prescription verification and patient counselling)
Begley, 2019			P	+	IPE (IPC, team skills and team performance linked to IPEC core competencies)
Bottenberg, 2013			P	+	IPE perceptions and attitudes toward IP collaboration
Boukouvalas, 2018	P			+	PC (attitude towards suicidal crises)
Bowers, 2021			P	+	IPE perceptions, knowledge retention, IP care plan development
Bowers, 2017		P		+	MC (insulin injection technique, counselling skills, knowledge retention)
Brennan, 2021			P	+	IPE (perceptions of IPC, teamwork, communication, RR, patient outcomes from collaborative practice)
Brock, 2013			P	+	IPE (attitudes toward team communication, motivation, knowledge, IP communication)
Candelario, 2019		P		+	MC (TOC education)
Chen, 2015	P			+	PC (empathy, perceptions, attitude toward elderly patients)
Chen, 2011	P			+	PC (perceptions of attitudes toward older adults, understanding of patient experience)
Chen, 2008	P			+	PC (empathy, care of underserved patients)
Chen, 2015	P			+	PC (confidence in providing patient counselling)
Christopher, 2019			P	+	IPE (attitude toward collaboration and teamwork, RR)
Clauser, 2020			P	+	IPE (perceptions of physician-pharmacist IP clinical education)
Cobb, 2019	P			+	PC (communication skills, empathy, and confidence)
Cooke, 2017			P	+	IPE (attitude toward collaborative practice)
Cowart, 2021		P		+	MC (confidence in performing manual blood pressure technique, communication skills, drug information)

Reference	Simulation training's impact			Type of impact (+, -, 0)	Description of impact measured
	PC	MC	IPE		
Crowl, 2021			P	+	IPE (value of IP simulation, confidence)
Curley, 2019			P	+	IPE (assertiveness and confidence in team environments, assessment of patients, knowledge, IP communication)
Curran, 2005		P	P	+	IPE (role perception, IPC, self-reported teamwork, confidence), MTM (to develop an IP care plan for simulated HIV/AIDS patients), satisfaction
Davies, 2015		P	P	+	IPE (performance and confidence in physician communication), MTM (patient education, therapy communication and assessment skills)
Draime, 2020		P		+	PC (HIV treatment knowledge), TBL
Efstathiou, 2013			P	+	IPE (self-perceived improvements in knowledge, skills, confidence, competence in end-of-life care communication)
Egelund, 2020			P	+	IPE (communication, teamwork)
El-Den, 2018	P			0	PC in Mental Health First Aid (confidence, performance)
Estes, 2016			P	+	IPE (collaboration, telehealth communication)
Eukel, 2021	P			+	PC communication abilities in difficult patient encounter and affective domain skills
Fejzic, 2015	P			+	PC (professionalism and practice skills application)
Fejzic, 2016	P			+	PC (professional communication skills)
Flores, 2018		P		+	MC (ability to assess skin disorders and to make recommendations), confidence and satisfaction
Frenzel, 2019			P	+	IPE (perceived competence in managing adult cardiac arrest, teamwork and collaboration, professional identity)
Fusco, 2020			P	+	IPE (self-reported competence toward IP collaboration, active participants, or observers)
Fusco, 2021			P	+	IPE (Interprofessional Socialisation)
Galal, 2012	P			+	PC (social and emotional competence)
Gallimore, 2008	P			+	preference for various types of simulated patients, MTM (clinical skill development)
Gillette, 2017	P			+	PC (pharmacist-patient communication compared to traditional active-learning activities)
Gough, 2013			P	+	IPE (perceptions of interprofessional learning and patient safety)
Grice, 2013	P			+	EI (patient relationship and communication skills using FHM)
Guadalupe, 2014		P		+	satisfaction, MC knowledge application
Gulpinar, 2021	P			+	patient-centered communication
Haddad, 2010	P			+	PC (emotions, communication in crisis situations, ethic dimension)
Hamilton, 2021			P	+	self-perception of IPE
Hannings, 2016		P		+	MC in mass dispensing and mass triage skills
Harris, 2018	P			+	EI (empathy and confidence in counselling on diabetes diet)
Hollamby, 2018			P	+	IPE (confidence, role understanding, awareness of patient safety issues)
Hussainy, 2012	P			+	PC (communication skills)
Isaacs, 2015	P			+	PC (perceptions of empathy and counselling skills)
Iverson, 2018			P	+	perceptions of IPE (teamwork, communication, RR)
James, 2001	P			+	PC (confidence, perceived ability to conduct an effective consultation)
Jebara, 2021			P	+	perceptions of IPE (collaboration, roles and responsibilities)
Joyal, 2015			P	+	IPE (knowledge, skills, attitude)
Jung, 2020			P	+	perceptions toward IPE, self-efficacy for IP experiential learning, perceptions toward IP competency
Karpa, 2019			P	+	IPE (knowledge and skills in geriatric assessment, roles and responsibilities, teamwork)
Kayyali, 2016			P	+	IPE (confidence, roles and responsibilities, IP communication and teamwork)
Kerr, 2021	P			+	communication training (effective communication between pharmacists and patients)
Kerr, 2015	P			+	PC (empathy when treating patients with diabetes, self-efficacy in diabetes management, counselling skills)

Reference	Simulation training's impact			Type of impact (+, -, 0)	Description of impact measured
	PC	MC	IPE		
Kiersma, 2009		P		+	MTM (knowledge and confidence in detecting, preventing, resolving, and communicating medication errors)
Komperda, 2019		P		+	MTM (perception of ability to perform medication reconciliation)
Koo, 2014			P	+	IPE (roles and responsibilities, confidence, teamwork)
Kostoff, 2016			P	+	IPE (perception of IP competence, attitude toward IP collaboration)
Kubota, 2018		P		+	IPE (perception of IP competence, attitude toward IP collaboration)
Kusnoor, 2019			P	+	IPE (collaborative problem solving, respect, shared accountability)
Lucas, 2020			P	+	IPE (IPC, role understanding, RR, team-based care)
Luiz, 2015	P			+	PC (oral and written communication)
Lynch, 2018		P		+	MTM (process of contraceptive prescription), satisfaction
Ma, 2020			P	+, (-)	(+) IPE (satisfaction with ability to work together) (-) satisfaction with distance technologies
MacDonnell, 2012			P	+	IPE (perceptions of IPC and teamwork)
MacDonnell, 2016			P	+	IPE perceptions of IP clinical experience (teamwork, communication, RR), knowledge and identification of domestic violence
Marken, 2010	P			+	PC (recognise and engage a difficult conversation with patient in an IP team)
Marshall, 2020			P	+	IPE (IPC, attitudes, competencies, and confidence in conducting team-based error disclosure)
Mathews, 2011	P			+	PC (cultural competency, communication with deaf and empathy toward all patients who have limited English language skills)
Miller, 2020	P	P		+	PC (chronic disease management, empathy), MTM (realization of an individualised medication)
Moote, 2019			P	+	IPE (values/ethics, roles and responsibilities, IP communication)
Motycka, 2018			P	+	IPE (attitudes toward teamwork and MTM to prevent medication errors)
Nestel, 2007		P		+	MC (medication counselling training), satisfaction with experience
Norville, 2021		P		+	MC (knowledge, self-confidence in the pharmaceutical care for patient with cancer)
Ottis, 2016		P	P	+	IPE (IPC, RR), MTM (patient safety in acute pain management, drug-related problems identification)
Patel, 2018		P		+	MTM (knowledge, confidence, and patient counselling skills on clinical pharmacogenetics)
Paterson, 2015			P	+	IPE perceptions, attitudes toward IP collaboration, confidence
Planas, 2008	P			+	EI (empathy, patient communication)
Popkess, 2017			P	+	IPE (attitude toward errors disclosure)
Powers, 2019		P		+	MTM (knowledge, confidence, and patient counselling skills on clinical pharmacogenetics)
Quesnelle, 2018			P	+	IPE (communication, IPC, RR, teamwork), PGx confidence
Ragucci, 2014			P	+	IPE perception on professional development
Ragucci, 2016			P	+	IPE (confidence, satisfaction IP communication, team disclosing error to patient)
Rao, 2011	P			+	PC (patient-care skills in communication and information gathering)
Ray, 2018		P		+	MTM (computer use skills, pharmacotherapy plan counselling), retention into next professional year, confidence
Ray, 2017		P		+	MC (ability to incorporate computers into patient medication counselling)
Rickles, 2009	P			+	PC (communication skills)
Rivera, 2018			P	+	IPE (IPC, communication skills, teamwork, team-based practice)
Sales, 2013	P			+	PC (cultural competency: cultural skills and cultural desire component)
Schultz, 2007	P			+	PC (patient centered care, clinical skills)
Schwindt, 2018			P	+	IPE (perceived self-efficacy and self-reported counselling abilities, IPC skills)
Seghal, 2019			P	+	IPE (awareness of interprofessional values/ethics, roles/responsibilities, communication, and teamwork)
Serag-Bolos, 2018		P		+	MC oncology-related knowledge, confidence, and perceived understanding of the roles of oncology pharmacists

Reference	Simulation training's impact			Type of impact (+, -, 0)	Description of impact measured
	PC	MC	IPE		
Serag-Bolos, 2017		P		+	TOC (perceptions and knowledge of pharmacist roles in TOC)
Shaikh, 2020			P	+	IPE self-perceived IPC (teamwork and collaboration skills)
Sharder, 2015			P	+	IPE (attitude toward IPC, confidence in IP communication skills)
Sharder, 2014			P	+	IPE (perceived competence in IP collaboration)
Sharder, 2013			P	+	IPE teamwork scores on clinical outcomes in a simulated healthcare environment
Sharder, 2016			P	+	IPE (attitude toward health care team with various methods of communication, perception of communication technologies to enhance collaboration)
Sharder, 2011			P	+	IPE (attitude in IP teamwork, satisfaction)
Sincak, 2017			P	+	IPE (IPC, knowledge, skills, attitude, self-perceived behaviours, and patient care)
Singla, 2004		P	P	+	IPE (attitude toward IPE through), MTM (medication adherence skills)
Smith, 2019			P	0	IPE (IPC, RR, profession knowledge of either profession)
Smith, 2020			P	0	IPE (IPC, RR)
Smithburger, 2013			P	+	IPE (communication and teamwork)
Southall, 2021			P	+	IPE (attitude toward collaboration and teamwork, RR)
Stehlik, 2018			P	+	IPE (attitude toward IPC)
Stewart, 2013		P		+	confidence in knowledge and application of legal concepts
Suematsu, 2018			P	+/-	IPE (perceived competence in IP collaboration)
Suematsu, 2021			P	+	satisfaction of online IPE (IPC)
Tallentire, 2021			P	+	transformative learning (students' IPE behaviours and relationships)
Terriff, 2017		P		+	MC (interest, comfort, and confidence in ability to administer a paediatric vaccination)
Thakur, 2020		P		0	MC, EI (communication in a consultation with LEP patient about opioid)
Thomas, 2021			P	+	IPE (communication skills, roles and responsibilities, caring patients at the end of life)
Tilley, 2021			P	+	IPE (communication, collaboration, roles and responsibilities, collaborative patient/family approach, conflict resolution and team functioning)
Tremblay, 2018			P	+	IPE (satisfaction and perception of a CRM simulation)
Tremblay, 2017	P			+	PC (perception of learning and emotions with SP versus SCI)
Tremblay, 2019	P	P		+	PC (cognitive load), MTM (task performance) and perception of learning SCI
Ulutaş Deniz, 2018		P		+	satisfaction (EI communication skills and MTM knowledge application)
Victor-Chmil, 2016			P	+	IPE perceptions (problem resolution, IPC, IP communication in learning and reporting about child abuse)
Vyas, 2012		P		+	MC (perception of preparedness before APPE, knowledge, APPE abilities)
Vyas, 2018	P	P		+	PC, MC (knowledge, attitudes, and ability to address vaccine hesitancy/refusal)
Vyas, 2012		P	P	+	MC (knowledge, attitude, skills in patient safety), IPE (IPC, teamwork, communication skills)
Wagner, 2021		P		+	knowledge and confidence in MTM (medication reconciliation and discharge counselling)
Wang, 2020			P	+	IPE (IPC, RR)
Wen, 2019			P	+	IPE (IP core competencies)
Westberg, 2006			P	+	IPE (satisfaction, knowledge of the roles of other professions)
Willson, 2020	P			+	PC in suicide prevention and communication (knowledge, confidence and skills in suicide prevention and counselling individuals considering suicide)
Wong, 2021			P	+	IPE (communication, collaboration, roles and responsibilities, collaborative patient/family approach, conflict resolution and team functioning)

Patient communication

The definition of communication used for this paper is the ability to communicate with patients, using effective verbal and nonverbal communication, considering patient's beliefs and attitudes, and delivering relevant information (Tindall *et al.*, 1990; Kimberlin, 2006; Mafinejad *et al.*, 2017). In this study,

the term 'patient communication' includes emotional areas and skills such as empathy, social competency, and attitude. PC was assessed and was seen to be present in 26% of the selected studies (37 papers). Simulation training was found to have had a positive impact on this in all but one of the articles.

Type of cases

The cases included chronic role-reversal simulation (in which each student took the role of a pharmacist and/or a patient) (Chen *et al.*, 2015a). Sensitive and difficult patient topics of conversation (Westberg *et al.*, 2006; Schultz & Marks, 2007; Marken *et al.*, 2010; Eukel *et al.*, 2021) included: suicide risk (Boukouvalas *et al.*, 2018; El-Den *et al.*, 2018; Willson *et al.*, 2020), cancer (Serag-Bolos *et al.*, 2018), vaccination (Vyas *et al.*, 2018), risk of opioid abuse (Thakur *et al.*, 2019), teratogenic drugs (Haddad, 2010), pregnancy, erectile dysfunction (Kerr *et al.*, 2021b), pharmacogenetics (Powers *et al.*, 2019), and end of life palliative care (Efstathiou & Walker, 2014; Thomas *et al.*, 2021). The skills worked on included social competencies, attitude toward elderly patients, cultural competence, assertiveness (Luiz Adrian *et al.*, 2015), leadership, verbal and non-verbal behaviour (Barker *et al.*, 2018), communication skills (Rickles *et al.*, 2009), social competence (Galal *et al.*, 2012), empathy and holistic care (Gülpınar & Özçelikay, 2021; Thomas *et al.*, 2021).

Assessment of the impact of simulation training on patient communication

PC competencies were assessed using different tools. These were Communication Skills Assessment Form (CSAF) (Rickles *et al.*, 2009), the Social Emotional Development Inventory (SED-I) (Galal *et al.*, 2012), the Four Habit Model (FHM) (Grice *et al.*, 2013a) and the patient-centred communication tool (PaCT) (Gülpınar & Özçelikay, 2021).

Medication counselling

MC included knowledge application, medication therapy management (MTM) and transition of care (TOC), which referred to patients moving from one healthcare setting to another. This involved a team which included the patient, multiple providers, and family or social support (Serag-Bolos *et al.*, 2017). MC was studied in 28% of the studies selected (39 papers), and simulation training was said to have been beneficial in 38 studies.

Type of cases

The scenarios in the studies used for MC training purposes included patient counselling (i.e. use of effective interview sequence and structure during interactions), medication reconciliation, medication

review and management, and error disclosure (Shrader *et al.*, 2011; Ragucci *et al.*, 2016), vaccination, device technique demonstration, drug-induced skin reactions, sepsis management, first aid for asthma, pharmaceutical care for patients with cancer (Serag-Bolos *et al.*, 2018; Fusco *et al.*, 2021; Norville *et al.*, 2023), clinical pharmacogenetics (Patel *et al.*, 2018; Powers *et al.*, 2019), diabetes management, contraceptive counselling or pharmacogenetics (Lynch *et al.*, 2018; Patel *et al.*, 2018).

Assessment of the impact of simulation training on medication counselling

Students' knowledge, confidence and medication counselling skills were assessed using evaluation forms, marking scales, objective structured clinical examination (OSCE), a checklist, pre-post surveys and knowledge scales.

Interprofessional education (IPE)

In total, 53% of the selected studies focused on IPE. Simulation training was seen to have had a positive impact on different domains of IPE core competencies in 71 of the identified articles.

Type of cases

A number of different IPE core competencies were included in the simulation scenarios, including interprofessional communication and telehealth, interprofessional collaboration (IPC) and team functioning (Estes *et al.*, 2016; Quesnelle *et al.*, 2018; Begley *et al.*, 2019; Wong *et al.*, 2021; Baalmann *et al.*, 2023), roles and responsibilities (RR) and professional identity, collaborative patient/family, conflict resolution and error disclosure (Kusnoor *et al.*, 2019; Baalmann *et al.*, 2023). The skills worked on included medication dispensing, drug dependence, care of older adults, crisis resource management (CRM), and pneumonia patients (Bottenberg *et al.*, 2013; Fejzic & Barker, 2015; MacDonnell *et al.*, 2016; Cooke *et al.*, 2017; Tremblay, 2018; Schwindt *et al.*, 2019; Fusco & Foltz-Ramos, 2020; Tilley *et al.*, 2021). The cases were used to develop student's confidence, self-perceived value, knowledge retention, patient safety/care (Suematsu *et al.*, 2018), TOC (Shrader & Griggs, 2014; Ragucci *et al.*, 2016; Sen *et al.*, 2016; Shrader *et al.*, 2016; Stehlik *et al.*, 2018; Frenzel *et al.*, 2019; Meny *et al.*, 2019; Wen *et al.*, 2019; Fusco & Foltz-Ramos, 2020; Smith, 2020), discharge counselling, polypharmacy and acute pain management (Ottis & Gregory, 2016; Sehgal *et al.*, 2019). The IP teams that were most frequently observed brought together medical, nurse and pharmacy students (54% of the IPE articles).

The SBAR (Situation, Background, Assessment, Recommendation) communication tool was the most

popular for improving self-perception of interprofessional competence and attitude toward interprofessional collaboration (in 9 articles) (Koo *et al.*, 2014; Shrader *et al.*, 2015; Shrader *et al.*, 2016; Ottis & Gregory, 2016; Iverson *et al.*, 2018; Patel *et al.*, 2018; Curley *et al.*, 2019; Cowart & Updike, 2021). The SBIRT (Screening, Brief Intervention and Referral to Treatment) tool helped students collaborate to identify potential medication misuses (Marken *et al.*, 2010; MacDonnell *et al.*, 2016; Clauser *et al.*, 2020; Egelund *et al.*, 2020; Acquavita *et al.*, 2021).

Assessment of the impact of simulation training on interprofessional education

IPE was measured with validated tools in 28 studies. The following scales were used to measure a number of aspects of IPE: The Readiness for Interprofessional Learning Scale (RIPLS) was the most frequently applied scale as it measured changes in attitude toward teamwork and IPC, knowledge of roles and responsibilities of healthcare team members (Bottenberg *et al.*, 2013; Gough *et al.*, 2013; Efstathiou & Walker, 2014; Paterson *et al.*, 2015; Christopher *et al.*, 2019; Frenzel *et al.*, 2019; Wang *et al.*, 2020; Southall & MacDonald, 2021). Other assessment scales used were JEFFSATIC (Jefferson Scale of Attitudes Toward Interprofessional Collaboration) and ATHCTS (Attitude Toward Health Care Teams Scale) (Shrader *et al.*, 2016; Smith *et al.*, 2019; Smith, 2020), SPICE-R (Students Perceptions of Interprofessional Education Revised) (MacDonnell *et al.*, 2016; Iverson *et al.*, 2018; Clauser *et al.*, 2020; Brennan *et al.*, 2021), ICCAS (Interprofessional Collaborative Competencies Attainment Survey) (Kostoff *et al.*, 2016; Wen *et al.*, 2019; Fusco & Foltz-Ramos, 2020; Wong *et al.*, 2021); C-ICE (Creighton Interprofessional Collaborative Evaluation), CATS (Frankel's Communication and Teamwork Skills assessment) (Smithburger *et al.*, 2013; Begley *et al.*, 2019; Egelund *et al.*, 2020), Interprofessional Attitudes Scale (IPAS) (Marshall *et al.*, 2020), RR quiz (Kusnoor *et al.*, 2019; Smith *et al.*, 2019; Hamilton *et al.*, 2021; Suematsu *et al.*, 2021) and TSS (Team Skill Scale)(Begley *et al.*, 2019).

Gaps

Gaps shown by the assessment of the simulations' effectiveness

The main gap that was observed was a lack of objective measures or validated evaluation tools, especially for the assessment of emotional skills (Galal *et al.*, 2012; Chen *et al.*, 2015a; Isaacs *et al.*, 2015; Cobb *et al.*, 2019).

The absence of a control group from data before and after a survey meant there was a risk of participant bias

in the simulation experience (Bottenberg *et al.*, 2013; Paterson *et al.*, 2015; Ottis & Gregory, 2016; Cobb *et al.*, 2019; Curley *et al.*, 2019; Meny *et al.*, 2019; Brennan *et al.*, 2021). Some studies had limitations in their methodology, mainly due to lack of time, personnel and resources (Westberg *et al.*, 2006; Marken *et al.*, 2010; Sales *et al.*, 2013; Guadalupe, 2014). A common limitation in the studies included in the review was that the sample size was often small, consisting of only one cohort or academic year. In a few cases, the opposite was true and the sample size was too big, which may have hindered the effectiveness of the simulation. Additionally, there was a risk of student selection bias and response bias, which may have influenced the results. Social desirability bias was also a concern, as well as the potential for social acceptance bias in some studies. Simulation debriefing is a critical component of IPE (Meny *et al.*, 2019), but many studies lacked feedback/debriefing sessions (Nestel *et al.*, 2007; Chen *et al.*, 2015b; Shrader *et al.*, 2016; Gillette *et al.*, 2017; Rivera *et al.*, 2018; Gülpınar & Özçelikay, 2021). Most of the studies had not been measured quantitatively but were based on self-assessment or self-perception measures rather than changes in behaviour (Harris *et al.*, 2018).

Specific gaps in SiP modality

The amalgam in the literature of "*simulated patient*" and "*standardised patient*" was also seen to be present in the analysis of the results. These concepts are not always clear and the terminology used in the context of the simulated and standardised patient is prone to confusion (Burnier *et al.*, 2019).

Language barriers, cost, differences between the different SiP in one activity, lack of experience with sensitive topics, complexity and realism of scenarios could be said to limit the transferability of potential learning in the real world (Grice *et al.*, 2013b; Chen *et al.*, 2015b; Hannings *et al.*, 2016; Ray & Valdovinos, 2017; Terriff & McKeirnan, 2017; Flores & Hess, 2018; Kubota *et al.*, 2018; Bajis *et al.*, 2019; Cobb *et al.*, 2019; Thakur *et al.*, 2019; Willson *et al.*, 2020; Bajis *et al.*, 2021; Kerr *et al.*, 2021a).

Specific gaps in hybrid modality

There were a number of validated tools available to measure IPE competencies but they were not systematically used and were sometimes adapted to meet specific simulation needs or the needs of a particular curriculum (MacDonnell *et al.*, 2012; Ottis & Gregory, 2016; Quesnelle *et al.*, 2018; Suematsu *et al.*, 2018; Wen *et al.*, 2019; Egelund *et al.*, 2020). The influence of one profession on another was sometimes difficult to measure due to the use of post-surveys only

being performed immediately after the simulation (Gough *et al.*, 2013; Ottis & Gregory, 2016; Smith *et al.*, 2019; Crowl *et al.*, 2021; Bowers *et al.*, 2022). The use of students from different professional programmes has sometimes resulted in participants with differing levels of clinical experience. However, the absence of control over earlier experiments carried out by team members, such as using a human simulator, or an unequal distribution of students from each profession due to smaller class sizes, may have had an impact on the results. Moreover, some studies indicate that the full range of professions is not equally represented in interprofessional teams, creating an imbalance and potential selection bias, even causing some students to feel frustrated or underprepared. Additionally, there is a need for standardisation of simulation scripts, with equal participation time for each profession during the simulation. Students may also lack knowledge in certain areas, such as tobacco addiction, which can lead to discomfort during simulations (Shrader *et al.*, 2011; Vyas *et al.*, 2012; Bottenberg *et al.*, 2013; Ragucci *et al.*, 2016; Victor-Chmil & Foote, 2016; Iverson *et al.*, 2018; Curley *et al.*, 2019; Frenzel *et al.*, 2019; Schwindt *et al.*, 2019; Clauser *et al.*, 2020; Egelund *et al.*, 2020; Shaikh *et al.*, 2020; Bowers *et al.*, 2022).

In rural areas, technological frustrations or difficulties sometimes outweighed the benefits of the proposed videoconferencing option. Satisfaction with distance technology was subsequently lower in a small number of studies compared with the satisfaction of students who participated face-to-face (Wen *et al.*, 2019; Clauser *et al.*, 2020; Ma *et al.*, 2020).

Discussion

This exploratory and reproducible study mapped simulation activities aimed at pharmacy students and could add to the existing literature the main fields of application commonly used and the challenges encountered in implementing this type of activity.

Implication of simulation training in SiP modality

Simulation training is a way of enhancing pharmacy practice experience when direct student-patient interactions are limited (Wagner *et al.*, 2021). Results showed it can be a useful tool for developing essential patient-care skills including information gathering, developing a patient care plan (Rivera *et al.*, 2018), discharge counselling (Planas & Er, 2008; Kiersma *et al.*, 2009; Komperda & Lempicki, 2019; Wagner *et al.*, 2021), medication reconciliation knowledge (American College of Clinical Pharmacy *et al.*, 2012; Sen *et al.*, 2016; Serag-Bolos *et al.*, 2017), and to be aware of the

pharmacist's role during emergency situations (Hannings *et al.*, 2016; Terriff & McKeirnan, 2017).

The simulation methodology helped students put theory into practice and recognise the challenges of effective communication (James *et al.*, 2001; Planas & Er, 2008; Rao, 2011; Guadalupe, 2014; Ray & Valdovinos, 2017; Ray *et al.*, 2018). Role-reversal chronic disease simulation provided an approach to foster communication and patient care, empathy and comfort in the interaction with patients (Mathews *et al.*, 2011; Isaacs *et al.*, 2015; Kerr *et al.*, 2015; Harris *et al.*, 2018; Miller *et al.*, 2020). During simulations, some students did not communicate in their native language (i.e. English) (Bajis *et al.*, 2019; Bajis *et al.*, 2021). Adapting the communication of the pharmacist (as well as the physician) based on the patient's cultural context, linguistic abilities, and intellectual quotient (IQ) represents a crucial area for improvement in simulation-based training at a time when many areas are cosmopolitan in character.

Implications of simulation training in HM

The number of publications on IPE has underlined the importance of health professionals' collaboration and guiding institutions in developing educational programmes (Suematsu *et al.*, 2018). In some countries, IPE is not well known, which could be said to be another gap that needs to be filled (Smithburger *et al.*, 2013; Shrader & Griggs, 2014; Kayyali *et al.*, 2019; Egelund *et al.*, 2020; Jung *et al.*, 2020).

In TOC, simulations helped students to understand the extent to which pharmacists play a vital role in ensuring continuity of care as part of a team consisting of different healthcare professionals (Serag-Bolos *et al.*, 2017). Students improved self-reported IPC (Shrader & Griggs, 2014; Ragucci *et al.*, 2016; Sen *et al.*, 2016; Shrader *et al.*, 2016; Stehlik *et al.*, 2018; Frenzel *et al.*, 2019; Meny *et al.*, 2019; Wen *et al.*, 2019; Fusco & Foltz-Ramos, 2020; Smith, 2020), believed themselves to be more competent, trusted the opinion of their colleagues (Bottenberg *et al.*, 2013; Fejzic & Barker, 2015; MacDonnell *et al.*, 2016; Cooke *et al.*, 2017; Tremblay, 2018; Schwindt *et al.*, 2019; Fusco & Foltz-Ramos, 2020; Tilley *et al.*, 2021) and developed a positive attitude toward teamwork, which they believed to be crucial for improving patient safety (Popkess *et al.*, 2017; Iverson *et al.*, 2018; Motycka *et al.*, 2018).

Despite some technological difficulties (Wen *et al.*, 2019; Clauser *et al.*, 2020; Ma *et al.*, 2020), communication technologies had positive impacts on students and taught them a lot about approach, confidence, performance related to interprofessional communication, collaboration, and the development of

an interprofessional care plan (Shrader *et al.*, 2016). Telephone conversations were considered by authors to be a creative way of breaking down barriers of location, cost, scheduling, and lack of access to healthcare professions (Moote *et al.*, 2019). Some barriers to interprofessional education were eliminated thanks to a telehealth simulation, particularly during the Covid-19 pandemic. In this way, the telehealth simulation was able to improve the student's confidence in the use of these technologies (Estes *et al.*, 2016; Begley *et al.*, 2019; Wen *et al.*, 2019; Ma *et al.*, 2020; Cowart & Updike, 2021; Wong *et al.*, 2021; Baalmann *et al.*, 2023). Incorporating telehealth-learning into a curriculum may give students an opportunity to be better prepared to practice in the ever-evolving healthcare environment (Estes *et al.*, 2016). However, further research is still needed to compare the effectiveness of online IPE learning with traditional face-to-face IPE (Suematsu *et al.*, 2021). The results of this review showed simulation training is one way to practice IPE and it is recognised the world over as a key concept in initiatives aimed at improving the efficiency of health services currently offered to the population and improving the quality of delivered health care.

Insights for future research

Addressing the gaps seen in simulation assessment

To more effectively assess the impact of skills learned by simulation training, more stringent assessment measures should be developed and could include a well-designed randomised controlled trial with clear outcomes. Gaps discovered in education highlighted the need for more robust evaluation measures and standardisation of simulation scripts to improve the quality and effectiveness of interprofessional simulation-based education (Haddad, 2010; Gough *et al.*, 2013; Chen *et al.*, 2015a; Fejzic *et al.*, 2016; Terriff & McKeirnan, 2017; Pawluk *et al.*, 2018; Serag-Bolos *et al.*, 2018; Cobb *et al.*, 2019; Kusnoor *et al.*, 2019; Korayem & Alboghdadly, 2020; Eukel *et al.*, 2021). Transferability (as long-term gains in knowledge and skills and changes in behaviour after a simulation) should, in practice, be assessed (Mesquita *et al.*, 2010; Chen *et al.*, 2011; Chen *et al.*, 2015a; Bowers *et al.*, 2017; Pawluk *et al.*, 2018; Tremblay, 2018; Vyas *et al.*, 2018; Komperda & Lempicki, 2019; Wang *et al.*, 2020; Gülpınar & Özçelikay, 2021; Bowers *et al.*, 2022). However, the fact that assessing emotional intelligence skills can be complicated and even, in some cases, inappropriate should be considered.

Addressing the SiP modality gaps

The international literature makes a clear distinction between simulated and standardised patients, but there is still a need for a clear definition of these concepts. By clarifying them, this exploratory review guarantees the reproducibility of the research, enabling the classification of articles that used the rather vague term simulated patient. For example, the presence of a written scenario in the full-text description of an activity made it possible to verify whether it was an SP or a SiP taking part in a role-playing game.

The involvement of simulated patients when giving feedback is important for training in person-centred care (Paterson *et al.*, 2015; Sincak *et al.*, 2017). Various approaches could be considered to address the limitations encountered with simulated patients: replacing actors with students to keep costs to a minimum (Hollamby *et al.*, 2018; Thomason *et al.*, 2018), involving non-pharmacy students (faculty administrative staff) (Schultz & Marks, 2007; Gallimore *et al.*, 2008), and involving drama students to enhance the authenticity of simulations (Fejzic *et al.*, 2016). However, it is important to note that using healthcare providers as simulated patients also reduces the possibility of findings making their way to the wider public (Singla *et al.*, 2004). Similarly, storyline details need to be organised to ensure consistency or level of complexity (Chen *et al.*, 2015b; Hannings *et al.*, 2016; Kubota *et al.*, 2018).

Inconsistencies exist regarding the involvement of real patients in training healthcare professionals (Basheti, 2014; Boukouvalas *et al.*, 2018; Barrickman *et al.*, 2020; Wang *et al.*, 2020; Christopher *et al.*, 2021). Therefore, further investigation is needed to explore the relationship between different types of simulated patients and students' results (Gallimore *et al.*, 2008).

Adaptations to the level of the learners

Outcomes of communication education interventions are influenced by the level of the learner. Intervention choice, based on the level of learning, is important (Kerr *et al.*, 2021a). There is a need for the development of adapted guidelines in simulation for novices (Westberg *et al.*, 2006; Vyas *et al.*, 2012; Karpa *et al.*, 2019). SCI was reported as being more cognitively demanding than using SiP (Tremblay *et al.*, 2017; Tremblay *et al.*, 2019). Repeated simulations, at different times during the term, provided multiple opportunities for students to conduct simulated pharmacy practice activities and reinforce performance, skills development and knowledge retention (Rickles *et al.*, 2009; Begley *et al.*, 2013). Tailoring a patient activity to the students'

needs, especially for students with a lower level of communication (including those who had to communicate in a language that was not their mother tongue), is paramount if they are to fully develop and retain communication skills (Grice *et al.*, 2013a; Cobb *et al.*, 2019; Kerr *et al.*, 2021b). However, it is also necessary to develop education regarding the discussion of sensitive topics, as students found these more demanding and were embarrassed and reluctant to discuss them during the activity (Bajis *et al.*, 2019; Thakur *et al.*, 2019).

Strengths and limitations

There may be several elements of the design of this research that create uncertainty regarding the contribution of the knowledge gained. Indeed, the exhaustive nature of the research and the inclusion criteria resulted in a large amount of data needing to be classified. There is a great heterogenicity of the intervention methods and tools to evaluate the impact of simulation training. Another classification gap for "*simulated patients*" was revealed. In the same way as in the literature on the subject, this results from confusion about the terms used (simulated patients, standardised patients). Although a definition for each term was given, the reproducibility of this study may be impacted.

The review follows the PRISMA criteria, but there was no double reading of the full texts (full texts were only read by the first author, AG). These uncertainties could, therefore, have an impact on the relevance of the work, mainly in terms of reproducibility. Finally, in terms of quality, a quality assessment such as the Medical Education Research Study Quality Instrument (MERSQI) could have been conducted.

Almost all the studies considered in this review have been conducted in countries with Anglo-Saxon cultural, intellectual, and/or educational backgrounds, which may not necessarily be globally representative. The patient populations targeted in each country do not have equal access to healthcare and medication. As a future area to focus on, studies should aim to reach the standard set by the Kirckpatrick/Barr learning outcomes models, including the improvement of patient outcomes (Sehgal *et al.*, 2019; Marshall *et al.*, 2020). Adapting the pharmacist's communication style and establishing a therapeutic alliance with each patient remains a significant challenge in the field of public health.

Conclusion

This study is an overview of on-site simulation training programmes currently available to pharmacy students. This paper focused on in-person simulations: SiP modality or IPR for the purpose of patient-centred care in a hybrid modality. Simulation training had a positive impact on student satisfaction, knowledge, and skills in various areas (emotional intelligence, medication counselling/knowledge application and IPE). This scoping review proposes alternatives and avenues of research to overcome the highlighted gaps. It provides insights for future research in the simulation area and could serve as a source of inspiration for countries that have still to adopt simulation practices. Thanks to this review, more effective simulation training programmes for pharmacy students, ultimately improving their preparedness and ability to provide high-quality care to their patients, may be created.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A: General characteristics of the included studies (extraction table)

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Acquavita, 2021	Outcomes of an interprofessional SBIRT training program: Knowledge attainment and perceived competence for practice.	MS, NS, PS, and SWS (n=197)	Online coursework and interprofessional experiences. Students completed a minimum of 2 IP SBIRT experiences (screening, brief Intervention, referral to Treatment).	SBIRT knowledge, perceived competence, application of SBIRT knowledge and FOC (SMaRT, ATN-SBIRT), satisfaction (CSAT survey)	pre-post survey	H	IPR and SP	2 students from different disciplines implemented SBIRT with a SP. SBIRT aimed at addressing risky substance use by targeting the misuse of substances.
Baalmann, 2022	Interprofessional medication error disclosure training Utilizing a telehealth consultation simulation.	MS and PS (n=173)	IP telehealth simulation utilising Zoom in 3 phases: (1) individual student preparation; (2) IP telehealth consultation encounter for the error disclosure between the pharmacy and medical students; (3) IP debrief sessions.	confidence in error disclosure, use of health professionals, role of the community pharmacist (12-point rubric)	pre-post survey	H	IPR and patient chart	Telehealth consultation: pharmacy student and a medical student as the discharging hospital physician who was responsible for the patient's discharge MTM (rectification of discharge medication, medication errors identification and correction).
Bajis, 2021	Teaching asthma first aid to pharmacy students: A comparative study between an online course and simulation by role-play	3-, 4-, 5-year bachelor PS (n=50)	2-hour bimodal workshop: online training course and RP simulation on pharmacy students' ability to perform asthma first aid (AFA).	Preferred methods of learning were investigated by evaluation forms and focus group discussion (semi-structured survey)	comparative study	SiP	RP	Students in the simulation training group participated in a scenario-based interactive RP session. Patients in AFA scenarios experienced classic symptoms of acute asthma exacerbation. Immediate formative feedback and coaching were provided to the group of students by the facilitator after each role-play.
Bajis, 2019	Pharmacy students' medication history taking competency: Simulation and feedback learning intervention.	4 and 5-year PS (n=144)	3 days of simulation-based training activity. In-classroom and feedback-driven training activity.	medication reconciliation assessment (marking scale), self-perceived confidence questionnaire, focus group	mixed method, pre-post survey	SiP	RP	Scenario-based cases of patients on admission to hospital (simulated patient medication interview, reconcile the medication history against a hospital medication chart). Immediate feedback and focus group.
Barker, 2018	Simulated learning for generic communication competency development: A aase study of Australian post-graduate pharmacy students	Master of PS (MPharm, n=95)	4-h simulated learning modules (SLMs). 2 SLMs included Social Interaction Maps (SIMs) and involved interaction to learn generic social competencies.	survey before, during and after workshops (ECS), reflections from facilitators	mixed method, pre-post survey	SiP	RP	Commonly experienced pharmacy practice scenarios generated by pharmacists/pharmacy educators. Students developed their generic social competencies including participating in a team, refusing a request, and giving feedback.

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Barrickman, 2020	Development of coupled patient care experience courses to enhance patient care skills in the ambulatory and acute care settings.	3-year PS (n=104), 3-year MS and 4-year NS	Coupled patient care experience: 2 MTM simulation and a direct patient care activities outside of the normal class time, video recorded sessions.	Grading MTM acute care experience and students' feedback.	mixed method, post survey	H	IPR, patient chart, SP, real-life patient	IPE rounding simulation with medical and NS in randomly assigned groups. 2 patient charts to be established before the simulation. During the simulation, students work together as an IP team to assess both SPs and develop collaborative care plans before visiting a real patient (MTM).
Bartlett, 2020	Large-group, asynchronous, interprofessional simulation: Identifying roles and improving communication with student pharmacists and student nurses.	1-year NS (n=126) and 1-year PS (n=152)	Information regarding the simulation was provided to both groups of students separately following the IPE asynchronous simulation.	confidence, satisfaction (National League for Nursing Student Satisfaction and Self-Confidence in Learning instrument) and IP communication (feedback survey for pharmacy students)	(retrospective) pre-post survey	H	IPR and patient chart/case	Pharmacy student received, transcribed, filled a prescription that they received from nurses on voicemail lines (asynchronous IPR). Individual groups simulation debriefing occurred immediately following the simulation. A 25-min large-group, structured debriefing session occurred in the classroom, with both the nursing and pharmacy faculty.
Basheti, 2014	The effect of using simulation for training pharmacy students on correct device technique.	5-final year PS (n=99)	Students randomly assigned to 2 groups: intervention A (no simulation, n=54) and intervention B (simulation, n=55). Students' assessments on device technique repeated 1-week post-intervention. Focus group session for students from intervention B (n=15) 4 weeks following baseline.	device technique counselling assessment and focus group	single-blinded parallel group study, mixed method	SiP	RP	Real patient in RP. In group B, each student was randomly allocated to deliver education to a real patient using 1 of the 3 study devices proposed. Other students observed their peers delivering the patient education. The counselling involved verbal and physical demonstration until the patient performed all steps correctly.
Begley, 2013	Repeated testing to improve skills in a pharmacy practice laboratory course.	PS (814 students from 2008 to 2012, in average n=163)	Timed, repeated learning experiences (increasing complexity) for 5 years (cohort).	OSCE (10 stations) to measure performance (software programme for non-interactive tasks or faculty preceptors as SP for interactive stations)	cohort	SiP	SP	Scenarios standardised to contain the same type of information's and focused on management of various acute chronic diseases (drug utilisation review, advising a new medication, prescription verification). Consistent testing with evaluation and feedback.
Begley, 2019	Impact of interprofessional telehealth case activities on students' perceptions of their collaborative care abilities.	PS (1-, 2-, 3-, 4-year) and 2-year PAS; (n=172)	6 virtual rooms using telehealth technology for IP teams moderated by a pharmacy faculty member. Students' teams rotated through 6 rooms in 15 min sessions.	TSS and Creighton and Interprofessional Collaborative Evaluation (C-ICE) instrument, thematic analysis of students' reflections	mixed method, pre-post survey	H	IPR and RP	Telehealth IPR. Platform for distance-based participation in a real time IPE case study. "*Real-life*" experience to provide safe patient care (students joined virtual rooms, made recommendations, and received feedback on their performance).

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Bottenberg, 2013	Assessment of interprofessional perceptions and attitudes of health professional students in a simulation laboratory setting	2-and 3-year MS, 3- and 4-year PS, bachelor, and advanced degree NS, (n=163)	Mannequins exhibits human physiologic functions. 4 medical and 2 pharmacy students in each team with occasionally 2 NS. Following the simulation, students participate in a 30–60-minute discussion session with faculty from the different academic institutions.	24-item survey based on IPC, ATHCTS, RIPLS, and Interdisciplinary Education Perception scale	post activity assessment	H	IPR and manikin	IP students' teams performed simulated acute emergency room clinical situations on mannequins. Teams evaluate patient cases in the simulation lab for 20-30 minutes. The pharmacy students were responsible to provide drug information to team members on items such as dosages and adverse effects and to help identify and resolve drug-therapy problems.
Boukouvalas, 2018	Confidence and attitudes of pharmacy students towards suicidal crises: patient simulation using people with a lived experience.	final-year bachelor PS (BPharm, n=186) master PS (MPharm, n=66)	All students received a Mental Health First Aid training. Following MHFA training, group 1 directly participated in the simulation, group 2 observed, and group 3 had no exposure to the simulation.	ATTS	parallel group study, pre-post survey	SiP	SP	Real patients with a lived experience of mental illness acted as SiP experiencing a mental health crisis, including possible suicidal ideation. 3 different patient scenarios similar in nature were delivered (focus on mental health and symptoms of depression).
Bowers, 2021	Comparison of knowledge retention between case studies utilizing a simulated EHR with various degrees of simulated experiences.	1-year professional PS cohort 2018, 2019, 2021 (n=238), 1-year PAS	Each year an element of simulated experience was added into the previous case (simulated EHR): utilisation of the EHR (2018), OSCE with SPs (2019), interaction with student physician assistants (2021). Case scores and student perceptions were compared between groups.	OSCE, knowledge retention and student perceptions	prospective cohort study	H	IPR and SP	The SP acted as the patient described in the EHR. Additional information needed was collected from the SP to communicate the plan in IP interaction. Student pharmacists were randomly paired with 1 PA. PAs performed the physical examination and worked with the student pharmacists to develop a plan. After, students completed SP case.
Bowers, 2017	Impact of standardized simulated patients on first-year pharmacy students' knowledge retention of insulin injection technique and counseling skills.	1-year doctor PS (n=103)	A cluster of randomisations determined intervention group with simulated patients and control group without simulated patient. Intervention group received simulated SP interaction in addition to traditional coursework.	pre- and posttest scores to assess insulin injection, counselling skills and knowledge retention (yes/no format)	single-blind, single-cluster randomised study	SiP	SP	Students counselled the patient on correct insulin injection technique using an insulin vial and syringe. Students used the teach-back method with hands-on demonstrations until the patient was sufficiently trained in using their insulin.
Brennan, 2021	Improving health professions students' understanding of interprofessional roles through participation in a Patient stabilization simulation.	final year MS (n=41) and PS (n=17) and post-licensure nurses (n=22); (n=80)	Students worked together to stabilise a simulated acutely ill standardised patient, 10-min simulation.	SPICE-R version 2, formative feedback	pre-post survey	H	IPR and HPS	Patient with an acute medical crisis requiring immediate stabilisation. A nurse, a medical and a pharmacy students worked together to stabilise the patient. Debriefing was conducted immediately after the simulation (formative feedback).

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Brock, 2013	Interprofessional education in team communication: Working together to improve patient safety	4-year MS, 3-year NS, 2-year PS and 2-year PAS (n=306)	4h training included a 1-h TeamSTEPPS didactic session and three 1-h team simulation and feedback sessions.	TeamSTEPPS Teamwork Attitudes Questionnaire (TAQ); Attitude, Motivation, Utility and Self-Efficacy (AMUSE)	pre-post survey	H	IPR, LFM, SP	Students worked in groups balanced by a professional programmed in a self-selected focal area (adult acute, pediatric, obstetrics).
Candelario, 2019	Description of a transitions of care and telemedicine simulation lab activity	2-year PharmD PS (n=59)	1-hour TOC lecture, 1-hour introduction to review patient case, 15-min discharge simulation at the hospital bedside (with a manikin), 15-min follow-up telemedicine encounter (with SP). Six medication-related-problems (MRP) were incorporated into the activity.	student competency (activity document, telemedicine follow-up checklist and patient perception scale)	post activity assess ment	SiP	SP	In telemedicine follow-up encounter, 2 SP portrayed the patient at a 72-hour follow up visit. Pharmacists utilised effective interview technique/assessment skills to identify MRP (including laboratory test indicated, cost, failure to receive therapy, completion of therapy, adverse drug reaction, indication without medication). Activity required students to collect, assess, create, and implement a plan and follow up.
Chen, 2015	Impact of an aging simulation game on pharmacy students' empathy for older adults.	1-year PS (n=156)	Students participated in an aging simulation game. The game incorporated the experiences and challenges of older adults in health care.	empathy (KCES, JSE-HPS), perceptions of older adults' experiences and game experiences (ASES)	pre-post survey	SiP	RP	Role-reversal activity where students "*role-played*" the older adult in 6 stations (physician's office, nurse practitioner visit, pharmacy, test and benefits, home, activities). Station facilitators mimic real health care providers and exhibit different amounts of empathy or caring. Reflective discussion at the end of the activity with facilitators.
Chen, 2011	Impact of the geriatric medication game on pharmacy students' attitudes toward older adults.	1-year PharmD students (n=624)	Students participated in the *Geriatric Medication Game.* Students "*became*" older adults during a 3-hour pharmacy practice laboratory.	reflection questions about experience and attitudes toward older adults (content analysis)	post activity assess ment	SiP	RP	Students were given aging-related challenges (physical disabilities) and participated as patients in simulated healthcare scenarios. They navigated in health care system (physician's office, pharmacy, other healthcare provider, laboratory tests, home). Cards required students to incorporate diseases/medications in their RP.
Chen, 2008	Impact of patient empathy modeling on pharmacy students caring for the underserved.	PS (n=26)	Pharmacy students participated in 1 of 4 Patient Empathy Modeling (PEM) scenarios to complete over 10-days. They wrote a daily journal and a reflection paper.	empathy (JSPE) HP version	pre-post survey	SiP	RP	Each student "*became the patient*", simulating the life of an actual patient with multiple chronic disease who was coping with an economic, cultural or communication barrier to optimal healthcare. Debriefing session with

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
								verbal feedback from preceptor and colleagues.
Chen, 2015	Evaluation of student perceptions of standardized patient simulation on patient counseling confidence during introductory pharmacy practice experiences	1-year PharmD PS (n=128)	Evaluation of students' perceptions about the usefulness of simulation in IPPE performance.	perceptions about patient counselling confidence	pre-post survey	SiP	SP	5-10 minutes to analyse the scenario before simulation with the SP (by using the required communication techniques). After encounter (20 min), SPs gave the student feedback regarding the communication techniques based on the developed rubric.
Christopher, 2019	Anemia interprofessional team role-play case for students in outpatient primary care	1-year PAS (n=41), 2-year PS (n=48)	Briefing with explication of the role of different healthcare professions, objectives, and instructions. 5 min to review the case individually. Formative debriefing session in large group after activity.	RIPLS	pre-post survey	H	IPR and SP	(1) PS acted as the patient during the first half of encounter (SP script). PAS performed history and physical exams on the PS before a collaboration in their respective roles. (2) Students switched roles and pharmacy students became the health care provider and counselled the PAS (now in the patient role) on the diagnosis, treatment plan and education regarding diet therapy, pharmacotherapy, and follow-up.
Clauser, 2020	Standardized patient simulation using SBIRT (Screening, brief intervention, and referral for treatment) as a tool for linterprofessional learning.	NS, PS, MS, PAS, SWS, dietetics, and occupational therapy programmes students (n=1255)	activity over 2 academic years. 2-hour online informational component and a 2-hour in-person application session. Participation was required as a class assignment in each profession-specific programme.	RR, teamwork, identification of potential substance misuse (question from SPICE-R, CSAT)	post activity assessment (impact survey)	H	IPR and SP	IP triad with a least one student prescriber in one of the 3 simulations. Feedback rubric for the observer role. Every student acted each role (patient, provider, observer) over the course of three cases. Formative feedback and feedback from SP. Large group debrief focused on the IP experience.
Cobb, 2019	Evaluation of an individualized vs non-specific standardized patient activity in improving communication skills amongst pharmacy students.	2-year PS (n=19)	20 min SP activity into individualised or a non-specific SP group. Communication skills rubric to identify the student's AOI in communication skills. Sessions videotaped for assessment.	communication skills (4-component 64-point rubric) and confidence (11-questions Likert survey)	pre-post survey	SiP	SP	SP with a glaucoma and issues using eye drop. Individualised group had and SP intervention activity tailored to their identified communication AOI. Non-specific group had an SP intervention activity with acting skills untargeted to any specific area.

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Cooke, 2017	Tracing the prescription journey: a qualitative evaluation of an interprofessional simulation-based learning activity.	3-year PS (n=10) and 4-year MS (n=9)	SBE activity with IPE. Briefing and learning objectives before simulation. Small mixed-disciplinary groups with the simulated patient.	IPE (focus group and thematic analysis)	qualitative evaluation	H	IPR and SP	(1) The medical student leads the consultation; the pharmacy student observes the interaction; (2) Medical and pharmacy students collaborate in the management plan; (3) a simulated pharmacist dispenses drugs to the SP
Cowart, 2021	Pharmacy student perception of a remote hypertension and drug information simulation-based learning experience in response to the SARS-CoV-2 pandemic	1-year professional PS (n=87)	Live didactic lecture and a laboratory instruction on performing manual blood pressure assessment. The hypertension/drug information SBL activity occurred after a patient vignette to prepare. Activity utilised Blackboard Collaborate Ultra, a web-based real-time video conferencing tool.	confidence in performing manual blood pressure technique, communication skills, drug information (formative feedback and Qualtrics pre-post survey)	pre-post survey	SiP	SP	In the virtual "*encounter room*", (1) the student was provided a drug information question from the medical provider; (2) the student verbalised step-by-step how to conduct a manual blood pressure assessment; (3) the student asked the patient for 3 minutes; (4) the student presented to the provider their response to the drug information request utilising SBAR.
Crowl, 2021	Determining the impact of an interprofessional simulation focused on social determinants of health among pharmacy students.	PS (n=121) and SWS (n=12)	60 min simulation: 8 min introductory/case review, 20 min pharmacy visit, 5 min consultation and transfer between pharmacy student and SW student, 12 min SW visit and 15 min group debriefing	confidence regarding substance use and impact of IP simulation (pre-post survey)	pre-post survey	H	IPR and SP	Pharmacy students discovers obstacles in the patient's management of diabetes (difficulty obtaining medication and respecting their diet, high-risk alcohol consumption, benzodiazepines). Pharmacy students consulted with their SW team member and included them in the visit to help address the issue of DSS and substance use.
Curley, 2019	Pharmacy students' perspectives on interprofessional learning in a simulated patient care ward environment	Bachelor of PS (n=97), 5-year MS and final year NS; (n=388)	2 days simulation-based course in an acute care, hospital ward setting (WardSim). Pharmacy students participated in day 2. 30-min scenario and 30-min debriefed for each case during 30 min.	IPL experience (Likert-type scale, open-ended items)	post activity assessment	H	IPR and SCI	4 IP scenarios: respiratory difficulty post-surgery, iatrogenic anticoagulant overdose, neurological symptoms and lithium, epileptic patient. Nursing and pharmacy students entered each scenario 15 min before medical students.
Curran, 2005	Influence of an interprofessional HIV/AIDS education program on role perception, attitudes, and teamwork skills of undergraduate health sciences students.	3-year NS (n=45), 2-year MS (n=62), final year PS (n=26), (n=133)	Problem based learning (PBL) format involving small groups (8-10 students from each profession). 3 occasions for 1 hour over a 3-week period. Session 3 with a SP.	IPE (Role Perception Checklist, Weekly Team Inventory, Participant Evaluation Survey, Team dynamics Observations Checklist)	pre-post survey	H	IPR and SP	Session 3 provided an opportunity for students to interact with a SP, who simulated a HIV/AIDS patient. The students were oriented with a brief history the SP prior to meeting him and were expected to collaborate as an interprofessional care plan.

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Davies, 2015	Changes in student performance and confidence with a standardized patient and standardized colleague interprofessional activity.	3-professional year PS (n=109)	Clinical-cases activity included a SP interaction, a SOAP note preparation, and a standardised colleague interaction. SP were actors trained at the university; standardised colleagues were volunteer family medicine physicians.	MTM (assessment rubric to evaluate interview skills, pre-post survey to assess comfort in counselling patient), IPE (pre-post survey to assess confidence in making recommendations to physicians)	pre-post survey	H	IPR and SP	Patient medication profile received before their interview with the SP. Students wrote a SOAP note to document their recommendations. They communicated evidence-based recommendations and issues to standardised colleague physician and defend their assessment plan.
Draime, 2020	Assessing the effects of a paired TBL session and patient simulation on pharmacy student HIV treatment knowledge.	2-year professional PS (n=48)	Baseline knowledge assessment before a 4-hour HIV TBL session, which included the use of an online HIV Patient Management Simulator. Post-simulation, students were again administered the scale.	MTM knowledge assessment (HIV Treatment Knowledge Scale)	pre-post survey	SiP	SP	HIV patient simulation: new antiretroviral plan to a patient diagnosed with HIV 2 years prior that had not received treatment. The patient had oropharyngeal and esophageal candidiasis, as well as a decreased CD4 count and increased HIV viral load.
Efstathiou, 2013	Interprofessional, simulation-based training in end-of-life care communication: a pilot study.	final year students (n=50) in MS (n=14), NS (n=18), PS (n=7), physiotherapy (n=11)	3 end of life scenarios, video recording enabled observation and retrospective viewing, RP with a professional role player, facilitated feedback and group discussion.	IPE knowledge, skills, confidence, competence in end-of-life care communication (Likert scale rating questionnaire based on RIPLS and IEPS)	pre-post survey	H	IPR and RP	Scenario before death, during the last days of life and after death. Feedback based on video replay, fear in the box (acknowledgment of fears and anxiety in each situation) and management of interaction in a different context.
Egelund, 2020	Recognizing opioid addiction and overdose: An interprofessional simulation for medical, nursing and pharmacy students	3-year PS (n=19), 3-year MS (n=16), NS (n=32), (n=67)	High-fidelity overdose in IP team using SBIRT IP communication to analyse recorded scenarios. 5 min briefing, 15 min simulation, 10 min debriefing immediately after the simulation at the bedside.	Frankel's Communication and Teamwork Skills (CATS) assessment tool	post activity assessment	H	IPR, HPS, SP	Motor vehicle accident while under the influence of opioids. The IP team was exposed to an opioid overdose and SBIRT tool were used.
El-Den, 2018	Assessing mental health first aid skills using simulated patients.	4-year bachelor PS (n=163)	Tutors enacted vignettes. 30 minutes interaction were audio-recorded. Experienced tutor in MHFA assessment (on reflected performance) and self-assessment (confidence) post-training.	MHFA skills (ALGEE assessment rubric), self-perceived confidence	post activity assessment	SiP	RP	Postnatal depression and suicide vignette were required each student perform in different skills in an over-the-counter request, a first-aid situation, a discharge, a drug information, a medication-related ethical dilemma, a patient's medication history, a Home Medicines Review (HMR).

Reference	Title	Population	Settings	Assessment	Study design	Simulation modality	Type of simulator	Scenario design/activity description
Estes, 2016	Discovering eHealth technology: An innovative interprofessional graduate student learning experience.	advanced practice registered nurse student, 2-year Doctor of PS (n=15)	Implementation of a telehealth-learning experience, students were paired to form an IP team. Actor trained to portray SP. Students were provided a brief patient history including the initial indication and instructions for the use of the telehealth tools.	IPE qualitative evaluation (open-ended questionnaire to evaluate telehealth experience)	post activity assessment	H	IPR and SP	Simulated telehealth in a simulated IP clinical environment. IP team conducted a telehealth patient visit with a SP in videoconference, with telehealth monitoring tools and simulated academic electronic health record (EHR). SP case involved a patient with an history of heart failure, obstructive sleep apnea, and hypertension.
Eukel, 2021	Simulation design, findings, and call to action for managing difficult patient encounters.	3-professional year PS (n=236)	3 students cohorts participated in the simulation. Simulations scenarios represented difficult patient encounters. 50-minute didactic lecture and a 2-hour laboratory session each week.	ability to communicate during difficult patient encounter (self-assessment 0-100 scale)	cohort, pre-post survey	SiP	RP	3 roles: actor, student facilitator, student pharmacist. Actors in each scenario portrayed attributes that required students to respond using specific communication techniques, and to use soft skills from the affect domain. Scripted actors were angry, embarrassed, worried, in pain or hurried and were sometimes resistant to plan of care.
Fejzic, 2015	Implementing simulated learning modules to improve students' pharmacy practice skills and professionalism.	4-year PS (n=95)	Simulation learning modules (SLM), 3 hours of lectures and 8 hours of workshop. SLM focused on specific scenarios from practice and placements RP with trained actors.	professionalism (Measure of Pharmacy Professionalism scale), pharmacy practice skills (Measure of Pharmacy Practice skills scale), qualitative data about student's evaluation	mixed method, pre-post survey	SiP	RP	Each SLM included a briefing, role-playing with actors, animation, debriefing on social interaction cards (SIM). During the role play, the community pharmacist shows a disagreement with the hospital regarding a medicine. Pharmacist should comment on cross-sensitivity for allergy.
Fejzic, 2016	Communication capacity building through pharmacy practice simulation.	4-year PS (n=94)	SLM lectures and workshops over a 6-weeks period. 6 SLM themed around pharmacy practice and pharmacy placements comprised RP with actors, facilitation using Social Interaction Maps (SIMs) and debriefing. Evaluation of long-term effect on self-perceived practice skills.	quantitative (SLM evaluation) and qualitative surveys (open-ending question coding)	mixed method, pre-post survey	SiP	RP	RP focusing on interactions between pharmacy colleagues, pharmacists and other health professionals, pharmacists and patients, and preceptors and students. Actors participated in all SLM workshops, assisting with the demonstration of scenarios in one-on-one RP, as well as post practice debriefing.

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Flores, 2018	Comparing teaching methods on skin disorders using standardized patients dressed in moulage vs paper cases.	3-professional year PS (n=70)	50-min lecture on drug induced skin disorders (DI) and contact dermatitis (CD). 90 minutes laboratory. Teams of 5 on 4 skin disorders (2 SP cases and 2 paper cases), 20 min per case in a cross-over design. Survey before and immediately after laboratory, final examination 3 weeks later.	knowledge, confidence in skin disorder assessment, satisfaction (multiple-choice questions)	observational (cross-sectional) pre-post survey	SiP	SP	(1) groups completed a picture-based paper case, or an interview of a SP dressed in CD-like with a moulage. (2) groups completed 2 cases on DI skin disorders and reviewed (a picture-based paper case or a SP dressed in DI-like moulage) in a cross-over design. Students were asked to identify the skin disorder, determine the cause, and make a recommendation to the patient (triage decision).
Frenzel, 2019	Measuring health care students' attitudes toward interprofessional learning, perceptions of effectiveness as an interprofessional team member, and competence in managing adult cardiac arrest.	3-year PS (n=93) and senior NS (n=57)	60 min of simulation (included 10 min pre-briefing and debriefing)	RIPLS, TSS surveys	pre-post survey	H	IPR and HPS	HFS using HPS focused on adult cardiac arrest in IPR. Discharge education by 2 students of either discipline. Other students observed the interaction in a conference room.
Fusco, 2020	Impact of pharmacy student observation versus active participation in an interprofessional simulation	2-year PS (P2, n=130), 3-year PS (P3, n=121), senior NS	Active participants were P3 and NS (teams of 4), P2 were observers. Scenario synopsis before the simulation, 2 IP simulation cases, debriefing.	ICCAS	pre-post survey	H	IPR and SP	Scenario 1: TOC, with an older adult patient after acute coronary syndrome episode. Scenario 2: medication error and hypoglycemia due to incorrect dose of insulin
Fusco, 2021	Interprofessional escape room improves knowledge and collaboration among nursing, pharmacy, and physical therapy students.	senior NS, 3-year PS and 2-year physical therapy programmes students (intervention group, n=133, control group, n=129), (n=262)	Activity included 1-hour asynchronous online learning about sepsis management and post-operative hip precautions prior escape room: (1) acute management of sepsis (intervention group), (2) general acute care (control group) escape rooms. Students were divided into teams of 2 pharmacy, 2 nursing and one physical therapy student. 30 minutes to complete the escape room prior to participating in a simulated patient discharge case.	Knowledge assessment and impact study. Interprofessional Socialisation and Valuing Scale (ISVS-21)	pre-post survey	H	IPR and SP	Escape room included puzzles focused on the theme of sepsis management and post-operative precautions for patients following total hip arthroplasty. The control escape room included puzzles focused only on general knowledge of acute care practice. After participating the escape rooms, students were tasked to create a discharge plan to a SP with hip arthroplasty complicated by sepsis. Plus-Delta debriefing framework.

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Galal, 2012	Development and assessment of social and emotional competence through simulated patient consultations.	1-year PS (n=212)	Students completed the Social Emotional Development Inventory (SED-I) online and then participated in a series of mock patient consultations on smoking cessation and non-prescription medication.	self-perceived social emotional competence (quantitative tool, 48-items self-report measure) and social competence in patient counselling (patient counselling assessment form)	post activity assessment	SiP	RP	Students conducted simulated patient consultations (smoking-cessation, non-prescription medication counselling exercises) in which they provided recommendations for self-care, assessed the patient and provided a treatment plan.
Gallimore, 2008	Pharmacy students' preferences for various types of simulated patients.	2-year PS (n=155)	Students were observed in live or using a streaming video by an instructor using an evaluation rubric. A survey tool evaluated student's preferences and experiences working with the different types of simulated patients.	self-perceived skill development (communication, medication education) and preference (survey tool)	post activity assessment	SiP	SP	Students were exposed to a simulated patient through a progression of health problems, from dyslipidemia and hypertension to coronary artery disease, to atrial fibrillation with warfarin anticoagulation. Simulated provided formative feedback to student using a separate evaluation tool.
Gillette, 2017	Improving pharmacy student communication outcomes using standardized patients.	2-year PS (n=220)	quasi experimental design to compare effectiveness of 2 active learning methods in the flipped classroom model: case studies, discussion, peer-RP vs 5 SP encounters	communication skills (high-stakes communication assessment, counselling assessment rubric)	post activity assessment	SiP	SP	Prior speaking with the SP encounter, students researched the case and corresponding medications. Patient cases focuses upon the topic of the day (risk communication, health literacy). Students counselled the patients following the same rubrics that would later be used to assess the student during the communication assessment.
Gough, 2013	Innovations in interprofessional learning and teaching: Providing opportunities to embed patient safety within the pre-registration physiotherapy curriculum. A Pilot Study	undergraduate physiotherapy, nursing, MS and PS (n=13)	4 consecutive days course. Topics were taught sequentially with tutorials, group activities, video cases studies, simulated case scenarios. Evaluation of perceptions post-course and perceived application of knowledge 3-month later.	perception IPE, perception patient safety (RIPLS, thematic analysis)	sequential mixed method	H	IPR and SP	2-hours ward scenario, during which participants were required to manage 4 SP, a high-fidelity simulated patient and admit a new SP from the medical assessment unit. Each SP completed a simulation observation sheet which was used to provide feedback during the debrief. 1,5-hour faculty lead debriefing.
Grice, 2013	Health literacy: Use of the Four Habits Model to improve student pharmacists' communication.	3-year professional PS (n=191)	Utilisation of the Four Habits Model (FHM): (1) introduction to FHM in a patient interview lecture, (2) practice interview with SP, formative assessment, (3) practice interview in lab, formative assessment, (4) final	relational aspects of student pharmacist-patient communication skills (FHM criteria formative and summative assessment with SP)	post activity assessment	SiP	SP	Students practiced FHM during an SP simulation: (1) establish rapport and build trust rapidly, (2) facilitate the effective exchange of information, (3) demonstrate and concern, (4) increase the likelihood of adherence and positive health outcomes.

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			interview with SP, summative assessment					
Guadalupe, 2014	Patient simulation-based learning in pharmaceutical care subject provided to fourth-year pharmacy students in Spain	4-year PS (n=70)	Communication modules and practice laboratories to facilitate the implementation of communication skills. Students were assigned to groups of 7 and play the role of pharmacists in a community pharmacy setting in which 10 simulated patients experienced 10 case scenarios.	satisfaction (anonymous questionnaire), communication skills and knowledge application (grading rubric, formative feedback)	post activity assessment	SiP	RP	Consultation with a simulated patient (cold, constipation, cough, diarrhea, hemorrhoids, headache, heartburn, eczema, osteoporosis). Student was asked to meet the patients' pharmacotherapeutic need and resolve drug related problems. The consultation was filmed and recorded. Students viewed the video and evaluated the process to determine the strengths and weaknesses.
Gulpinar, 2021	Development of a structured communication and counseling skills course for pharmacy students: A simulation-based approach.	undergraduate PS (n=21)	A Pharmacist-Patient Communication and Counselling Skills education (PPCCE) programme with simulated patient as teaching method. Videotapes for assessment.	communication skills (modified version of the patient-centered communication tool PaCT)	mixed method	SiP	RP	4 scenarios: (1) a patient with type-2 diabetes afraid of giving injections to himself; (2) a patient with osteoporosis afraid about the side effects of the drugs; (3) an insistent patient wanting the pharmacist to persuade her daughter to use a food supplement; (4) patient with osteoporosis with a medication issue
Haddad, 2010	What health science students learn from playing a standardized patient in an ethics course.	PharmD PS (n=7) and health NS in senior year	4 clinical simulations with SP that focused on different ethical issues and designed to be a teaching/learning tool. All students provided written consent to participate in the project. SP were trained 90 min prior the simulation.	emotions on communication in crisis situations (self-reflection, open-ended question)	qualitative evaluation and thematic analysis	SiP	SP	The clinical simulation (10 min) involved a young childbearing-age woman who is taking a highly teratogenic drug, isotretinoin, and suspects that she might be unintentionally pregnant. Time at the end for feedback from the SP and basic communication skills.
Hamilton, 2021	Evaluation of inter-professional education (IPE) with medical, nursing and pharmacy students through a simulated IPL	final year MS and NS and pre-registration pharmacy trainees (n=118)	One day simulated IPE intervention "*Evening On-Call*" involving nursing, medical and pharmacy students in an on-call setting. Manikin and actor patients in a simulated ward. Post-IPL questionnaire	IPE perceptions (pre-post questionnaires)	pre-post survey	H	IPR and SP	Each participant was provided a document, which detailed the patient on the wards to mimic practice. The participants were blinded to the scenarios prior of the start of the session. After each 60-min session, participants reflect on their experience

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	educational intervention.		immediately after completing intervention and follow-up 6 months after intervention.					and discuss the session with a trained facilitator from their own profession.
Hannings, 2016	Assessment of emergency preparedness modules in introductory pharmacy practice experiences.	2-year PS (n=144)	3 hours simulation focusing on mass triage and mass dispensing. The mass triage consisted of virtual and live victims to be triaged and assigned a transport order.	Mass triage exercise and mass dispensing skills (performance and perceived competence)	mixed method, post activity assessment	SiP	RP	SP triage following a mass casualty event. Evaluation of each victim and categorisation in the mass triage. In the mass dispensing simulation, students assumed patient and pharmacist roles in a point of dispensing exercise of influenza. Each student rotated through 3 roles: simulated patient, pharmacist, and case reviewer.
Harris, 2018	The use of a disease state simulation assignment increased students' empathy and comfort with diabetes nutrition counseling.	PS (n=140)	Students in the intervention group completed an empathy assignment, which involved developing and following a diet plan appropriate for a patient with diabetes followed by a reflection of their experiences.	empathy (Kiersma Chen Empathy Scale)	pre-post cross-over survey	SiP	RP	3 half-days rotation per week for 5 weeks. Patient encounters varying from 30-60 minutes, with patient from different cultural and socioeconomics background. The intervention group as to live as a patient with diabetes for one week.
Hollamby, 2018	Preparing students for safe practice using an interprofessional ward simulation	5-year MS, 3-year NS, 3 and 4-year PS, (n=92)	Interprofessional ward simulation: 7 half-day simulation sessions. Each session comprised 3 simulations through which the students rotated.	confidence, role understanding, awareness of patient safety issues (pre-post questionnaires), Kirckpatrick Training Evaluation Model was applied	pre-post survey	H	IPR, LFM, SP	Students acted into their respective professional roles on ward or into patient /relative roles. 2 beds held high fidelity manikins, one a low fidelity manikin and 5 beds contained simulated patients, played by students. Debriefing sessions followed simulations.
Hussainy, 2012	A virtual practice environment to develop communication skills in pharmacy students.	2-year PS	Virtual practice environment (VPE): a video of a real-life community pharmacy in operation on a regular day was recorded and displayed over 3 screens as a "*backdrop*". VPE included cameras to recorded class role plays.	OSCE, evaluation of students' experiences and focus group	mixed method	SiP	RP	Students viewed prescriptions and practiced RP with each other and explored the use of non-verbal communication in patient-pharmacist interactions. Barriers that usually occur in the community pharmacy were maintained in the video (noise) to create an immersive environment. Each group was able to access electronic drug information databases to search information. Tutorial included

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								antibiotics, asthma medicines and antihypertensives.
Isaacs, 2015	A chronic disease state simulation in an ambulatory care elective course.	PS (n=130)	2 weeks of simulation. Students alternating playing the role of patient and pharmacist after one week.	empathy, counselling skills (course surveys, written reflections, SOAP notes)	post activity assessment	SiP	RP	Chronic disease state simulation activity (hypertension, diabetes, dyslipidemia, rheumatologic disorders, respiratory diseases, depressive and anxiety disorders), done in pairs, with students alternating the roles of pharmacist and patient.
Iverson, 2018	Development and assessment of an interprofessional education simulation to promote collaborative learning and practice.	Doctor of NS (DNP, n=16), PharmD Doctor of Pharmacy (n=23), (n=39)	25 minutes to complete the scenario in both the outpatient and inpatient setting and an additional 5 minutes for the transfer of care telephone call between providers. 5 minutes allowed for immediate feedback to acute care students. Each simulation involved 2 NS and 1 pharmacy student.	perceptions, attitude toward IPE (SPICE-R, reflection questions)	mixed method	H	IPR and SP	Simulated patient presented to the primary care requiring transfer to an acute care facility. The primary care DNP student evaluated the patient's condition, collaborated with the outpatient PharmD student, and made recommendation. The primary care student provided report in SBAR format for the acute care student.
James, 2001	The design and evaluation of a simulated-patient teaching programme to develop the consultation skills of undergraduate pharmacy students.	3-year undergraduate PS (n=91)	Questionnaires were administered before and after delivery to the teaching programme. 6 scenarios involved pharmaceutical interventions to address patient's illness and treatment.	perceptions of the difficulty of conducting a consultation, confidence (structured questionnaire)	pre-post survey	SiP	RP	2 scenarios were constructed around the need to take a thorough medication history. 2 scenarios focused on patient compliance. 1 scenario involved a sensitive chronic medical condition. Students were divided into 3 groups of 4, and each group was given a scenario. One student of the group was nominated to undertake the consultation with a (volunteer) simulated patient.
Jebara, 2021	Pharmacy and medical student interprofessional education placement week.	3- and 4-year PS and MS (n=10)	5-day IPE for pharmacy and medical students (ward rounds, outpatient clinics, investigations, and interventions). Students completed mini-Clinical Evaluation exercises in their pairing (medical and pharmacy student).	IPE qualitative evaluation (focus group), Kirckpatrick Training Evaluation Model focused on levels 1 and 2	post activity assessment	H	IPR and SP	Ward-based immersive simulation: students 'acted-up' as qualified junior pharmacists and doctors. Simulated patients in a ward setting. At the end of the scenario, students were debriefed on their experience by the placement coordinator.

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Joyal, 2015	Interprofessional education using simulation of an overnight inpatient ward shift.	1-year MS, 2-year NS, 3-, 4-year nursing, 2-year MS, 4-year PS, (n=45)	Academic staff from 3 faculties served as mentors. The shift included IP ward rounds, simulated patient records and staged patient event. Debriefing session with faculty in the morning prior to student's departure.	perceptions about IPE (4-questions using a 10-point Likert scale, open-ended questions)	pre-post survey	H	IPR and SP	IPE, overnight inpatient ward shift: 1-year medical, 2-year nursing performed the role of SP in a simulated 12-hour night simulation called Nightmare Night Care (NMNC). 3-, 4-year nursing, 2-year medicine, 4-year pharmacy students performed their respective roles.
Jung, 2020	The effectiveness of interprofessional education programs for medical, nursing, and pharmacy students	final year MS (n=42), final year NS (n=46), final year PS (n=29), (n=116)	6-hour period on a single day IPE activity (small-group activities and roleplay). Intervention group and control group.	Perceptions toward Interprofessional Education (PIPE), Self-Efficacy for Interprofessional Experiential Learning (SEIEL), Perceptions towards Interprofessional Competency (PIC), satisfaction	pre-post survey	H	IPR and patient chart/case	Scenario simulated a medication error due to the absence of IP communication. Students were led to detect problems and solutions through roleplay.
Karpa, 2019	Geriatric assessment in a primary care environment: A standardized patient case activity for interprofessional students.	MS (n=142), NS (n=55), occupational therapy (n=48), physical therapy (n=36), PS (n=30), dental hygiene (n=21), dietician (n=8) students (n=340)	Intercollegiate collaboration involving 7 colleges. 30 minutes for students' instructions. 14 simultaneous simulation rooms (with a physician facilitator) during the 1st day and 16 the 2nd day.	Interprofessional Self-Assessment Questionnaire	pre-post survey	H	IPR and SP	Each student participates in one encounter, each SP portrayed a geriatric patient for one day. Each experience occurred over 180 minutes, 2 hours interaction with the SP and 30 minutes debriefing.
Kayyali, 2016	Simulation in pharmacy education to enhance interprofessional education.	PS (n=126), NS (n=314)	Simulated hospital ward and a general practitioner (GP) for a simulation setting model (SSM) specific for SBL in healthcare. 4 phases: (1) introduction, (2) briefing, (3) scenarios, (4) debriefing.	IPE (20-item questionnaire, short interview for a thematic analysis)	post activity assessment and thematic analysis	H	IPR and RP	In the hospital setting, the environment resembled a hospital ward and trained amateur role-players played patients dressed in hospital gowns and wearing makeup to reflect injuries, intravenous (IV) lines. At the bedside, facilitators act as a nurse in charge and prescribers where necessary. Phone calls could be made and received during this time.

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Kerr, 2021	A realist evaluation exploring simulated patient role-play in pharmacist undergraduate communication training.	3-year PS (n=183)	SP session in a men's and women's health module. The class was split into randomly assigned small groups of 12 students for the training session, with students divided into six pairs. Sessions took place in a simulation center.	complex communication skills (Explanation and Planning Scale EPSCALE, video recording of training and OSCE sessions, focus group)	mixed method	SiP	SP	Students rotated through 6 scenarios in pairs (smoking cessation, alcohol in pregnancy, emergency hormonal contraception, erectile dysfunction, medication teratogenicity), with students taking it in turns to act as pharmacist and observer. 5 minutes for each interaction. During the debrief session, all student in the small group watched one video of each student's interaction.
Kerr, 2015	Assessing empathy and self-efficacy levels of pharmacy students in an elective diabetes management course.	3-year PS (n=24 in 2012; n=30 in 2013)	Pharmacy students enrolled in a diabetes elective course were paired to act as a patient with diabetes or as a provider assisting in the management of that patient during a 6-week simulation activity. After 3 weeks, students switched roles.	empathy (Jefferson Scale of Empathy JSE-Health Professional) and a self-efficacy (survey)	pre-post survey	SiP	RP	The simulation was designed with activities to build empathy. The patient/provider interaction simulation activity randomly paired students, with one assigned the role of patient and the other, clinical pharmacist provider. The patient consulted a physician. A course coordinator acted as the "*community pharmacist*".
Kiersma, 2009	Laboratory session to improve first-year pharmacy students' knowledge and confidence concerning the prevention of medication errors.	1-year PS (n=160)	Skill based laboratory divided into 5 sections of 32 students and designed to allow students to apply material from lectures and share experiences from personal observations in pharmacy setting. Students received instructions on strategies for medication error reduction in course.	3 survey instruments: (1) knowledge regarding medication error prevention, (2) confidence in preventing and resolving errors, (3) laboratory evaluation. Measure of the correlation between knowledge and confidence scores.	pre-post survey	SiP	SP	The simulated prescription contained a variety of misinformation, making errors likely to occur during prescription intake. One facilitator per small group acted as the patient/caregiver. The second laboratory activity was a RP scenario on how to manage and communicate errors once they occurred.
Komperda, 2019	Effectiveness of a medication reconciliation simulation in an introductory pharmacy practice experience course.	3-year PS (n=183)	3 groups of pharmacy students (A, B, C). "*A*" attended a 30 min lecture, "*B*" attended the lecture and participated in a 90 min workshop, "*C*" received no training. After A et B completed their assigned learning activities, all students participated in a simulated medication reconciliation activity with a SP.	pre-post intervention survey, formative assessment of the SP encounter (feedback on performance and recommendations)	pre-post survey	SiP	SP	Medication reconciliation simulation: 10 min to review the patient's electronic medical record, 15 minutes to interview the patient and review medication, 30 minutes to complete a post-encounter task documenting the patient's reconciled medication list.

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Koo, 2014	Qualitative evaluation of a standardized patient clinical simulation for nurse practitioner and pharmacy students.	PS (n=14) and nurse practitioner (n=32)	8-hour day course, students were divided into 3 group and rotated through the 2 clinical scenarios.	IPE (qualitative data from 3 focus groups, content analysis)	qualitative evaluation	H	IPR and SP	Vaccination case scenario in a community pharmacy which required students to communicate by telephone and videoconferencing. Anticoagulation therapy clinical scenarios included history taking, physical examination, communication with another healthcare. Tasks were divided among nurse practitioner and pharmacy students, and they turn actively participating in the scenario while the other students observed the simulation.
Kostoff, 2016	An interprofessional simulation using the SBAR communication tool.	senior NS (n=94), 3-year PS (n=96)	60-minutes simulation, 30-minutes debriefing. During each simulation, the pharmacy and nursing groups had to communicate and collaborate on 4 separate cases, with each case lasting 15 minutes.	ICCAS	mixed method	H	IPR and patient chart/case	Students used telephones and the SBAR communication tool to collaborate on the development of a shared plan. The simulation created communication from pharmacy settings to the corresponding nurse settings regarding a variety of clinical content (drug interaction, narcotic use, immunisations, patient education, drug administration/monitoring, inpatient order clarification, adverse drug reaction). For 3 cases, a pharmacy student was the SBAR communicator, for the fourth case, the roles were reversed.
Kubota, 2018	Clinical pharmacy education in Japan: Using simulated patients in laboratory-based communication-skills training before clinical practice.	4-year PS (n=242)	3 days laboratory work. 4 groups for each session with 1 faculty member 1 simulated patient per group/case. Feedback by both the simulated patient and the faculty after each presentation.	knowledge, skills, and attitude (questionnaire survey)	post activity assessment	SiP	RP	Students were asked to obtain patient data from a model medical chart, before performing simulated patient interviews covering hospital admission and patient counselling. Next day, 1 representative group simulated the patient interview in front of the whole class.
Kusnoor, 2019	An interprofessional standardized patient case for improving collaboration, shared accountability, and respect in team-based family discussions.	4-year PS (n=464), 3 and 4-year MS (n= 450), 4-year NS (n=237)	70 minutes sessions. Teams to disclose a medical error to a SP. Icebreaker exercise wherein students learned about each other's. Students worked in teams of 3 (nursing, medical and pharmacist).	IPE team performance, IPC, communication (post-session survey)	post survey	H	IPR and SP	Teams disclosed a medical error. An 80-year-old patient was erroneously given an overdose of heparin. The son returned to the hospital at the request of the team to discuss what happened to the patient. After simulation,

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								students regrouped for a 30-45-min debriefing.
Lucas, 2020	"*Two heads are better than one*"- pharmacy and NS' perspectives on interprofessional collaboration utilizing the RIPE model of learning.	1-year master PS MPharm (n = 56), NS (n = 8)	RIPE model applied in a simulation laboratory (multiple workstations between pharmacy and NS). Students were allowed a maximum of 15 minutes per station.	pre and post survey (6-point Likert-type scale) and debriefing session with written reflective statement	mixed method	H	IPR and RP	Pharmacy students gathered information in 10 workstations (including a patient or a healthcare professional). 4 workstations were hospital bedside stations, which included either a medium or high-fidelity manikin or a SP. The final station involved a SP in bed.
Luiz, 2015	Developing pharmacy student communication skills through role-playing and active learning.	2-year PS (n=92)	Pharmacy students divided to take the class over 2 terms. Practice role-playing sessions were scored as a baseline measure to compare to later sessions.	oral communication skills (evaluation rubric inspired by Bruce Berger's Communication Skills for Pharmacist), written communication skills (written critique questionnaire)	pre-post survey	SiP	RP	All students search for patient drug information, received patient scenarios, and read assigned chapters from Berger's book (communication skills for pharmacists). Oral communication in the scenarios emphasised course goals as well as development of cultural competency, patient conflict and anger management, techniques for assertiveness and persuasion, and appropriate diction and nonverbal signals.
Lynch, 2018	Assessment of a simulated contraceptive prescribing activity for pharmacy students.	3-year PS (n=11)	PS learned about relevant state legislation and attended a clinical skills center simulation activity where they utilised a prescribing algorithm. Students attended workshop in 2 groups. Each student was randomly assigned 2 of the 3 scenarios.	clinical decision-making, interpersonal skills (faculty graded clinical decision making based on assessment and plan)	observational (cross-sectional) survey	SiP	SP	SP scenarios were designed to mimic realistic situations: a contraceptive start, adjusting an oral contraceptive dose and referral to the physician in the presence of exclusion criteria for contraceptive prescribing. Students had 20 min to meet with the SP individually, make a recommendation, counsel the SP, and electronically document the assessment.
Ma, 2020	Evaluation of distance facilitation and technology in an interprofessional simulation exercise.	3-year MS (M3), 3-year NS (N3), SWS, medical doctor (MD), registered nurse (RN), 3-	Hawaii Interprofessional Team Collaboration Simulation (HIPTCS) and involved an IP team's hospital discharge for a complex geriatric patient. The HIPTCS sessions consisted of four on-site rooms conducted	ability to work through the simulation, satisfaction with the use of distance technology (questions to facilitators and students)	mixed method	H	IPR and SP	IRP with distance technology: (1) collaboration case (complex geriatric patient) and required on-site and distance students; (2) students from each profession represented their respective discipline when the team met a family member to develop a

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		year PS (P3) n=875 over 3 years	simultaneously with 8-10 students (M3, N3, PH and/or SW students). Each room included a team of interdisciplinary co-facilitators.					patient-centered, culturally appropriate plan of care. A theater arts student plays the role of the family member.
MacDonnell, 2012	An introductory interprofessional exercise for healthcare students.	2-year MS, 4-year NS, 3-year PS (n=251)	Teams alternated between working together on patient cases focusing on chronic obstructive pulmonary disease and asthma, and on the evaluation of standardised pneumonia patient (SP).	teamwork (global rating scale for faculty member and SP), perceptions (voluntary questionnaire prior and after workshop)	post activity assess ment	H	IPR and SP	IP workshop that introduces students to a team-based, patient-centered care experience. Teams were given the patient's health information and went to examination rooms to assess, diagnosis and develop treatment plans for a SP with pneumonia.
MacDonnell, 2016	A team-based practicum bringing together students across educational institutions and health professions.	4-year NS (n=120), 2-year MS (n=121), 3-PharmD PS (n=120), 2-year SWS (n=48), 2-year Doctor of Physical Therapy Students (n=34)	Students collaborated in assigned health professions teams. The workshop included 3 activities through which the groups rotated. The focus was on the activity with the SP case.	SPICE-R	post activity assess ment	H	IPR and SP	The SP (a patient actor) presented to the emergency department with a laceration. He received the wound into a financial argument with their partner. Teams were asked to take a patient history, perform a focused and brief physical examination, make a diagnosis and perform a procedural component.
Marken, 2010	Human simulators and standardized patients to teach difficult conversations to interprofessional health care teams.	senior PS (n=1), 1-year pharmacy resident (n=3), pediatric medical residents (n=3), senior NS (n=4), pediatric emergency medicine fellow (n=1)	Teams responded to preliminary questions regarding difficult conversations, listened a brief discussion on difficult conversations, formed teams to interact with the SP and debriefed and self-reflection.	interprofessional teams in difficult conversation self-assessment	observ ational (cross-section al) per-post survey	H	HPS, SP and IPR	Pharmacy students and residents, students' nurses and medical resident formed ad hoc teams and interacted with a SP (mother) and a human simulator (child), discussing the infant's health issues, intimate partner violence and suicidal thinking.

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Marshall, 2020	A mixed methods approach to assess the impact of an interprofessional education medical error simulation	4-year MS (n=85), 3-year PS (n=50), 2-year PAS (n=15), NS (n=36), (n = 186)	Half-day high-fidelity IPE error disclosure simulation. Online assignments on medical error disclosure prior simulation (readings, videos). IP teams of 4 or 6 members. Focus group 8 month after the simulation.	IP attitude (IPAS survey and focus group)	mixed method	H	IPR and RP	Health care team interact with the patient's parent (actor) and inform on a medical error: child was inadvertently given potentially toxic doses of an ototoxic antibiotic. 3 interactions with a different actor's demeanor (disbelief, anger, sadness) during the simulation.
Mathews, 2011	Role-reversal exercise with Deaf Strong Hospital to teach communication competency and cultural awareness.	1st-year PS (n=76)	Students were the patients in a Deaf Hospital. Volunteers from a local deaf community acted health provider.	cultural competency, debriefing session, role-reversal exercise	post activity assessment	SiP	RP and SHP	Standardised health care providers. Students navigated into a hospital and received a prescription filled at a pharmacy without receiving or using any spoken language.
Miller, 2020	Ambulatory care elective: Introduction to core practice concepts.	3-year PS (in a 4-year Doctor of Pharmacy programme) n=43	The ambulatory elective course included six modules employed lecture, active learning activities, role playing and simulation. An online web conferencing system allowed the practicing pharmacists to provide real time feedback to students.	satisfaction and students' reflections	post activity assessment	SiP	RP	Role-reversal multiple chronic disease state simulation (diabetes and hypertension/ hypothyroidism/chronic obstructive pulmonary disease). Students experienced the role of a patient (with a medication and monitoring of glucose, diet, and exercise) and the role of a pharmacist (to provide a standardised interview sheet and create an individualised medication).
Moote, 2019	Interprofessional education telephone simulation for campus-based pharmacy students and distance-learning family nurse practitioner students.	4-year PharmD PS (n=36) and Family Nurse Practitioner (FNP) students (n=10)	1 FNP and 2 pharmacy students in each team. 1 week to complete the activity via telephone conversation.	perception of team communication (post-simulation perceptions assessment survey), patient care plan, team concordance (rubric to assess therapy and concordance among groups)	post activity assessment	H	IPR and patient chart/case	IPR in telephone simulation. Interprofessional work by teams to achieve optimal patient care (to develop a treatment plan in an ambulatory anticoagulation case and a complicated urinary resistant infection case).
Motycka, 2018	Using interprofessional medication management simulations to impact student attitudes toward teamwork to prevent medication errors	2-3-year PS (n=15), half-way programme NS (n=21), 4-year MS (n=12), (n=48)	TeamSTEPPS simulation: teams of 4 students, introduction by a faculty facilitator, 15-min scenario, 10-min debriefing.	Teamwork Attitude Questionnaire (TTAQ)	pre-post survey	H	IPR and HFS	4 simulated IPE MTM scenarios: (1) febrile baby with the wrong chart; (2) allergy to penicillin; (3) rash, kidney-based drug toxicity; (4) spider bite and MRSA. Debriefing took place after each simulation.

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Nestel, 2007	Using volunteer simulated patients in development of pre-registration pharmacists: Learning from the experience	4-year bachelor PS, n=121	Students worked in groups of 8 with experienced pharmacist tutor and SP. Each student was the pharmacist in a 5-min RP and then receive feedback from the simulated patient, peers, and tutor. Each role was played twice in each group, with a different student and simulated patient.	evaluation forms for students, tutor, and SP	post activity assessment	SiP	RP	Scenarios of real-life interaction (hemorrhoids, stress headache, hay fever and advice on smoking cessation). Simulated patient interview and colleagues' observation in different scenarios. Facilitation by an experienced pharmacist. SP, students, and tutors participated in feedback.
Norville, 2021	The design, implementation, and evaluation of hybrid cancer clinic simulations: Escaping the norm.	3-year PS (n=36)	6 groups completing a series of Pharmacist Patient Care Process (PPCP) activities involving patient actors. PPCP activities were puzzles and games to simulate an escape room.	knowledge in cancer pharmacy patient care process (learning and retention measured by pre-post simulation quizzes and course exams), perception (post-simulation survey)	mixed method	SiP	SP	SP actors performed the role of the cancer patient, and a pharmacy faculty member played the role of the physician in 2 cancer clinic simulation: teams counselled the SP on conveying patient-specific recommendations in (1) a newly diagnosed non-small cell lung cancer patient, (2) a newly diagnosed lymphoma patient, in prevention of chemotherapy-induced nausea and vomiting.
Ottis, 2016	An interprofessional nursing and pharmacy student simulation in acute pain management	4-year PS and 3-year NS (n=343)	IPE exercise integrated into existing courses for both the nursing and pharmacy school.	IP attitude toward acute pain (pre-post survey validated tool adapted for the specific needs of simulation), ability to identify drug-related problems (analytical checklist)	pre-post survey	H	IPR, SP, manikin	Simulation of a post-operative patient recovering from a hip replacement. Pharmacy students were provided to review medications. SP received inappropriate dosing of morphine. Pharmacy and NS continued to discuss patient concerns and the identified potential threats to patient safety as an interprofessional team at the bedside. Students utilized communication tools such SBAR for interprofessional communication.
Patel, 2018	Evaluation of pharmacy students' knowledge and perceptions of pharmacogenetics before and after a simulation activity.	3-year PS in the four-year Doctor of Pharmacy (PharmD) (n=113)	Double-sided mirror to view and hear the live encounter outside the room. Prior the simulation, students complete a non-randomised, voluntary, anonymous pre-simulation assessment.	knowledge (multiple-choice questions), perceptions of individual ability to interpret and provide drug therapy results (Likert scale questions)	pre-post survey	SiP	SP	Clinical scenario involving a patient with acute coronary syndrome (coronary intervention with stent placement). Each team taking the lead on counselling the SP to explain why the pharmacogenetics test was ordered, what the test result meant, and how the test result would impact the selection of antiplatelet therapy.

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Paterson, 2015	Inter-professional prescribing masterclass for medical students and non-medical prescribing students (nurses and pharmacists): A pilot study.	4-year MS, pharmacist independent prescribing students, nurses prescribing students, 2 simulated patients, (n=10)	Medical students learn to prescribe at an undergraduate level while non-medical prescribers and pharmacist prescribers can gain extra skills in prescribing post-registration.	perceptions, attitude toward IP collaboration (RIPLS), confidence (validated self-efficacy score), trust in healthcare professional (trust in physician scale)	post activity assessment	H	IPR and SP	Students worked together to formulate and implement an evidence-based prescription. 3 cases which would be encountered in the practice were designed: (1) sepsis required antimicrobial treatment; (2) polypharmacy, uncontrolled hypertension; (3) community based-case, confusion secondary to multiple medication.
Planas, 2008	A systems approach to scaffold communication skills development.	Students in 3-professional year of the Doctor of Pharmacy curriculum.	A communication skills development (CSD) system included various types of learning activities and feedback processes (sections with SP). Each student was assigned to a laboratory session. SP actors received a training session before each set of interviews.	communication skills (faculty, patient, self and peer assessments to recognise communication strengths and areas of improvement)	post activity assessment	SiP	SP	Students received interview criteria to assess their performances (active listening, empathy, communication barriers, constructive feedback, patient-centered communication). Students completed the interview, wrote a SOAP note based on the encounter, and received verbal feedback from their patient.
Popkess, 2017	Interprofessional error disclosure simulation for health professional students	3-year dental students (n=49), 3-year PS (n=79), senior-level NS (n=74), (n=202)	Students were required to review a video on error disclosure prior to the simulation. 48 interprofessional teams, consisting of 4 to 5 members of each simulation. The standardised family member roles were portrayed by 8 students selected from the theater department. Simulation required 2,25 hours.	IPE, knowledge (10-item created by investigator), attitude about error disclosure (11-item 5-point Likert scale adapted pre-post evaluation, feedback evaluation)	pre-post survey	H	IPR and SP	Each IP team participated in one disclosure simulation and observed 2 other teams where the standardised family member reacted in a relieved, angry, or sad/distrustful affect. Simulations were followed by an IP faculty-facilitated debriefing (comparison among the teams and the different standardised family member affects).
Powers, 2019	Implementation of an active-learning laboratory on pharmacogenetics.	3-year PS (n=130)	active-learning laboratory session in a 1-credit course. 50-min lecture on clinical pharmacogenetics before laboratory (interpretation of a genetic profile in terms of CYP450 enzyme polymorphism)	knowledge (pre-post lecture, post laboratory multiple-choice questions on pharmacogenetics), confidence in pharmacogenetic counselling (pre-post lecture, post laboratory confidence survey)	pre-post survey	SiP	RP	Clinical case scenario and patient genetic profile to counsel a simulated patient played by an advanced pharmacy practice experience student or a graduate teaching assistant. Feedback on communication competencies given using a rubric.

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Quesnelle, 2018	Interprofessional education through a telehealth team-based learning exercise focused on pharmacogenomics.	1-year MS (n=67) and 3-year PS (n=23)	TBL IPE activity designed to serve a 2-hour stand-alone exercise within each curriculum. The application exercise was initially presented in the large group setting via PolyCom conferencing.	IPE attitude toward physician-pharmacist Collaboration (SATP2C), PGx confidence (2 additional specific questions)	pre-post survey	H	IPR and patient chart/case	Medical and pharmacy students conducted separate class exercises. The pharmacy student class exercise focused on analysis of pharmacogenomic data that may aide in predicting the response to narcotics. After, small groups teach each other about the diagnosis, comprehensive treatment plan, and recommendation for narcotics in this patient based on pharmacogenomics and simulated map data. Debriefing in large group using PolyCom conferencing.
Ragucci, 2014	Student evaluation of a clinical assessment course and related interprofessional simulation exercises	3-year PS (n=75), 3-year MS (n=36), 2-year NS (n=36), 1-year PAS (n=36)	2-week IP simulation experiences in a clinical assessment course	IPE perceptions (student feedback from 4 different professions, online anonymous simulator center survey, instructor evaluation), OSCE	post activity assessment	H	IPR and HPS	Teams of 5 and, 10 minutes to review 2 patient cases: (1) gastrointestinal bleed due to incorrect use of anticoagulants along with the use of non-steroidal anti-inflammatory medications, (2) sepsis and arrhythmia. The pharmacy student performed a medication history. After, the facilitators go back to debrief the students.
Ragucci, 2016	Evaluation of interprofessional team sisclosure of a medical error to a simulated patient.	3-year PS (n=75), 4-year MS (n=36), PAS (n=18), NS (n=18)	Simulated IP rounding experience of a medication error with a duplication of anticoagulation therapy. 10 minutes to review the chart before simulation. Faculty facilitators assigned to each room and followed the same script. One facilitator played the role of the patient.	IP team disclosing error to patient (validated rubric post simulation), satisfaction with IP communication	post activity assessment	H	IPR and HPS	IP simulation to recognise the duplication of anticoagulation therapy based on the medication list and patient history and disclose the error at hospital discharge. 30 minutes to stabilise and treat the patient, 10 minutes to provide discharge counselling and 10 minutes to debrief.
Rao, 2011	Skills development using role-play in a first-year pharmacy practice course.	1-year PS (n=130 in term 1, n=129 in term 2)	Instructors RP patient and pharmacist to show the roleplay process. A debriefing session held after the demonstration. Term 1: each group member played each one of the roles for each case. Term 2: each student assumed different roles for different cases. Group discussion	verbal communication, information gathering-skills, perceived usefulness of the model (term 1 and term 2 survey assessments)	post activity assessment	SiP	RP	Students performed different roles, including that of a pharmacist and a patient, and documented case notes in a single interaction.

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			and feedback at the end of each interaction.					
Ray, 2018	Retention of students' ability to incorporate a computer into simulated patient encounters.	2-professional year PS (n=166), n=82 from the 2016 class and n=84 from the 2017 class	PS (2 cohorts) completed the laboratory series courses. Patient encounters were video recorded, interactions were timed.	performance (blinded computer use skills rubric), awareness and confidence using computers	pre-post survey	SiP	SP	Individual encounter with a SP in a primary care clinic or emergency department, students gathered medication lists from or performed pharmaceutical care assessment. Interactions were timed (15-20 minutes per encounters). They developed and delivered pharmacotherapy plans to their patient or another health care provider.
Ray, 2017	Assessment of students' ability to incorporate a computer into increasingly complex simulated patient encounters.	3-year PS (n=78)	PS received specific instructions on effective computer use during patient encounters.	Students were evaluated by instructors on their ability to effectively incorporate a computer into a SPE using a rubric.	pre-post survey	SiP	SP	Increasingly complex simulated patient encounters: 15 minutes to gather a medication list to a cooperative simulated patient, but who expressed anxiety and sadness. After the simulation, 15-minutes of specific instruction on how to incorporate a computer into a patient encounter. In the last simulation, the simulated patient was taking 2 medications as needed and was uncooperative, agitated, and reluctant to give information.
Rickles, 2009	The impact of a standardized patient program on student learning of communication skills.	2-year PS (n=127)	Lecture-laboratory course on student communication skills. PS were assigned to 5 standardised patients 60-80 minutes. Pre-laboratory assignments included a review of the communication topics.	patients encounter self-assessment (Communication Skills Assessment Form CSAF)	blinded retrospective analysis	SiP	SP	5 PS met the SP for 7 minutes. After, they watched their tapes and self-assessed their encounter using the CSAF. Scenarios topics included learning how to listen, showing empathy, communicating with confused/aggressive/non-adherent patients, and using motivational techniques.

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Rivera, 2018	Integrative health: An interprofessional standardized patient case for prelicensure learners.	3-year dentistry, physical therapy, MS, 2-year nurse practitioner students, 4-year PS, SWS and nutrition trainees (n=520)	Classroom-based sessions before ISPE. 3-hours 15-min ISPE: students worked in IP teams of 4-5 learners, members discussed case information, interviewed the SP individually, joined a care plan of the SP. Debriefing with a facilitator.	ISPE collaboration-related behaviors, communication skills (Student Feedback Form, Student ISPE Evaluation Form)	post activity assessment	H	IPR and SP	SP interviewed individually while the other team member observed in encounter room (10 minutes per interview, 5 minutes break). During the break, SP completed the Student Feedback Form. Each interprofessional team met a faculty facilitator to present their plan briefly and discuss the interprofessional experience (35 minutes).
Sales, 2013	A comparison of educational interventions to enhance cultural competency in pharmacy students.	2-year PS (n=108)	3 educational interventions: (1) lecture on cultural competence and 2 patient cases. (2) lecture providing some background on cultural competence and written case (3) a simulation-patient activity	cultural assessment survey	pre-post survey	SiP	RP	The simulation group received a brief lecture providing some background on cultural competence and then was split into groups for 2 SiP encounters in which one student interviewed a patient non-Caucasian background, played by pharmaceutical sciences graduate students.
Schultz, 2007	Community-based collaboration with high school theater students as standardized patients.	3- and 4-professional year PS (n=75)	High school theater students portrayed patients in a laboratory during 2 consecutive years. Special make-up effect in the first-year cohort. 6 patients' rooms that are each monitored by a video camera. PS completed 1 encounter.	perceptions, effect of simulation with high school theater students on clinical skills (quantitative analysis for PS), qualitative analysis for theater students, semi-structured interviews	mixed method	SiP	RP	Realistic improvisation and patient centered care in triage encounters. Ambulatory care cases including cough and cold, infected wood splinter, suspected pregnancy, dog bite, minor burn, dermatologic cases (atopic dermatitis, psoriasis), smoking cessation.
Schwindt, 2018	Training future clinicians: An interprofessional approach to treating tobacco use and dependence.	NS (n=13), SWS (n=14), PharmD PS (n=9)	IP tobacco education programme: all participants completed 6 hours of training (a 2-hour web-based module, a 3-hour classroom training, a simulation with a SP, a group audio recorded debriefing session with faculty)	ICCAS, DML	mixed method	H	IPR and SP	Brief patient history before starting. 15 min tobacco cessation counselling simulation with varied SP. Students paired with a peer from a different profession for a cross-discipline consultation. Faculty-facilitated post-simulation debriefing session with all students together guided by the DML method.

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Seghal, 2019	First do no 'pharm': Educating medical and pharmacy students on the essentials of medication management.	2-year MS (n=60) and volunteers 2, 3 and 4-year PS (n=8)	polypharmacy simulated patient, flipped classroom and IPE with a SP	thematic analysis (ATLAS, vivo)	post activity assessment	H	IPR and SP	2 parts in an IPE activity. (1) PS simulated the patient in a polymedication pillbox exercise (2) IP medication reconciliation exercise with a SP. MS portrayed the physician and PS portrayed a community pharmacist (participating by phone). Students preformed a medication reconciliation.
Serag-Bolos, 2018	Enhancing student knowledge through a comprehensive oncology simulation.	3-year PS (n=109)	16 teams (n=5-6 students) rotated in 3 stations in a chronological order: (1) to complete a detail order set for chemotherapy, (2) SP counselling on chemotherapy, (3) chemotherapy preparation. Debrief session after simulation.	knowledge, perceptions regarding pharmacists' roles in the oncology setting (anonymous voluntary pre-post assessment using Qualtrics peer reviewed by core faculty)	pre-post survey	SiP	SP	SP case (station 2) involved a 56-year-old-female with newly diagnosed ovarian cancer who had undergone surgery prior chemotherapy initiation. Students provided education on ovarian cancer for 20 minutes (prognosis the chemotherapy schedule, expectations and side effects of the chemotherapy regimen, appropriate supportive care medications).
Serag-Bolos, 2017	Assessing students' knowledge regarding the roles and responsibilities of a pharmacist with focus on care transitions through simulation.	3-year PS (n=51) with community pharmacy work experience	2 simulations assessments, one simulation each term. Patient cases utilised electronic medical records (EMR). The class was divided into 10 academic groups, each consisting of 5-6 students, to rotate through the stations.	knowledge, perceptions of pharmacist roles in TOC (anonymous assessment of knowledge before and after simulation each term)	pre-post survey	SiP	SP	Heart failure and atrial fibrillation cases. Same tasks for each simulation. Cases included all aspects of a patient chart such as demographics, vital signs, allergies, medication list, medication administration records, discharge notes. Each simulation day entailed a four-hour class period. Debriefing sessions after the simulation.
Shaikh, 2020	Assessing self-perceived interprofessional collaborative competency on advanced pharmacy practice experiences through interprofessional simulations.	4-year PS (n=157), MS, NS, dental hygiene, physical therapy, PAS	SP actors trained prior the simulation. PS collaborated with at least one student prescriber (NS, dental hygiene and/or physical therapy student). Each simulation included preparation work before simulation.	ICCAS	pre-post survey	H	IPR and RP	Case 1: Patient with dementia, depression, and constipation. Case 2: Non-adherence to diabetes regimen due to adverse reactions. Case 3: Homeless patient who suffers from alcohol use disorder.
Sharder, 2015	Incorporating standardized colleague simulations in a clinical assessment course and evaluating the impact on	4-year doctor PS (n=171)	Active-learning strategies with lectures and laboratory sessions. Prior the standardised colleague simulation, students are required to view a 60-minutes recorded	attitude toward IPC (survey instrument), communication skills, clinic performance (OSLE)	pre-post survey	H	IPR and SHP	2 simulations were inpatient and outpatient setting where students used the SBAR communication tool to deliver recommendations to a standardized colleague (anticoagulation clinic who needed warfarin and atrial fibrillation).

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	interprofessional communication.		lecture, included SBAR demonstrations.					10 minutes of simulated rounds and 10 minutes debriefing.
Sharder, 2014	Multiple interprofessional education activities delivered longitudinally within a required clinical assessment course.	3-year PS (n=71), MS NS and PAS	Separate activities using various strategies and simulated patients. Two-part hybrid simulation that used a human-patient simulator mannequin (part 1) and standardised patient (part 2). In part 2, students teams developed a TOC from hospital discharge and communicated a plan to the patient.	Interdisciplinary Education Perception Scale (IEPS)	pre-post survey	H	IPR, HPS, SP	Part 1: students applied TeamSTEPPS to an attending physician in simulation using human-patient simulation mannequins. Part 2: students teams participated in a home-visit to a geriatric patient to interview the patient and conduct a medication assessment.
Sharder, 2013	Interprofessional teamwork skills as predictors of clinical outcomes in a simulated healthcare setting.	4-year MS (n=25), 3-year PS (n=76), 1-year PAS (n=19); (n=120)	IP teams to manage a "*patient*" in a health care simulation setting. Each team encounter was video recorded. Formative evaluation.	teamwork performance (TWS Teamwork Score based on TeamSTEPPS observation tool), IEPS	post activity assessment	H	IPR and HPS	IPR and and high-fidelity mannequin (patient). Team discussion based on a patient's medical record. Team cared for the simulated patient during a hospital rounds (to conduct a patient interview and physical examination, to order tests and medications), to observe vital signs. Teams were allotted 20 minutes to stabilise and treat the patient before debriefing.
Sharder, 2016	Using communication technology to enhance interprofessional education simulations.	4-year doctor PS (PharmD, n=163)	Applications-based capstone course. Students were randomly assigned to an IPE simulation with other health professions students using communication method such as telephone, e-mail, and videoconferencing.	ATHCTS, satisfaction (written reflection papers)	mixed method, pre-post survey	H	IPR and patient chart/case	3 simulations: (1) SBAR simulation included nursing and pharmacy students collaborating on a variety of patients scenarios; (2) MTM included medical and pharmacy students following a patients' discharge from the hospital; (3) TOC simulation included IP students' teams consisting of dietetics, nurse practitioner, occupational therapy, and pharmacy students.

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Sharder, 2011	A simulated interprofessional rounding experience in a clinical assessment course.	3-year PS (n=77), 3-4-year MS and 1-year medical assistant (n=37)	IP rounding experience using HPS. 22 IP teams were assigned 1 time slot (75 min) during 3 laboratory days. Students provided comprehensive medical care in an inpatient setting. An instructor explained objectives and HPS function 15 min orientation. After, teams reviewed the medical chart.	attitude toward IPC (survey instrument), performance (clinical outcomes checklist)	mixed method	H	IPR and HPS	Medication error/interaction scenarios: gastrointestinal bleeding related to warfarin or a patient with digoxin toxicity and related cardiac arrhythmias. Students conducted a patient interview and physical examination, ordered laboratory, diagnostic and medication. The IP team had 20 min to stabilise and treat the patient; then faculty debriefed students about simulation (20 min).
Sincak, 2017	Transformation of an online multidisciplinary course into a live interprofessional experience.	PS (n=212), osteopathic MS (n=190), dental medicine (n=130), PAS (n=83), physical therapy (n=55), occupational therapy (n=50), speech and language pathology (n=41), clinical psychology (n=22); (n=783)	Lectures to the entire class in a large auditorium. After, students were divided into 5 sessions of 160 students. Sections were subdivided into small teams of 5 for the SP encounter.	IP skills, team dynamic (SP checklist), students' perceptions on IP knowledge, skills, and attitude (IPE course survey questions)	post activity assessment	H	IPR and SP	The team had 25 minutes to interview the SP as a group. The SP also provided verbal feedback and completed a checklist about the team's interprofessional skills and group dynamics. After the interview, the small teams worked together to answer a series of questions that focused on the different roles of each profession played when taking care of the patient.
Singla, 2004	Interdisciplinary approach to teaching medication adherence to pharmacy and osteopathic medical students	3-year PS (n=92), 2-year osteopathic MS (n=115)	MS paired with PS. Pharmacy counselling interventions: A (script material, counselling, and placebo medication), B (group A intervention and a postcard mail reminder sent after 2 weeks), C (group A intervention and counselling session after 2 weeks of therapy), D (MS control group)	medication adherence skills (medication adherence assessment), IPE perceived attitude (attitudinal survey)	post activity assessment	H	IPR and RP	Needlestick exposure and HIV prophylaxis for a physician (played by a medical student). PS provided medication education on the placebo HIV prophylaxis regimen (Tic-Tac's as placebo). After 4 weeks, all groups met for a medication adherence session. Students worked together to identify barriers to medication adherence and possible solutions to these barriers.

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								After, post session discussion to review issues learned from the project.
Smith, 2019	Collaborating to care for a standardized patient in the outpatient setting: An interprofessional learning activity for dental and pharmacy students	2-year PS (n=226), 4-year dental students (n=68)	Online tool to discuss roles/responsibilities of their professions with their team members prior the IPLE. IP teams of 6 pharmacy students and 3 dental students.	JEFFSATIC, RR quiz	pre-post survey	H	IPR and SP	Teams interviewed a medically complex SP presenting with acute dental. Students collaboratively discussed therapeutic options and developed a treatment plan. The SP case was a patient with atrial fibrillation, diabetes, hypertension, and periodontal disease who presents with acute dental pain for an interprofessional visit at a free clinic.
Smith, 2020	Incorporating the pharmacists' patient care process into an interprofessional second year capstone.	2-year PS (n=230 in 2017, N=265 in 2018) and dental students (n=68 in 2017, N=90 in 2018)	IP teams (6 pharmacy, 2 dental students). PPCP to provide a framework for consistent delivery pharmacy services across continuum of care.	JeffSATIC and RR quiz	post activity assessment	H	IPR and SP	Pharmacy students collaborated with dental students to collect information from a SP, assess dental and pharmacy-related problems, and develop a plan (using PPCP) resolving the problems identified. Students documented a SOAP note and followed up with the SP after an emergency room visit.
Smithburger, 2013	Advancing interprofessional education through the use of high-fidelity human patient simulators.	PS, MS, NS, social work, and PAS (n=8)	1-day a week for a 4-week period, students work together to complete complex simulation scenarios in small IP teams.	CATS assessment	post activity assessment	H	IPR, HPS, RP	4 TOC simulations scenarios from emergency department (HTA crisis and bacteremia). Students assumed their roles and interacted with a faculty member who was playing the role of the patient's daughter. The debriefing session provided immediate feedback that allowed the students to reflect on their performance and apply new skills to the next simulation scenario.
Southall, 2021	Fostering undergraduate medicine, nursing, and pharmacy students' readiness for interprofessional learning using high-fidelity simulation.	senior undergraduate MS (n=9), NS (n=11), and PS (n=4), (n=24)	24 students in 7 IP teams. Each team participated in a high-fidelity interprofessional education module designed to teach the clinical management of an adult patient experiencing acute anaphylaxis.	RIPLS	pre-post survey	H	IPR, HPS, SP	30-min briefing session, 1-hour clinical simulation, 30-min debriefing session. Care of a patient experiencing acute anaphylaxis. Students had access to a chart containing the patient's admission history and medication administration records. As the simulation progressed,

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								the patient deteriorated and the team managed care including the administration of a bolus of epinephrine and cardiac monitoring.
Stehlik, 2018	Effect of hospital simulation tutorials on nursing and pharmacy student perception of interprofessional collaboration: Findings from a pilot study.	final year PS (n=68), and NS (n=58)	Scenario-based patient care in a simulated environment. The sessions were conducted over a 5-week period in weekly 2-hours sessions (admission of the patient to discharge).	IEPS score	pre-post survey	H	IPR and HPS	1) provide a medical chart review to a medium fidelity mannequin admission review and to hand over recommendations to the NS. 2) to provide discharge counselling to a patient.
Stewart, 2013	Student self-assessment of knowledge and application of legal concepts in a community pharmacy simulation	1-professional year PS (n=43)	Community pharmacy setting (counselling room and pharmacist workstations equipped with a computer to enable interaction with patients). Each pharmacist was assigned to one of the workstations along with a support staff, which included one pharmacy intern, two technicians and one technician candidate.	pre- and post-assessment on confidence and knowledge of legal requirements, faculty observation, post-simulation questionnaire	pre-post survey	SiP	RP	Simulation in a realistic community pharmacy environment in which practitioners are forced to multi-task. Students role-played as pharmacists, technicians, interns in a series of 10-minutes simulations. Students in the role of pharmacist were challenged with several violations that they would have recognised.
Suematsu, 2018	A Scottish and Japanese experience of patient-centered diabetic care: descriptive study of interprofessional education on live webinar.	5 and 6-year MS (n=3), 5-year PS from Japan (n=4), MS, PS (n=2), nutrition and occupational therapy student (from Scotland).	A case-based scenario that reflected diabetes care was developed in each country. The same virtual learning environment was used in both the countries: Blackboard Collaborate.	IEPS	pre-post survey	H	IPR, VE, SP	International IPE with SP in a live webinar. The case-based scenario reflected diabetes care in each country. SP interviewed in each country. Exchange care methods for the SP: each national team presented their diabetic care plan, and all students discussed the diabetic car plan online.

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Suematsu, 2021	A novel online interprofessional education with standardized family members in the COVID-19 period.	MS (n=44), NS (n=40) and PS (n=16)	Online IPE with asynchronous self-study using online videos and synchronous online discussion modalities that enable real-time participation. 3 sessions: clinical scenario focusing on an older population with diabetes and dementia, profession's role discussion and interview of SFM. 2 mixed professional groups.	SFM gave feedback from SFM, satisfaction (student's reflections)	post activity assessment	H	IPR and SP	Teams of medical, nursing and pharmacy students interviewed an SFM (because the patient setting in the scenario was people with dementia) whose mother-in-law was hospitalised for treating diabetes. SFM acted as family members who lived with the scenario of a patient with dementia. SFM were interviewed by students and gave to them feedback to promote reflection.
Tallentire, 2021	Exploring transformative learning for trainee pharmacists through interprofessional simulation: A constructivist interview study.	pre-registration pharmacists (n=15), MS	Exploration of the impact of an immersive IPE simulation scenario on transformative learning (Mezirow's phases)	semi-structured interview based on the transformative learning framework; transcripts analysed with Mezirow's phases of perspective transformation forming the initial coding template.	constuctivist study	H	IPR and HPS	PS paired with MS in 15-min scenario (a simulated environment consisted of a mannequin simulator). Post-scenario debriefs focused on teamworking. Participants were interviewed after simulation session, using a semi-structured interview schedule based on the transformative learning framework initial coding template.
Terriff, 2017	Training student pharmacists to administer emergency pediatric influenza vaccine: A comparison of traditional vs. just-in-time training.	3-professional year PS (n=50)	Briefing about mass vaccination. Traditional training (TT) and just in time training (JITT) comparison.	interest, comfort, and confidence in ability to administer a pediatric vaccination	pre-post survey	H	IPR, SP, manikin	During a fictional H7N9 influenza pandemic, PS were needed to provide influenza immunisation at a mass vaccination clinic. They provided vaccination to a child manikin who may require a different dose and injection site.
Thakur, 2020	Pharmacy studentopioid consultations with standardized limited english proficiency patients.	3-year PS (n=23)	5 min to review patient profile/drug information prior consultation. No instructions about opioid topics. Consultations video recorded. Coding protocol analysis.	verbal and non-verbal communication skills (structured coding tool)	observational and descriptive study	SiP	SP	SP who spoke 30% English and 70% non-English language with a prescription for oxycodone for severe pain.
Thomas, 2021	End of life simulation to improve interprofessional competencies: A mixed methods study.	PS, physical therapy, NS (n=320)	2-hour low-fidelity, RP simulation focused on end-of-life (EOL). Students were assigned to one of 4, replicated, IP simulations across two 16-weeks terms.	perceptions of IPE and skills (Interprofessional Socialisation and Value Scale)	mixed method, pre-post survey	H	LFM, RP and IPR	5-8 members IP teams (2 students of each team played the role of a patient with a terminal disease). "*Palliative care team meeting*" for 30 minutes, patient's goals listening and establishing the team care plan. After the simulation, IP faculty med a 20-min class debrief.

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Tilley, 2021	Real-time, simulation-enhanced interprofessional education in the care of older adults with multiple chronic comorbidities: a utilization-focused evaluation.	advanced practice NS (NP) and Doctor of PS, n=96	2 HPS-enhanced IPE (Sim-IPE) implemented to assess IP competencies in simulations involving patients with chronic cardiovascular disease.	ICCAS, satisfaction	post activity assessment (impact survey)	H	IPR and HPS	Students conducted a patient health history and collected pertinent medication information relevant to the chief complaint (20 minutes) and developed a comprehensive treatment plan (30 minutes). IP teams presented their diagnosis, proposed treatment plan, and educated the SP on his/her medications. PEARLS debriefing.
Tremblay, 2018	Simulation-based crisis resource management in pharmacy education.	undergraduate PS (70%) and pharmacy technician students (30%), n=202	Scenarios of various complexity level targeting different CRM principles. 2 simulation technicians orchestrate the technical aspects of the scenarios (10-15 minutes). A pharmacist who has received training on debriefing techniques and CRM principles accompanies each group.	satisfaction and perceptions	post activity assessment	H	IPR and patient chart/case	Teams of 6-9 students, 3 scenarios required the participation of 4 students (other students observed the simulation). Each participant contributed to the 30-min debriefing per case (Debriefing with Good Judgement).
Tremblay, 2017	The simulated clinical environment: Cognitive and emotional impact among undergraduates.	4-year (PharmD) PS (n=143)	SCI and SP in a crossover design. After each debriefing period, participants completed a questionnaire (cognitive load, self-perceived learning, emotions associated with the simulation and an appreciation of both SCI and SP. Focus groups to explore their perception of learning in simulation.	cognitive load, self-perceived learning, emotions associated with the simulation and an appreciation of both SCI and SP	mixed method	SiP	SP or SCI	Participants experienced both SP and SCI in a crossover sequence. Participants played different roles in rotation during simulation sessions (pharmacist, SiP, and observer). The main difference between SP and SCI is the interactions with the physical environment (telephone and medication were not available with SP).
Tremblay, 2019	Simulation-based education for novices: complex learning tasks promote reflective practice.	2-year PS (n=167)	Students were randomly assigned to groups of 3-4 students to undertake one simple and one complex learning task in SCI consecutively. Semi-structured interviews were conducted.	cognitive load and task performance	mixed method	H	SCI and RP	The simulation started with a short briefing exposing overall objectives. 2 consecutive SCI learning tasks: one simple and one more complex (10-15 min per case) followed by the respective debriefing (15-25 min). Other participants observed student's simulations and listed actions executed by the pharmacist using a checklist developed for each task.

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Ulutaş Deniz, 2018	Feedback for a simulation practice on communication skills in pharmacy education: A pilot study	2-year pharmacy technician students (n=22) and 3-year PS (n=4)	6 scenarios were used and recorded. 4 SP were trained to portrayed different patients.	written feedbacks for a thematic analysis	post activity assessment	SiP	SP	Scenarios were randomly assigned to the students (antibiotic use, drug abuse, preparation of magisterial drug, tobacco use, patient privacy). Each student was asked to interview with the patient for 5 minutes. Performances were recorded. At the end of the debriefing sessions, students were asked to provide written feedback.
Victor-Chmil, 2016	An interprofessional simulation for child abuse reporting	NS (n=55), 3-year Doctor of PS (n=74), (n=129)	A Child Abuse Reporting Interprofessional Simulation-Based Experience (CAR-IBSE) was an online training for undergraduate pharmacy and NS. Scenarios exposed students to a realistic yet safe situation in which child abuse reporting is mandatory.	simulation evaluation, perceptions (online post simulation survey, Likert Scale)	post activity assessment	H	IPR, LFM, SP	CAR-IBSE included planning, performing and debriefing stages (20 minutes each). 2 medication diversion scenarios: (1) home environment with a narcotic medication that was being diverted from the client (grandmother played by a SP) was being taken by the client's daughter (not present during the scenario), (2) and walk-in clinic setting in which a new single mother who was breastfeeding her 7-week infant (LFM).
Vyas, 2012	Patient simulation to demonstrate students' competency in core domain abilities prior to beginning advanced pharmacy practice experiences.	PS (n=28)	60h of IPPE to provide clinical experiences. Assessment of core domain abilities in APPE. Control group.	Perception of Preparedness to Perform (PREP) survey), knowledge, APPE core domain abilities	pre-post survey	SiP	SP	Students were divided into 10 teams of 2 to 4 students each. Prior simulation, students were given treatment guidelines or readings to prepare the scenario. Simulation experience was divided into 3 sections of 30 minutes (case preparation, patient encounter, debrief session).
Vyas, 2018	Training students to address vaccinehesitancy and/or refusal.	PS (n=203)	Before the learning unit, students complete an Immunisation Training Certification programme. 2 SP encounters performed 1 week apart. Faculty members developed the scenarios and scripts for the SP based on vaccines myths. A conflict escalation was put into each script.	knowledge, confidence (attitude survey prior and post simulation), communication skills, social, emotional competence (SP grading rubric), satisfaction (post survey)	pre-post survey	SiP	SP	The scenario was vague as students were expected to evaluate the patient by asking questions, providing counselling, mediating any conflict, and maintaining the patient-provider relationship despite possible disagreements. A conflict scenario would be triggered if the SP felt the pharmacy student was not listening, not being properly empathetic or exhibiting a condescending or dismissive attitude.

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Vyas, 2012	An interprofessional course using human patient simulation to teach patient safety and teamwork skills.	PS (n=23), MS, NS, health administratio n (n=210)	Groups of 10-12 health professions students that included 1-2 pharmacy students. 5 patients' cases were developed using a combination of SP, HFS and hospital staff members, including resident physicians.	pre-post simulation survey of knowledge, skills, and attitudes	pre-post survey	hybrid	IPR and RP	5 semi-urgent situations that required interprofessional collaboration (pregnant patient with teratogenic medication, baby with a head trauma, asthmatic patient, wrist pain and allergy to morphine, chest pain). 20 minutes for each scenario. Debriefing session following the simulation.
Wagner, 2021	Activities to enhance introductory pharmacy practice experiences.	3-year PS (n=36)	Instruction on the approach to clinical evaluation of a patient: a live real-time internal medicine (IM) or infectious disease (ID) service, and a group discussion related to the patient case; IP (rounding experience) during combined IM and ID.	patient communication, rounding interactions (standardised rubrics), knowledge, confidence (examination questions)	pre-post survey	SiP	SP	Simulated electronic health record prior the simulated rounding activity. Students completed a medication reconciliation and allergy assessment with the SP. Students presented their patent's assessment physician, including diagnoses and pharmacotherapy recommendations. The physician examined and evaluated the SP. Following completion of rounds, the students provided discharge counselling to the SP.
Wang, 2020	Use of profession-role exchange in an interprofessional student team-based community health service-learning experience	20 MS, 20 PS and 20 NS (n=60)	Students randomly divided into the profession-role exchange intervention group and the control group. Each group was composed of 10 students of each profession. Control group did not participate the profession-role exchange experiences.	attitudes toward IP clinical collaboration, role clarification (Roles and Responsibilities subscale of RIPLS)	pre-post survey	H	IPR and real patient	Teams (medical, pharmacy and NS) conducted household visits for the community residents suffering from diabetes, to educate them about diabetes self-management and address their healthcare needs. In the intervention group, the profession-role exchange experiences were a role-playing education game, in which healthcare students from different professions play one another's role in an environment like the clinical environment. Students in the intervention group were required to perform the responsibilities of the students from other professions.

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Wen, 2019	An interprofessional team simulation exercise about a complex geriatric patient.	MS (n=27), NS (n=49), PS (n=18), SWS (n=18)	Video of an IP team meeting and review of the case before IPE. Different disciplines were divided into groups representing teams. Pharmacy students attended the meeting remotely via videoconference from a neighboring island. 40-min debriefing after the simulation activity.	satisfaction (qualitative data), core competency domains (pre-post simulation questionnaire)	mixed method, pre-post survey	H	IPR and SP	The scenario was a simulation of a hospital discharge for an older adult with complex problems. Students collaborated to develop a discharge plan, followed by a simulated family meeting with a theater student. The scenario required the input and collaboration of all disciplines and touched many competencies.
Westberg, 2006	An interprofessional activity using standardized patients.	2-year PS (n=48), 2-year MS and 4-year NS	ISPE with social, environmental, and mental health components. Room with a one-way mirror for patient care events. After 1 hour SP scenarios, teams collaborate to develop a patient care plan. Pre- and post- experience surveys were conducted.	one-on-one feedback on the demonstrated skills/performance of the student by the faculty member	pre-post survey	H	IPR and SP	ISPE in which each student has time to interview the patient according to his/her own skills and patient care perspective. After assessment, the team collaborates to develop a patient care plan.
Willson, 2020	Training student pharmacists in suicide awareness and prevention.	PS (n=171)	Suicide prevention training programme. SP prescription counselling session was conducted 2 weeks after training session. Videos of the counselling sessions were reviewed to determine whether pharmacy students assessed the patient for suicide risks.	knowledge in suicide prevention (questions adapted from Suicide Prevention for Pharmacy Professionals training and Gatekeeper Training for Suicide Prevention Programme), ability to apply skills (summative assessment using a SP), reflections	mixed method, pre-post survey	SiP	RP	Students practiced incorporating Safer Homes messaging into patient prescription counselling and applied the LEARN framework to patient case scenarios using RP and group discussions.
Wong, 2021	From a distance: Nursing and pharmacy students use teamwork and telehealth technology to provide interprofessional care in a simulation with telepresence robots	2-year PS (n=84) and 2-year NS (n=37)	Students participated in a pilot telepresence robot simulation course. Multiple small group sessions were conducted to ensure students had an active role in one of the 2 scenarios. The course design included structured pre-work, icebreaker, patient encounter with virtual collaboration via telepresence robot, and debriefing.	ICCAS, students' feedback (qualitative assessment)	mixed method, post activity assessment	H	IPR and HPS	Pharmacy students and NS collaborated as an IP team via a telepresence robot, video teleconferencing, and telephone. During the simulation, nursing student (Campus A) collaborated with pharmacy students (Campus B) via telepresence robot to manage the care of a patient (high-fidelity manikin). Facilitators led debriefing sessions after each scenario using video teleconferencing cameras for video and telephone to connect Campus A and B.

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Abbreviations: ATN-addiction training for nurses ATN; APPE-advanced pharmacy practice experience; ASES-aging simulation experience survey; AOI-area of improvement; AFA-asthma first aid; ATHCTS-attitude toward healthcare teams scale; ATTS-attitudes towards suicide scale; CATS-communication and teamwork skills; CSAT-center of abuse treatment; CAR-IBSE- child abuse reporting interprofessional simulation-based experience; CSAF-communication skills assessment form; DML-debriefing for meaningful learning; EXCELL-excellence in Cultural Experiential Learning and Leadership; FOC-frequency of care; HFS-high fidelity simulation; HPS-human patient simulator; IEPS-Interdisciplinary Education Perception Scale; IP-interprofessional; IPAS-Interprofessional Attitudes Scale; IPC-interprofessional collaboration; ICCAS-interprofessional collaborative competency attainment survey; IPEC-interprofessional education collaborative; IPE-interprofessional education; IPR-interprofessional role-play; ISPE-interprofessional standardized patient case; ISPE-interprofessional standardised patient experience; IPPE-introductory pharmacy practiced experience; IPL-interprofessional learning; IPLE-interprofessional learning experience; JeffSATIC-Jefferson scale of attitude toward interprofessional collaboration; JSE-HPS-Jefferson scale of empathy-health professions scale; JSPE-Jefferson scale of physician empathy; KCES-Kiersma-Chen empathy scale; LEARN-look for warning signs, empathise and listen, ask about suicide, remove the danger, next steps; LFM-low-fidelity manikin; MC-medication counselling; MHFA-mental health first aid; MRSA-methicillin resistant S. aureus; MS-medical student; MTM-Medication Therapy Management; NS-nursing students; OSCE-objective structured clinical examination; OSLE-objective structured learning experience; PAS-physical assessment student; PCA-patient case, PC-patient communication, PEARLS- Promoting Excellence and Reflective Learning in Simulation; PPCP-pharmacist's patient care process; PGx-pharmacogenomics; PS-pharmacy student; RIPE-reflective interprofessional education; SATP2C-scale of attitude toward physician-pharmacist collaboration; SBAR-situation, background, assessment, recommendation; SBIRT- screening, brief intervention, referral to treatment; SiP-simulated patient; SMaRT-SBIRT medical and residency training; SCI-simulated clinical immersion; SLMs-simulated learning modules; SBE-simulation based education; SBL-simulation-based learning; SDOH-social determinant of health; SIMs-Social Interaction Maps; SWS-social work student; SFM-standardized family members; SHP-standardized health care provider; SP-standardised patient, SPICE(-R)-student perceptions of physician-pharmacist interprofessional clinical education(-revised instrument); SOAP-subjective, objective, assessment, plan; TeamSTEPPS-team strategies and tools to enhance performance and patient safety; TBL-team-based learning; RIPLS-readiness for interprofessional learning scale; TL-transformative learning; TOC-transition of care; TSS-team skills scale; VE-virtual environment.