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REVIEW

Simulation-Based Education Implementation in Pharmacy Curriculum: A Review of the Current Status

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Abstract: Simulation-based education (SBE) is a fundamental teaching method that complements traditional teaching modalities. SBE has improved students' knowledge, understanding, and numerous essential skills within undergraduate pharmacy education, similar to traditional teaching methods. However, SBE has become crucial for developing students' teamwork, decision-making, and communication skills. Even though the Accreditation Council for Pharmacy Education (ACPE) has acknowledged the benefit of SBE in interprofessional education (IPE) and the introductory pharmacy practice experience (IPPE). This article provides evidence that SBE can be effective beyond that. This narrative review is focused on the literature related to SBE modalities and the assessment methods of student learning outcomes in the undergraduate pharmacy curriculum. The review illustrates that SBE is an effective teaching method that could be utilized within the pharmacy curriculum. The review also could help pharmacy educators decide on the best modality and placement of integrating patient simulation within the pharmacy curriculum. Combining multiple simulation techniques may be the best way to achieve the desired student learning outcomes.

Keywords: patient simulation, pharmacy, education, simulation-based education, pharmacy curriculum

Background

Pharmacy education has evolved with the progression of the pharmacist role.[1] The emphasis on patient-centered care has become the core of the pharmacy curriculum.[1] As clinical pharmacy continues to develop, pharmacy students are expected to play a vital role in direct patient care.[2] Therefore, several innovative teaching approaches have been implemented to enhance students' pharmaceutical knowledge and clinical skills.[2] There is a massive shift in pharmacy education from traditional teaching methods into active learning methods.[3] Active learning includes class discussions, project-based learning, problem-based learning, case studies, and simulation.[4]

Simulation-based education (SBE) is one of the teaching strategies that has been widely used in health profession education. Simulation-based learning is defined as "An array of structured activities representing actual or potential situations in education and practice,,.[5,6] These activities allow participants to develop or enhance their knowledge, skills, and attitudes or analyze and respond to realistic situations in a simulated environment.[7] Patient simulation has been shown to be an effective teaching and assessment approach that replicates a patient within a clinical scenario in an educational setting.[8] It offers a controlled teaching environment for learners that is equivalent to realistic experiences without compromising patients' safety.[9] Simulation application in health education is never limited to utilizing technologies. Instead, it is a technique used to

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replicate the real experience.[10,11] Therefore, simulation techniques include all of the following: mannequins, part-task trainers, role-play (RP), standardized patients (SP), computer-based systems (CBS), virtual reality (VR), and gaming.[11,12]

Medical patient simulations originated in ancient times but advanced during the 1900s.[13] Patient simulation was first presented in medical learning and then expanded to other health disciplines.[13] Modern simulation was initially started using patient actors to teach medical students prior to the development of high-fidelity simulation.[14] Medical and nursing schools mostly use manikins to help develop students' clinical and communication skills.[6] The first documented human patient simulation utilization in the pharmacy curriculum was at the University of Pittsburgh in 2006.[15]

In 2007, the Accreditation Council for Pharmacy Education (ACPE) revised its accreditation standards to recommend using a hybrid of didactic, simulation, and experiential methods in teaching the pharmacy curriculum.[16] However, they encouraged simulation specifically in interprofessional education (IPE) and introductory pharmacy practice experience (IPPE).[16] The ACPE limited the duration of simulated practice experience to no more than 20% of the total IPPE required hours.[16] It also presented the types of simulation that pharmacy schools need to consider for IPPE and IPE, including virtual reality software, low- or high-fidelity manikins, role play, virtual environments, and standardized or virtual patients.[17] Nonetheless, over the past decade, several pharmacy schools have implemented various SBE methodologies in advanced pharmacy practice experiences (APPE) courses and others in the pharmacy curriculum.[18–22] During the COVID-19 pandemic, SBE emerged as an effective alternative teaching strategy due to its flexibility and the ability to train large numbers of students at various levels while maintaining students' and patients' safety.[23–25] Nonetheless, SBE should not always be perceived as an alternative teaching strategy; instead, it is a fundamental teaching method that complements traditional teaching.

This article presents a review of the utilization of patient simulation, including the type of simulation utilized, location in the curriculum, topics, intended learning outcomes, and assessment methods. In addition, we reviewed the needed resources, opportunities,challenges, and the published articles in which patient simulations were performed. We also assessed the student learning outcomes within undergraduate pharmacy education between 2007 and May 2021. After the literature review, six experts in the field of pharmacy and simulation education gathered to summarize the current literature and provide recommendations about the best implementation of SBE technologies within the pharmacy curriculum based on the literature and their expertise.

Patients Simulation Implemented in Pharmacy Curriculum

Standardized Patients (SPs)

Description

SPs refer to well-trained specialists who portray the case of a real-life patient in a consistent and replicable performance to different students and provide responses that vary based on the students' performance.[7,26] The SP portrayal should involve all aspects of the presented patient case, including but not limited to medical history, signs and symptoms, physical findings, emotional and personal characteristics, and body language. SPs may also assess students and provide feedback on their performance.[7,26]

Implementation in the Pharmacy Curriculum

Utilizing SPs in pharmacy education has been widely reported in the literature as an effective complementary teaching modality to advance clinical pharmacy education.[27–33] Many learning outcomes can be achieved using this modality, ranging from advancing patient interviewing and history-taking skills to the optimal implementation and monitoring of a pharmacotherapy plan.[34] The SP modality can be utilized in various courses throughout the pharmacy curriculum and at various student levels, especially when the learning objectives are aimed to boost students' confidence and develop the students' professional skills, such as patient interviews and communication skills, clinical knowledge, and practice, cultural and emotional competence, and team-based skills. Courses that focus on pharmacotherapy, immunization, medication therapy management, and psychiatry are some examples where SP could be utilized. In addition, the standardization in the SP modality makes it an excellent modality to use in high-stake assessments where the responses to students are standardized among all participating students.

Pharmacy schools could recruit paid or volunteer actors to play the role of the SP, train their faculty members to play this role, or utilize student peers. Each strategy carries some advantages and disadvantages that should be weighed when choosing between them for specific learning experiences. Paid or volunteer actors are mostly flexible and available when needed and unfamiliar with students; however, they require more training time and may be costly on some occasions. Faculty members are a great resource to play this role, as they need less training and provide high-quality assessments and feedback; however, their availability is not guaranteed all the time.

Using simulation through SPs has been proven to improve students' knowledge, perception,[30–32] cultural skills, and communication skills.[27,28] Tailoring the SP experience to the student's specific areas of improvement in communication skills showed better performance and satisfaction when compared to a non-tailored standardized patient group.[35] Although simulation through SPs did improve the attainment of various learning outcomes, it does hold some limitations, such as high cost, the need for well-structured training, and the scarcity of validated and reliable assessment tools, as shown in Table 1. The process of recruiting, training, and preparing SPs is expensive, despite the literature showing its cost-effectiveness.[26,28,36]

Recommendation

The SP modality should be incorporated throughout the pharmacy curriculum in courses that involve higher-level skills with the utilization of faculty members or student peers to perform the SP role, given the high cost associated with recruiting outside performers. Assessments of student encounters with SPs can be performed through immediate feedback, rubrics, pre and post surveys, SOAP notes, and quizzes.

Role-Play (RP)

Description

Role-play (RP) is a well-known learning practice in which students perform various roles in a simulation of real-life situations.[37] During role-play, a peer student (co-learner) may impersonate a patient, caregiver, or health care provider within a clinical scenario.[38] If the role is played with an individual who is trained to act as a patient or a family member, this can fall under an SP, as discussed earlier in this review.[38] This allows students to practice realistic experiences while remaining in a controlled environment.

Implementation in the Pharmacy Curriculum

Many pharmacy programs have reported successfully using RP to teach a wide range of skills in several core or elective courses and laboratories.[9,39–48] Moreover, it can be used in all levels of the pharmacy curriculum, including APPE.[9,39–48] Despite the variations in the application method, several researchers have reported positive outcomes regarding students' communication skills,[9,42–48] motivational interviewing skills[47,48] medication reconciliation,[46] patient presentation skills,[45] patient and self-care,[43] and patient counseling.[41] Furthermore, students have reported increased confidence,[41] knowledge,[44] and engagement.[48] All of these outcomes have been assessed using various methods, such as rubrics, checklists, immediate feedback, and exams.[41,43–46,48]

RP is considered one of the simplest simulation methods due to the ease of its application. It does not require many resources other than sufficient space, human resources, and sometimes money. However, training the faculty, students, or paid actors to play the role needed is time consuming. Furthermore, finding enough instructors is sometimes challenging when there are many students.[45] Language barriers have also been reported to be a drawback of this method, as it can result in a lack of understanding and fear of expression.[46] More details are presented about the advantages and disadvantages in Table 1.

Recommendation

Simulation using RP should be implemented at all levels within the pharmacy curriculum, especially when teaching and practicing patient-care skills. Most RP simulations can be assessed using rubrics and immediate feedback.

Table 1 Summary of the Features of Various Types of Patient Simulation Utilized in the Pharmacy Curriculum

Simulation Type	Locate in Curriculum	Example of Topics	Achieved Learning Outcome	Assessment Method	Essential Resources	Advantages	Disadvantages
Roleplay	• All Levels	• Medication reconciliation • Motivational interviewing • Patient-Counseling • Prevention of medication errors • Mock rounds • Emergencies in the Ambulatory Pharmacy	• Communication Skills • Clinical skills • Patient-care skills • Interviewing skills • Counseling skills	• Rubrics • Checklists • Immediate feedback • Quizzes/ Exams	• Classrooms • Facilitators	• Limited resources needed (manpower) • Low cost • Application of patient care skills	• Require small number of students to work best • Fear of expressing thoughts and opinions • Require training to some extent
Standardized patients	• High levels • Pharmacotherapy courses and laboratories	• Communication skills training • Psychiatry • Ambulatory care (Anticoagulation) • Immunization	• Cultural competency skills • Communication skills • Knowledge • Attitude • Clinical skills	• Pre and post survey • CSAF • Assessment rubric • Quizzes • SOAP notes	• Simulation laboratory • Standardized patient participants • Patient case scenarios	• Represents real-life scenarios • Cost effective -student peers are utilized as standardized patients • Safe and control learning environment • Strengthening of communication skills and patient history-taking • Recorded sessions provide great feedback for improvement	• Costly - hiring external trained individuals • Requires training of trained individuals • Need for well-structured case scenarios • Needs more validated and reliable assessment methods

Mannequin based simulation	High levels • Pharmacotherapy courses and laboratories	• Acute care management: (arrhythmia, heart failure, hypertensive crisis, acute decompensated heart failure, acute coronary syndrome Cardiovascular electrophysiology • DKA, thyroid storm) • Blood pressure assessment • Immunization certification • Physiology	• Knowledge (PTT, HFM) • Communication Skills (HFM) • Critical thinking skills (HFM) • Psychomotor (PTT, HFM) • Clinical skills (PTT, HFM) • PBL skills (HFM) • Team working skills (HFM) • Cognitive skills(HFM)	• Pre and post examinations • Objective rubrics • Debriefing	• Theaters • Mannequin • Space • Software Programs • Debriefing rooms • Trained staff	• Low maintance requirments (PTT) • Offers standardized realistic teaching. (HFM) • Clinical skills practice (PTT, HFM) • Safe and immersive learning environment (PTT, HFM) • Allow application of knowledge (PTT, HFM) • Exposure to critical and rare cases (PTT, HFM) • Strengthening of problem solving and critical thinking skills (HFM)	• High Cost for acquisition and maintenance (HFM) • Limited access (HFM) • Requires special training for both faculty and students (HFM) • Need of logistical arrangements. (HFM) • Requires resources; mannequin, facility, space, and software (HFM) • Students perceive it stressful (HFM) • unresponsive, unemotional mannequins affect students empathy (PTT, HFM)
Computer -based Simulation • DecisionSim™ • Virtual Community Placement (VCP) Virtual • PharmacySim	High levels • Pharmacotherapy courses and laboratories, APPE, IPPE	• Community Pharmacy Practice • Comprehensive disease management Courses (cardiac arrest cases, oncology cases) • Pharmacokinetics/ Pharmacodynamic	• PBL Skills • Knowledge • Critical thinking skills • Clinical skills • Team working skills • Decision making • Problem solving • Communication skills	• Pre and post examinations • Survey instruments • Performance tests	• Computer labs • Hard and soft ware • Facilitators • Internet connection	• Cost saving • Engaging • Less labor-intensive • Flexible • Adaptable • Accessible • Immediate feedback • High level of interactivity • Cater to large number of students simultaneously	• Require technology support • Unreliable internet connection • Require maintenance of hard and soft ware • Require staff and students training • Costly if designing a simulation program from scratch
Serious Gaming • Escape Room (X9) • MedSMART Medication History- taking game	All levels • Skill-based lab (APPE readiness) and elective courses	• Toxicology • Pharmacotherapy (Diabetes, heart failure, Oncology) • Opioid misuse and safety • Non-Sterile compounding • Medication history-taking • Geriatrics	• Knowledge • Cognitive skills • Communication skills • Medication history-taking skills • Problem-solving skills • Critical thinking skills • Decision-making skills • Interacting with peers • teamwork • Leadership skills	• Pre and post examination assessment • Delayed post-game examination assessment • Readiness assessment test • SWOC analysis • Thematic analysis (reflection, group discussion guide, feedback) • Rubrics	• Classroom • Facilitators • Game tools and objects (Deck of educational cards, dice) • Projector • Video game program • Mobile device/ipad • Evaluation forms	• Transferable activity • Adaptability • Interprofessional opportunity • Satisfying and engaging • Stimulates creativity • Highly perceived SG • Confidence booster • Cost efficient • Easily incorporated in courses	• Fluctuating cost, ranging from 0$ to 400$ • Time consuming for faculty members conducting them, ranging from 20–40 hours • Require significant amount of manpower and space • Students with no previous experience of the game can find it difficult to navigate

Abbreviations: APPE, Advanced Pharmacy Practice Experiences; IPPE, Introductory Pharmacy Practice Experience; Low levels, first year of pharmacy school; Advanced levels, second year of pharmacy school or above; DKA, Diabetic ketoacidosis; PBL, Problem based learning; OSCE, Objective Structured Clinical Evaluation; CSAF, Communication Skills Assessment Form; SOAP, Subjective, Objective, Assessment, Plan; SWOC, Strengths, Weaknesses, Opportunities, and Challenges; SG, serious gaming.

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Manikin-Based Simulation (MBS)

Description

Manikins are classified according to their levels of physiologic function; the simulation replicates real life with low-fidelity, medium-fidelity, and high-fidelity mannequins.[7] Low fidelity refers to part-task trainers, static mannequins, or dolls.[49] Medium fidelity utilizes manikins or task trainers with limited physiological functions.[31] In contrast, high-fidelity mannequin simulators present a full-body mannequin that physiologically reacts like a "real" patient and has a voice based on computer programs.[31] Manikin-based simulations (MBSs) combined with other simulation types, such as SPs or RP, have been widely implemented in the pharmacy curriculum, especially in experiential training.[9,21,50]

Implementations in the Pharmacy Curriculum

Several pharmacy schools have utilized and assessed MBSs in pharmacy curriculum in core and elective pharmacotherapy courses,[18,31] pharmacotherapy practice laboratories,[26] and certification programs,[33] in addition to mannequin-based simulator integration in IPPE and APPE.[21,33] Overall, MBSs have more frequently been used for advanced level pharmacy students.[26,32,34] This is expected, as pharmacotherapy courses and parallel laboratories are usually delivered at high pharmacy student levels. Moreover, many elective and certificate programs were built on preexisting knowledge from fundamental courses offered early in the pharmacy curriculum.

Nonetheless, most pharmacy schools have implemented MBSs in managing acutely ill patients with arrhythmia, decompensated heart failure, hypertensive crisis, or coronary syndrome.[15,18,51] Only a few schools have used MBSs in ambulatory care or non-acute settings,[33,52] as shown in Table 1. Evidence has shown that implementing SBE using MBSs within the pharmacy curriculum has improved students' learning, critical thinking, problem-solving, communication, clinical skills,[18,26,33,34] and information retention.[21,32] The use of mannequins in SBE can expose the students to high-risk and rare medical diseases. The benefit of MBSs has been evaluated through exams and OSCEs.[15,18,53–55] MBS has been shown to significantly benefit pharmacy learners through connecting didactic coursework with actual experiences.[26,33,34] However, it still has several drawbacks, as presented in Table 1. Some major disadvantages include the extensive resources needed to apply such a simulation, including equipment, facilities, and advanced technical skills.[18,52,56] Moreover, the costs for resource acquisition, implementation, maintenance, and training are high.[53] MBS also may require many facilitators for a small group of learners,[53,56] is labor-intensive and requires extensive logistics and time for arrangement and preparation.[19,55,57]

Recommendation

- MBS should be implemented as an active teaching method for high-level students within the pharmacy curriculum for acute and primary care situations, and formative or summative assessment methods should be used.

Computer-Based Simulation (CBS)

Description

Advancements in technology have allowed pharmacy students to experience patient care without stepping into an actual pharmacy. Computer-based simulation (CBS) software and applications bring the experience into the classroom setting in an innovative and engaging manner.[57,58] Virtual reality (VR), also known as augmented reality, is a type of CBS where simulation software is utilized to aid pharmacy students in learning specialized tasks or situations.[59,60] It combines multimedia elements, such as audio, graphics, and animation, with textual information. VR simulation software mimics reality by modeling a clinical setting, outpatient/community pharmacy, or how to deal with a virtual patient.[6,61] Some examples of these simulation programs include Mydispense®, Pharmacy Simulator,[36,49] DecisionSim™, and virtual patients software.[54,55]

Implementation in the Pharmacy Curriculum

Many pharmacy colleges have applied VR simulation as a teaching method in various courses at different points of the pharmacy curriculum.[62–64] For instance, software programs such as Cyber Patient and Virtual Organ Bath have been used in pharmacokinetics and pharmacodynamics lectures.[62] This has led to higher learning and understanding when

compared to traditional lecture-based teaching.[62] MyDispense, developed at Monash University, Australia, is another popular software program that simulates an authentic community pharmacy.[63] MyDispense software has been integrated into IPPE and therapeutic courses.[64,65] The use of such software has had positive effects on exam scores.[64] However, a randomized, parallel-group design was conducted at a private college of pharmacy to compare problem-based learning (PBL) and virtual simulated patient cases and found that the post-experience PBL scores were higher.[66] This suggests that a varied approach to simulated patient cases in education may lead to greater learning outcomes.[66]

CBS offers many advantages in providing an adaptable, flexible, and accessible virtual pharmacy environment that maximizes the realism of actual patient-centered care at a low level of risk and relatively low cost compared to SP or manikins simulation.[57,58] It allows a high level of interactivity[57,67] and immediate feedback[49,57,58] and simultaneously caters to a large number of students.[58,61] Virtual patients' demographic characteristics and comorbidities can be easily changed in virtual scenarios to follow the curricula and achieve the intended learning outcomes, as presented in Table 1.[68] These learning outcomes include critical thinking, decision making, problem solving, communication skills, and information retention.[55,68] However, CBS still has its limitations related to the management of hardware and software, technical support, and unreliable internet connections, as presented in Table 1.

Generally, published reports exploring the application of CBS in the pharmacy school curriculum are limited. However, the previous applications have been mainly used for higher-level students in comprehensive courses, therapeutic courses, and preparation before IPPE. Moreover, further studies are needed to assess the achievement of intended learning outcomes and integration into the curriculum.

Recommendation

CBS should be implemented in combination with other simulation techniques at all levels of the pharmacy curriculum along with pre and post-examinations and performance tests to help assess whether the desired learning outcomes have been achieved.

Serious Gaming (SG)

Description

Serious gaming (SG) is a relatively new concept of teaching that incorporates simulation.[69] Even though SG itself is not a simulation modality, it encompasses simulation activities using play for problem solving instead of entertainment.[69] SG is designed for educational purposes rather than entertainment.[7] Within SG, real-world events or processes are simulated to solve problems.[7]

Implementation in Pharmacy Curriculum

The 2013–2014 Academic Affairs Committee of the American Association of Colleges of Pharmacy (AACP) recommended that SG be incorporated in pharmacy education.[70] Faculty and student innovation in designing and implementing SG can be used to prepare future health care leaders.[70] As a result, the use of SG in pharmacy education has gained popularity in the past decade, particularly in in-patient simulations. Although most published research on gamification has aimed to assess student perceptions of these games, some have also assessed pre-and post-knowledge gain. For instance, the use of escape rooms resulted in a significant difference in knowledge and cognitive learning outcomes.[71–81] Escape rooms are a popular simulated gamification tool utilized in the enhancement of pharmacy student learning outcomes.[74,81] The rooms are used for groups or individuals who work to resolve several clues to "escape" simulated scenarios in a designated time frame.[76]

Most researchers have described the utilization of simulated SG in the early years of pharmacy education, including the first, second, and third years. Simulated gamification can be implemented to help students examine various pharmacotherapy topics, including diabetes,[75,81] heart failure,[80] cancer,[78] toxicology,[73] non-sterile compounding,[74] geriatrics,[82] and others, such as disaster preparedness,[79] skill-based leadership,[76] opioid medication safety, medication history taking,[71] and APPE readiness.[77] Moreover, in past experiences, SG has proven to be impactful on students' knowledge and learning experiences.[73,74]

The apparent advantage of using SG is that students find it fun and engaging,[73–83] but these games also aim to build leadership, communication, problem-solving, and teamwork skills.[76] More details about the advantages, disadvantages, and essential resources for SG are presented in Table 1. Several studies have highlighted the great potential of IPE using SG 67,68,72,74,76, and the remarkable adaptability of the game to use for any subject and in classes of any size.[71,75,77,81] However, these published studies lacked validity and reliability of the methods used since they mainly were pilot studies.[71–81] One of the drawbacks with SG was the fluctuating costs reported in these studies, which ranged from $0 to $400, and its dependence on available resources and funds.[74,75,77,79]

Although positive outcomes have been reported, SG is still considered a relatively new concept to pharmacy educators and may require further studies to assess its use in simulation practice in the pharmacy curriculum.[83] SG helps build extracurricular skills such as leadership, communication, problem-solving, and teamwork.

Recommendation

SG should be incorporated into various courses and within different levels of pharmacy education. The use of pre- and post-knowledge assessments is mandated to test the validity of the SG implemented.

Hybrid Simulation

Description

This describes the use of two or more simulation modalities in the same scenario to enhance the reality of the experience.[7] Primarily, this involves the use of MBS with supporting techniques to mimic real-life scenarios. These supporting methods include RP (involving another member of the health team or a caregiver), SPs, or CBS. Even though each of the mentioned simulation modalities has its advantages and disadvantages, the choice of the best SBE fit within the course depends on the desired learning outcomes.

Implications in the Pharmacy Curriculum

Numerous previous experiences in pharmacy education have involved the use of MBS with RP or SP.[21,74,84] Using hybrid SBE methods may be the best way to achieve the intended student learning outcomes. Hybrid simulation has proven to help students improve their knowledge, understanding, communication, and psychomotor skills.[19,21,34,54,55,84] However, its implementation may require extra resources, time, and workforce members. Previous reports have indicated the use of hybrid simulation in advanced pharmacy levels, including APPE. Various assessment methods have been used to evaluate student achievement, including summative and formative assessments, depending on the simulation modalities used and the intended learning outcome of the scenario.

Recommendation

Hybrid simulation is the best method to implement simulation scenarios to mimic real-world experiences for high-level pharmacy students and can be assessed using either summative or formative methods.

Future Recommendations About Patients-Simulation Implementation in the Pharmacy Curriculum

- Further studies are needed to assess the use of MBS within the pharmacy curriculum in non-acute care settings.
- Cost-effectiveness studies about patient simulation implementation within the pharmacy curriculum are needed given the high cost of some simulation methods.
- The integration of RP, SP, SG, and CBS should be explored for advanced pharmacotherapy courses, disease management, and care implementation within pharmacy school curricula.

Simulation Implemented in Interprofessional Education

IPE is defined as an experience involving two or more health care professionals who work collaboratively and learn from, with, and about each other to improve patient care.[85] This educational strategy has improved communication and the learning experience between pharmacy students and other health care professionals. The ACPE accreditation standards were establish to enforce the implementation of IPE in pharmacy curricula so that students can learn to be an active members of an interprofessional team.[16] The ACPE also encourages pharmacy schools to implement interprofessional

simulation (sim-IPE) experiences and the utilization of simulation into IPE so that students can understand the scope of practice of team members.[16]

The researchers who have previously applied sim-IPE for pharmacy students have mostly used hybrid simulations using human patients and MBS with SPs and/or RP.[20,86,87] They have demonstrated the possibility of enhancing students' attitudes, teamwork skills, confidence, and communication with other healthcare professionals.[87–90] Most IPE experiences have involved high-level pharmacy students or APPE.[85,88–90] IPE primarily uses high-fidelity simulation within its activities to help students better understand the pharmacist's role on the interdisciplinary team.

The major challenge in applying IPE within the pharmacy curriculum is finding the best course that fits its implementation and the arrangement with other health discipline schools.[87,90] In addition, IPE activities usually include a limited number of students in each session to achieve the desired outcomes.[87] Sim-IPE also carries the drawbacks of the types of simulation it utilizes, such as the need for resources, logistic arrangements, and extra cost. Thus, we suggest incorporating IPE within the pharmacotherapy laboratories of high-level pharmacy students, and advanced experiential training may be the best fit for IPE in the pharmacy curriculum.

Conclusion

Similar to traditional teaching methods, SBE has improved students' knowledge, understanding, and numerous essential skills within undergraduate pharmacy education. This review highlights various modalities of simulation and their incorporation into pharmacy curricula. It can help pharmacy educators identify the best type and placement of integrating patient simulation within the pharmacy curriculum to achieve the intended student learning outcomes. The SBE method is crucial for developing skills (eg, teamwork, decision making, and communication) that are difficult to achieve by conventional methods.

Even though the ACPE acknowledged SBE benefits in IPE and IPPE, this article provides evidence that they are effective within all pharmacy curricula. Combining multiple simulation techniques may be the best way to achieve the desired student learning outcomes. Some gaps in the literature involving the use of SBE in pharmacy education have been identified and need to be further investigated in future studies.

Abbreviations

ACPE, Accreditation Council for Pharmacy Education; APPE, Advanced pharmacy practice experience; CBS, Computer-based simulation; COVID-19, Coronavirus 2019; CSAF, Communication Skills Assessment Form; IPE, Interprofessional education; Sim-IPE, Interprofessional simulation; IPPE, Introductory pharmacy practice experience; MBS, Manikin based simulators; OSCE, Objective Structured Clinical Examination; RP, Role-play; SBE, Simulation-based education; SP, Standardized patient; SG, Serious Gaming; SOAP, Subjective, Objective, Assessment, Plan; SWOC, Strengths, Weaknesses, Opportunities, Challenges.

Disclosure

The authors report no conflicts of interest in relation to this work.

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