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Virtual patients with substance use disorders in healthcare professional education: a scoping review

Les patients virtuels ayant des troubles liés à l'usage de substances dans la formation des professionnels de la santé : une revue de la portée

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Abstract

Background and Objective: Virtual patient simulations are cost-effective methods for training health professionals. Yet, this teaching method is rarely used with clinicians who work or plan on working with people with substance use disorders. This scoping review summarizes the current state of the literature concerning virtual substance use disorder patient simulations in health professionals' training and provides suggestions for future directions.

Methods: Online databases were searched for peer-reviewed articles published between January 2010 and June 2024.

Results: Twelve studies were included. The development, administration, and evaluation of performance of the simulations are diverse. Most simulations aim to develop screening, brief interventions or referring skill, they target a variety of health professionals' disciplines and report positive learning outcomes. Virtual simulations have good acceptance rates from learners.

Conclusions: Enhancing the diversity of clinical skills and patient populations portrayed in simulations, alongside adherence to best practices in simulation development and implementation is suggested to optimize training outcomes in this critical area of healthcare education.

Résumé

Contexte et objectif : Les simulations de patients virtuels sont des méthodes rentables pour la formation des professionnels de la santé. Pourtant, cette méthode d'enseignement est rarement utilisée par les cliniciens qui travaillent ou prévoient travailler avec des personnes ayant des troubles liés à l'utilisation de substances psychoactives. Cette analyse résume l'état actuel de la littérature concernant les simulations virtuelles de patients ayant des troubles liés à l'utilisation de substances dans le cadre de la formation des professionnels de la santé et propose des orientations futures.

Méthodes : Des bases de données en ligne ont été consultées pour trouver des articles évalués par des pairs et publiés entre janvier 2010 et juin 2024.

Résultats : Douze études ont été incluses. Les méthodes de développement, d'administration et d'évaluation des performances des simulations sont variées. La plupart des simulations visent à développer le dépistage, les interventions brèves ou les compétences d'orientation, elles ciblent une variété de disciplines des professionnels de la santé et rapportent des résultats d'apprentissage positifs. Les simulations virtuelles sont bien acceptées par les apprenants.

Conclusions : L'amélioration de la diversité des compétences cliniques et des populations de patients représentées dans les simulations, ainsi que le respect des meilleures pratiques en matière de développement et de mise en œuvre des simulations sont suggérés pour optimiser les résultats de la formation dans ce domaine essentiel de l'enseignement des soins de santé.

Introduction

Substance use disorders (SUDs) pose a significant public health problem, making it crucial to provide healthcare professionals with evidence informed methods to improve their effectiveness in diagnosing, treating, and managing these complex conditions. In the United States alone, more than 41 million people aged 12 and older need treatment for a SUD.[1] Over the last decade, the high prevalence of SUDs has become an economic and social burden for society, leading to stigma and poverty.[2,3] Stigma can hinder healthcare professionals from addressing SUDs effectively and deter individuals from seeking treatment.[4,5,6] Despite the expectation that healthcare professionals manage mental health conditions like SUDs, maintaining and enhancing clinical skills remains a challenge.[7,8] As a result, the healthcare education sector seeks effective methods to enhance professional learning processes.[9]

One way to improve patient outcomes is for healthcare professionals to continue learning especially through experiential learning, which enhances their comprehension, attitudes, skills, and clinical practice.[10] Simulation training, a cornerstone of experiential learning,[11,12] is rooted in theories such as Kolb's model which highlights the cyclical process of learning through action, reflection, and assessment.[13,14] The National League for Nursing (NLN) Jeffries Simulation Theory further enriches this framework, emphasizing the interactive components crucial for effective simulation experiences.[15,16] According to Jeffries, dynamic interactions between the facilitator and the participants via pre-briefing, simulation progression, cues, and debriefing is essential to enhance the simulation experience.[15,16]

Healthcare education has increasingly embraced simulation to improve patient safety, reduce errors, and foster clinical judgment.[17] Clinical face-to-face human simulation is considered the traditional method in various healthcare education professions, such as nursing, medicine, and psychology.[18–20] However, advancements in technology have introduced new avenues for education, particularly through virtual patient (VP) simulations. VP simulations can be defined as "*a computer program that simulates real-life clinical scenarios in which the learner acts as a health care provider obtaining a history and exam and making diagnostic and therapeutic decisions*."[17] VP simulations use computer programs to replicate clinical scenarios, allowing learners to assume healthcare roles and make diagnostic and therapeutic decisions in virtual settings. These simulations vary in immersion and realism, from screen-based to fully immersive virtual reality environments.[21] VP simulations offer several advantages, including providing practical and repeatable experiences in a safe learning environment conducive to reflection and feedback.[18,19] Unlike face-to-face simulations, VP simulations can be completed an infinite number of times and multiple learners may interact with one VP simultaneously.[20,21] VP training can be as effective as traditional methods, with added benefits such as accessibility and adaptability,[18,22] particularly relevant in scenarios like the COVID-19 pandemic.[22]

While existing literature reviews highlight VP simulations' impact on healthcare skills development,[23,24] their application specifically in SUDs treatment remains underexplored.[25] To fill this gap, we conducted a scoping review to determine the current state of the literature concerning VPs with SUDs in healthcare professionals' education–irrespective of academic levels or disciplines–and provide suggestions for future directions.

Methods

Guided by Arksey and O'Malley's framework,[26] this scoping review examined the current state of the literature pertaining to the use of virtual SUD patients for health professionals' training. A scoping review is a "*form of knowledge synthesis that addresses an exploratory research question aimed at mapping key concepts, types of evidence, and research gaps related to a defined area or field by systematically searching, selecting and synthesizing existing knowledge*."[27] This is particularly relevant in fields where publications are scarce, making it difficult to synthesize findings into a cohesive whole.[28] This type of descriptive article synopsis is well suited for identifying emerging trends in the literature, summarizing the research and identifying relevant research gaps.[29]

We reported this study according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).[30] The methodology proposed by Arksey and O'Malley inspired the data extraction procedure we used.[26] We conducted an initial search in April 2021 and updated in June 2024 to include study results from articles published since the initial search. We consulted a librarian for the selection of databases and appropriate keywords, then searched for peer-reviewed empirical studies in five databases (APA PsycInfo, Academic Search Complete, CINAHL Plus with Full Text, Education Source, and MEDLINE with Full Text). We

selected a variety of databases, including multidisciplinary ones, as well as those specialized in education, psychology, and behavioral sciences, ensuring access to a wide range of literature relevant to VP simulations. A keyword strategy, in TX all text, was applied with these terms: (drug* OR substance* OR alcohol OR gambl*) N2 (use OR misuse OR abuse OR addict* OR disorder*) AND simulat*. We selected these keywords to ensure that the search captured relevant empirical studies related to virtual patients and SUDs. To supplement the database search, the first author scanned the reference lists of the included articles to identify any other relevant studies.

We developed the inclusion criteria *a priori* and refined them iteratively during the selection process. We then included papers if they (i) focused on the education of future or current health professionals (with no restriction on clinicians' field of expertise); (ii) targeted treatment for people with SUDs; (iii) used VP technology; (iv) were published in English or French; (v) were peer-reviewed; and (vi) were published between January 1, 2010 and June 18, 2024. We selected these dates to focus on the latest VP innovations, ensuring relevance and applicability to current healthcare education contexts, and capturing advancements in VP technology relevant to SUDs. We included all study designs. After deduplication, two authors split the dataset for title and abstract screening using Covidence.[31] We discussed studies receiving a decision of "Maybe" until reaching a consensus. Finally, one author assessed the full text of the articles for eligibility, and we discussed any articles excluded at this stage to confirm exclusion.

Two authors (who are academic educators and researchers) developed a data extraction form to systematically capture relevant information from each study, including study characteristics, participant details, and specific features of VP simulations. We piloted this form with a subset of studies, and made adjustments to improve clarity and comprehensiveness (e.g., some categories being combined or removed). Initially, one author independently extracted simulation characteristics such as developers, experts consulted, actors involved, interaction types, scenarios, and educational outcomes from each study. Two authors then reviewed these characteristics and grouped them into distinct categories using a bottom-up approach, which involved identifying common themes and categorizing them into broader groups (e.g., "Developers," "Interaction Modality and Format"). We initially aimed to extract information on whether simulations followed a specific pedagogical framework, but we eventually omitted this goal as only one study provided such information. Once we established categories, one author re-extracted characteristics from all included studies using these categories as a framework to ensure consistency. We then reviewed the final extracted data to ensure clarity and consistency in reporting. We extracted data about all simulations from the published manuscripts. For one study, we obtained additional information by contacting the authors directly.[32]

Results

Our search identified 2,840 records through online databases and reference lists. After screening, we deemed 13 studies eligible. We were unable to obtain the full text of one article, even after directly contacting the authors, resulting in the inclusion of 12 studies in the scoping review. **Error! Reference source not found.** includes the PRISMA flow diagram.

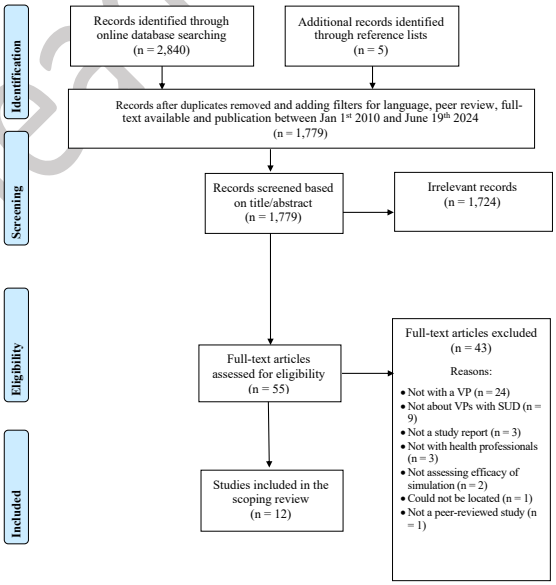

Figure 1. PRISMA flow diagram

Characteristics of studies included

Country and participants. We included a total of 12 studies in this scoping review (**Error! Reference source not found.**). Eleven studies were conducted in the United States, and one in Scotland.[33] Sample sizes ranged from 6 to 308 participants, and self-identified gender composition ranged from 40 to 85% of women (two studies reported having one non-binary participant). Ten studies involved university students in social work, psychology, nursing, or pharmacy,[21,32–40] three of which specified students'

graduate level. The other two studies recruited professional staff such as medical doctors or nurses.[41,42]

Table 1. Characteristics of the studies included in the review (n = 12)

Authors (year), country	Design, participants (gender composition)	Study objective	Aim of the simulation	Measures	Outcomes
Adamshick et al. (2024), United States[34]	A two-arm longitudinal pre-test/post-test design within two courses, 79 senior-level psychiatric and mental health nursing students (53 women, 67%)	To evaluate the impact of an interactive computer simulation with virtual adolescents on nursing students' attitudes, role security, therapeutic commitment, knowledge, confidence, competence, readiness to use SBIRT.	SBIRT skills for alcohol use with adolescents	**Quantitative** Attitudes (towards people with alcohol-related problems) Role security Therapeutic commitment Knowledge Confidence Competence Response to scenarios and cases **Qualitative** "Describe your experience" "What were the strengths of the simulation?" "What could be improved?" "Comment on your sense of confidence, competence, and readiness to use the SBIRT screening"	**Quantitative** Statistically significant improvements were observed on all measures **Qualitative themes** Developed skills (e.g., recognizing guided questioning) Communication and applying skills (e.g., adolescent-specific decisions and considerations) Performance strength and need for practice (e.g., strengths of the simulation and practice needed to support the learner)
Albright et al. (2018), United States[41]	RCT, 227 nurses, nurse practitioners and doctors (186 women, 81.9%)	To identify the impact of an online simulation where learners practice role-playing with emotionally responsive virtual patients to learn MI strategies to better manage SBIRT conversations	Attitudes, motivation and behaviors related to mental health screening and collaborative care of patients (MI interventions based on Miller and Rollnick, 2013) with generalized anxiety disorder, depression, substance abuse and posttraumatic stress disorder	**Quantitative** Means efficacy (seven items) Knowledge and skills (six items based on the Gatekeeper Behavior Scale to measure general abilities and preparedness to deal with mental health issues) Likelihood to screen and manage mental health issues (a single question: "How likely are you to screen and manage the treatment of patients that exhibit signs of trauma-related mental health disorders when visiting your primary care practice?") Behavioral data (a single question regarding participants' current frequency of mental health screenings)	**Means efficacy** 80.3% of participants rated the simulation as "very good" or "excellent" 89.7% agreed or strongly agreed that it was useful in their professional practice 92.6% agreed or strongly agreed the activity will enhance their knowledge and skills as healthcare provider **Knowledge and skills** Significant increase between pre- and post-test*** Significant difference between treatment group post-test and control group*** Likelihood to screen and manage mental health issues Significant increase between pre- and post-test*** Significant difference between treatment group post-test and control group**
Harris et al. (2013), United States†[42]	RCT (post-test only), 90 residents (post graduate years 1 to 3) and 30 faculty physicians (48 women, 40%)	To compare the educational effectiveness of two virtual patient-based e-learning strategies, versus no training, in improving physicians' substance abuse management knowledge, attitudes, self-reported behaviors and decision making	SBIRT skills for alcohol, cannabis and opioid use	**Quantitative** Self-administration of P-CSAT: a 63-item survey assessing physicians' knowledge, attitudes and self-reported behaviors in dealing with substance abuse Time spent taking the e-learning program and the number of sessions taken to complete the program	No difference between groups on P-CSAT (both intervention groups and control group) No difference between intervention groups on time spent and number of sessions taken
Hitchcock et al., (2019), United States[40]	A one-group pre-test/post-test design, 100 social work and nursing students (84 women, 84%)	To examine changes in students' attitudes about working with adolescents with a substance use disorder and beliefs about alcohol and drug use dependence	SBIRT and MI skills with adolescents	**Quantitative** Brief Substance Abuse Attitudes Survey (Chappel, Veach, & Krug, 1985), Perceived competence Confidence Readiness	Statistically significant increase*** from pre-test to post-test on perceived competence, confidence, and readiness to conduct SBIRT with adolescents Non-statistically significant improved in attitudes and beliefs about substance use disorders
O'Brien et al. (2019), United States[32]	RCT, 308 social work and nursing students (262 women, 85%)	To test the effect of online patient simulation, over and above in-person training, on students' SBIRT attitudes, knowledge and perceived skills.	SBIRT skills for cocaine use	**Quantitative** SBIRT Attitudes, Self-Perception of Skills and Knowledge survey (Confidence, Importance, Attitudes)	Significant increase from pre-test to post-test*** and 30-day follow-up***, in all domains
Perez et al. (2022), United States[37]	One group (post-test only),105 graduate nursing	To explore the use of virtual simulation among graduate nursing students as a teaching	Opioid misuse management (two other scenarios were unrelated to substance use)	**Quantitative** Likert scale questions on: simulation realism, confidence, comfort, identifying areas that need more practice in,	**Quantitative** More than 80% of participants agreed or strongly agreed with all statements

	students (unspecified gender distribution)	modality to manage difficult conversations		communication, application of knowledge, safety of the learning environment, quality of the debriefing, usefulness of simulation for the scenario content, meeting the learning objectives **Qualitative** Perceived applicability of simulation learning experience to professional practice Feelings and emotions related to the simulation experience How the simulation experience enhanced or impeded their learning.	Overall rating of simulation experience was lower for opioid misuse management compared to other scenarios unrelated to substance use **Qualitative** Anxiety and nervousness before starting the simulation, which faded away as the simulation started. Helpfulness of supportive faculty and staff Safety of the learning environment. Strong realism of the experience, although non-verbal cues were difficult to gauge Simulation enhanced learning
Putney et al. (2019), United States[34]	A one-group longitudinal pre-test/post-test design within two courses 54 Masters level social work students (44 women, 81.5%)	To evaluate changes in students' patient management, screening, brief intervention, engagement and relational skills, applying MI mechanisms and change planning	SBI and MI skills (Miller and Rollnick, 2013) for alcohol and cannabis use	**Quantitative** Patient management, screening and brief intervention Engagement and relational skills, applying motivational interviewing mechanisms and change planning	Significant increase in overall SBI*** and MI*** scores from pre- to post-test
Smith et al. (2021), United States[38]	A one-group pre-test/post-test design, 22 Masters of Social Work students (17 women, 77.3%, and 1 non-binary)	To evaluate the feasibility, acceptability, usability, and effectiveness of three VP simulations	CBT and MI skills (Miller and Rollnick, 2013) for problematic alcohol use	**Quantitative** Intervention satisfaction scale (for acceptability and usability) Counselor activity self-efficacy scale (for effectiveness) Total correct scores provided by the simulation **Qualitative** What did you like best about the simulation? What were the limitations of the simulation? How did the simulation compare with other training that you've received?	**Quantitative** Increase in total correct scores Simulation rated as "somewhat" to "very" acceptable and usable **Qualitative** Simulations provide a strong foundation that prepares beginners for clinical practice Presence of technical barriers to the simulation experience
Washburn et al. (2016), United States[35]	A one-group pre-test/post-test design 6 Masters of Social Work students (3 women, 50%, and 1 non-binary)	- To evaluate the feasibility and acceptability of virtual patient simulations for the development of brief behavioral health assessment skills - To determine if virtual patient simulations increase students' diagnostic accuracy and are associated with improvements in brief assessment skills	Increase diagnostic accuracy and brief assessment skills for anxiety, depression, posttraumatic stress and/or substance abuse	**Quantitative** Students DRF assessments scored by an independent expert OSCE: standardized measure assessing participants' proficiency in clinical interviewing **Mixed** Usability Feedback Form: assess student preferences and perceptions of usability	Significant increase in DRF*** and OSCE*** scores Students rated the overall usability of virtual patients in the "good" range
Washburn et al. (2020), United States[21]	Randomized 2x3 mixed factorial design with repeated measures, 22 Masters level students in social work and psychology (18 women, 81.8%)	To evaluate the diagnostic accuracy and self-efficacy of three different simulated training conditions	Increase students' self-efficacy (Bandura's, 1991) in brief clinical assessments for anxiety, depression, post-traumatic stress, substance abuse	**Quantitative** DRF Social Work Skills Self-Efficacy **Mixed** Usability Feedback Form	DRF Significant increase between pre- and post-test * Social work skills self-efficacy Significant increase between pre- and post-test** Usability feedback form Usability of virtual patients rated as "good"
Wood et al. (2022), United States[39]	A one group pre-test/post-test design, 40 first year Masters of social work students (33 women, 82.5%)	To assess one e-learning platform and examine the efficacy of first year MSW students in the use of SBIRT with virtual clients.	SBIRT skills for adolescents who use alcohol and other substances	**Quantitative** Performance score provided by the software (out of 100) Self-reported confidence in with engaging in the screening processes	Majority of participants obtained a passing score of 75 Large effect size for increase in confidence levels
Zlotos et al. (2016), Scotland[33]	A one-group pre-test/post-test design, 106 preregistration pharmacist trainees (no information on gender composition)	To evaluate virtual patient programs for injecting equipment provision and opioid agonist therapy services with respect to confidence and knowledge	Improve knowledge and confidence in the provision of services related to injecting equipment provision and opioid agonist therapy	**Quantitative** Self-report of confidence and knowledge of injecting equipment provision and opioid agonist therapy	Confidence increased significantly at post-test*** and 6-month follow-up** Knowledge increased the most immediately after using the program*** Decreased at 6 months but still higher than pretest

*† The authors declared having a conflict of interest; * p < .05, ** p < .01, *** p < .001 RCT: Randomized Control Trial; MI: Motivational Interviewing; SBIRT: Screening, Brief Intervention and Referral to Treatment; P-CSAT: Physicians' Competence in Substance Abuse Test; DRF: Diagnostic Rating Form; OSCE: Objective Structured Clinical Examination*

Aim of the simulations. Seven out of the 12 studies aimed to increase learners' skills and/or self-efficacy with screening, brief intervention, and referral to treatment (SBIRT) for SUDs. SBIRT is a comprehensive approach that aims to provide patients with the appropriate services based on the severity of their SUDs.[43] Three studies[34,38,40,41] also aimed to increase Motivational Interviewing skills. Motivational interviewing is a counselling style aimed at fostering change by increasing patient motivation through ambivalence resolution.[44] The remaining two studies[33,37] focused on improving learners' self-efficacy in provisional services related to opioid use (e.g., injecting equipment, opioid agonist therapy).

Although all studies mentioned substance use or abuse as being a part of the clinical profiles of VPs, seven studies explicitly mentioned the type of substance, such as alcohol,[34,36,38,42] cannabis,[34,42] cocaine[32] or opioids.[33,37,42] No VP had a behavioral addiction, such as gambling disorder. Three studies specified that the VP was an adolescent.[36,39,40]

Study designs and measures. Four studies were designed as randomized controlled trials,[21,32,41,42] six used a one-group pre-test/post-test design,[33–35,38–40] and one used a two-group pre-test/post-test where only one group received an educational reinforcement through debriefing.[36] All studies used quantitative measures to assess learning outcomes; three also used qualitative measures.[21,35,38] Two studies, conducted by the same research team, assessed learning outcomes with the help of an independent rater, a professional with over 10 years of practice.[21,35] The rater used a standardized scoring form, the "Diagnostic Reporting Form," that assesses diagnostic accuracy, history taking, and case conceptualization. These same two studies also incorporated a qualitative measure that allowed learners to share, in their own words, their subjective experiences of the simulations. All other studies assessed learning outcomes based on self-reported questionnaires, targeting elements such as confidence, knowledge and skills related to SBIRT implementation or general risks associated with substance use.

Learning outcomes. With the exception of one study,[40] all simulations that explicitly focused on SBIRT components yielded statistically significant improvements in SBIRT knowledge and skills,[34,36,41] confidence in and attitudes about SBIRT, as well as the importance of using a SBIRT approach.[32,36,39] There were also improvements in use of motivational interviewing mechanisms, relational skills,[34] the ability to conduct a thorough clinical diagnosis and clinical interviewing skills.[35,38] Finally, one other study[33] reported increased confidence in empathizing with SUD patients and recognizing SUD symptoms. This study also reported greater knowledge of opioid agonist therapy and the provision of safe injection paraphernalia, such as clean needles. [33]

Five studies also included questions about how learners perceived training programs' usability and usefulness.[21,35,37,38,41] Overall, usability of simulations ranged from "good" to "very good"[21,35,38,41] and 90% of learners reported finding the simulations useful.[41] In one study, learners reported that simulations not only reduced their anxiety about working with real patients but also expressed a strong preference for this immersive and realistic training method over traditional textbook learning.[35] Areas for improvement included the voice recognition component of the software[35] and the inconsistency of VPs' responses.[21] Some learners reported feeling uncomfortable because of the unnatural flow of conversation with VPs, whose answers often did not seem humane enough (e.g., did not react to empathic statements).[21,37]

Simulation characteristics

Simulation development. Eight simulations were developed by private companies specialized in simulation development,[32,34,36-41] and three others by academics with expertise in SUDs.[21,35,42] The remaining simulation did not specify whether development was outsourced or conducted inhouse.[33] No information was provided in all articles about the costs to develop the simulations (Table 2).

In six cases, expert scholars and clinicians well-versed in SUDs and mental health issues were called upon to help develop the simulations.[33,35–37,41,42] There was no such information for the other six simulations.[32,34,35,38-40] In one simulation, acting coaches were consulted to direct the actors playing the patients.[21] No information was provided regarding consultation of experts in teaching practices.

Table 2. Characteristics of the Simulations Studied (n = 12)

Authors (year)	Developers (type of institution and experts involved)	Interaction modality and format (virtual patient settings)	Number of scenarios administered (# of repetitions/scenario)	Learner preparation and feedback	Type of learning assessments
Adamshick et al. (2024)[34]	Private company specialized in simulation development; with the help of a group of experienced educators	No information on interaction modality. Human-like computer-generated animations (no information on setting)	1 scenario (could be completed as often as desired)	No information on preparation An intervention group (vs. control) received an in-person debriefing session (20 minutes) and a self-debriefing session (40 minutes).	Formative assessment using the software, which gave feedback about the reasons why one should choose particular answers.
Albright et al. (2018)[41]	Private company specialized in simulation development; with the help of end users and nationally recognized scholars and professionals in mental health, public health, social work and health education	Text-based multiple-choice options with human-like computer-generated animations (no information on setting)	2 scenarios (no information on number of repetitions)	No information on preparation. Personalized feedback provided by a virtual coach during the simulation	Formative and summative assessments using self-reported forms which provided scores
Harris et al. (2013)[42]	Academics; with the help of 12 national experts on substance abuse education	Text-based multiple-choice options with videotaped professional actors (no information on setting)	5 scenarios (each completed once)	No information on preparation. Extensive written and audio feedback provided after two initial scenarios. Feedback provided for each additional simulation based on simulation performance	Formative and summative assessments using the software, which gave standardized author-developed feedback based on participants' choices and total score
Hitchcock et al., (2019)[40]	Private company specialized in simulation development; no information about team expertise	No information	3 scenarios (no information about completion frequency)	Feedback provided by a virtual coach during the simulation. No information on whether participants were debriefed.	No assessments
O'Brien et al. (2019)[32]	Private company specialized in simulation development; no information about team expertise	No information	1 scenario (could be repeated as often as desired)	No information	Formative and summative assessments using self-reported forms which provided scores
Perez et al. (2022)[37]	Private company specialized in simulation development; scenarios developed by faculty.	Computer-generated avatars. Trained actors remotely played the voice of the avatar. No information about interaction modality.	1 scenario (completed once)	Preparation on how to use the simulation and learning objectives. Individual and group debriefing followed the simulation.	No assessments
Putney et al. (2019)[34]	Private company specialized in simulation development; no information about team expertise	Text-based multiple-choice options with human-like computer-generated animations (no information on setting)	2 scenarios (each could be repeated as often as desired)	No information on preparation. Feedback provided by a virtual coach during and after the simulation	Formative and summative assessments using the software, which gave scores and detailed qualitative feedback
Smith et al. (2021)[38]	Private company specialized in simulation development; no information about team expertise	Text-based multiple-choice options with videotaped professional actors (location resembled a traditional therapist's office)	3 scenarios (at least 4 repetitions per scenario)	45-minute orientation on how to navigate the simulation. Feedback provided by a virtual coach during the simulation. No information on whether participants were debriefed.	Formative and summative assessments using the software, which gave scores and detailed qualitative feedback
Washburn et al. (2016)[35]	Academics; no information about team expertise	Wireless mouse and voice recognition with human-like computer-generated animations (location resembled a traditional therapist's office)	6 scenarios (each completed once)	How to use the simulation and its process were presented. A mental health care professional with 10 years' experience provided feedback during and after the simulation	No formative assessment. Summative assessment conducted by Masters level professionals who observed and evaluated learners' performance
Washburn et al. (2020)[21]	Academics; no information about team expertise	Learners spoke out loud and a researcher would simultaneously type their responses into the program with human-like computer-generated animations (location resembled a traditional therapist's office)	4 scenarios (each completed once)	Context simulation was presented to the learners. A mental health care professional with 10 years' experience provided feedback during and after the simulation	Formative and summative assessments conducted by a PhD-level clinician who scored learners' self-reported diagnostic reporting forms
Wood et al. (2022)[39]	Private company specialized in simulation development; no information about team expertise.	No information	2 training scenarios and 1 test scenario (each completed once)	Feedback provided during training scenarios. No information on whether participants were debriefed.	Formative and summative assessments using the software
Zlotos et al. (2016)[33]	No information	Text-based multiple-choice options with human-like computer-generated animations (location resembled a traditional therapist's office)	2 scenarios (each completed once)	No information	Formative and summative assessments conducted using self-reported forms which provided scores

Interaction modalities and formats. VP simulations generally consisted of human-like computer-generated animations.[21,33–36,41] Three simulations used video or audio recordings of professional actors who served as VPs.[37,38,42] In four simulations, the patient was in a location resembling a traditional therapist's office.[21,33,35,38] In most simulations,[33,34,38,41,42] learners interacted with patients using text-based multiple-choice options that appeared on the screen. Two others allowed learners to speak naturally: one used voice recognition technology and another had someone else type the learners' words into the program.[21,35] The remaining four simulations provided no information about how learners interacted with the software.[32,37,39,40] None of these simulations used fully immersive technologies, such as virtual reality environments.

The number of different simulations presented to learners varied from one to six, depending on the study. In the case of multiple simulations, VPs were presented randomly or were predetermined by the researchers. While some studies only permitted learners to complete a simulation once,[21,33,35,39,42] others let them complete the same simulation as many times as desired.[32,34,36]

Learner preparation, feedback and assessments. Five studies[21,35,37–39] reported preparing participants before starting the simulations by either providing information about the software, allowing them to practice using the software, or briefing them on the clinical context of the simulation. Learners were also given supporting documentation to closely approximate real-life clinical settings. The other simulations reported no information on whether or how they prepared learners.

All simulations but four[32,33,36,38] indicated providing learners with feedback based on their performance. Eight simulations[21,34–36,38–42] gave feedback during the simulation (e.g., after an interaction with the VP), and five of these[21,34,35,38,42] also provided feedback after the simulation was completed. Personalized feedback was given either by a virtual coach embedded within the simulation software[34,36,38,40,41] or by a mental health care professional with 10 years of experience.[21,35] When given during the simulation, feedback was designed to help learners adapt their future responses. When the simulation was over, learners were also given feedback by a virtual coach[34,38] or a mental health care professional,[21,35] to receive advice on areas for improvement. In the simulation conducted by Harris and Sun,[42] participating learners were given feedback after each VP scenario using standardized author-developed feedback, based on learners' decisions and final scores.

Discussion

This scoping review aimed to determine the current state of the literature regarding the use of VPs with SUDs when training healthcare professionals and provide suggestions for future directions. Although research on the use of VPs is growing, researchers have published very few studies specifically on SUD patients to date. Almost all studies were conducted in the United States, and researchers provided little information to understand the overall clinical profile of patients in the simulations. Studies showed considerable variability in the development, administration, and evaluation of performance of the simulations, as well as the participants included. As a result, cross-study comparisons are difficult. Most simulations aimed to develop screening, brief intervention or referring skills, and targeted a variety of health professionals' disciplines. This scoping review also showed that virtual simulations received good acceptance rates from learners, who appreciated receiving feedback in a non-threatening setting as previously mentioned.[18,19] Results consistently indicated that learners achieved positive learning outcomes, including developing a variety of clinical skills, such as understanding SUDs, building positive relationships with patients, and screening for SUDs. Taken together, these studies highlighted that virtual simulations are promising ways to train health professionals who face real-world patients with SUDs. These findings align with previously reported outcomes of virtual simulations and mental health care[23,24] and emphasize the effect this novel teaching method can have for healthcare professionals working with people with SUDs. Despite the promising outcomes and emergent literature, this scoping review has identified gaps leading to a variety of suggestions toward further developments. These following suggestions aim to enhance the relevance, effectiveness, and inclusivity of healthcare education in the context of SUDs.

Diversifying SUD populations in simulations

Patients in the simulations used a variety of psychoactive substances. Yet, the lack of details on the characteristics of the patients highlights a need for more consistent reporting on the patients involved in the simulations. Many SUD populations remain underrepresented in the simulations. Some evident examples are people with comorbidities such as anxiety disorders, personality disorders and gambling problems, or even people

practicing "chemsex" (i.e., the voluntary use of psychoactive substances to enhance sexual experiences),[45] all of whom are at-risk populations for SUDs.[46–48] While no simulation appeared to include these aspects, individuals who require SUD treatment are not homogeneous and may present with a variety of characteristics. The diversity of profiles among people with SUDs, whether in terms of sociodemographic characteristics or clinical comorbidities, contribute to additional challenges when developing a constructive therapeutic relationship, especially in a time-constrained SBIRT setting. Therefore, future simulations should consider implementing virtual SUD patients with characteristics that may be more representative of diverse, real-world clinical populations to help overcome any pre-existing stereotypes. Virtual simulations could be a great opportunity to offer training with marginalized populations or people from minority groups, who *de facto* are difficult to reach. To maximize the educational value of these simulations, educators should consider learners' experience levels and adjust the complexity of patient profiles accordingly. For instance, they can offer simpler, more straightforward scenarios for beginners and progressively incorporating more complex clinical populations for advanced learners.

In addition, there were no simulations presenting VPs with behavioral addictions. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition,[49] officially recognizes gambling disorder as an "addiction and related disorders." Internet gaming disorder is another potentially addictive behavior that has also been mentioned as warranting further research. Therefore, VP simulations should consider including behavioral addictions, which are also part of the spectrum of addictive disorders.

Diversifying skills targeted by the simulations

Existing literature lacks diversity in terms of clinical skills targeted in simulations. Most simulations were built around screening and referral to treatment, preventing trainees from developing treatment skills, such as those used by professionals in SUD rehabilitation centers. Yet, in addition to motivational interviewing training, other brief interventions inspired by cognitive-behavioral therapy adapted to SUDs or behavioral couples therapy have been proven effective.[50–52] Brief interventions may be particularly useful in SUD populations due to varying levels of treatment contact and adherence. For example, people who inject drugs may come to a site on an irregular basis and may be unable to and/or only marginally interested in engaging in longer-term drug counselling services.[53] As such, it would be valuable to develop simulations that specifically train practitioners to employ brief interventions, given their effectiveness in SUD populations.[52] Future simulations should consider targeting skills useful to treat SUDs and focus on treatments proven to be effective considering the characteristics of the population.

Following best practices for building and using simulations

The results of this scoping review shows that development, administration, and evaluation of the simulations vary, making cross-study comparisons difficult. To encourage well-designed VP simulations, the International Nursing Association for Clinical and Simulation Learning (INACSL) Healthcare Simulation Standards of Best Practice™ lists a series of standards that simulation developers and simulations themselves should prioritize to reach their highest potential.[54]

One strategy would be to refer to the National League for Nursing (NLN) Jeffries Simulation Theory,[15] which includes seven conceptual components: simulation context, background, design, simulation experience, facilitator and educational strategies, participant, and outcomes. Encouraging dynamic interactions between the facilitators and the participants is essential to enhance the simulation experience, especially in the case of VP simulations. In the future, researchers who wish to examine the effects of VP training programs must align their training with the principles of the Healthcare Simulation Standards of Best Practice and the NLN Jeffries simulation theory. They should also do their best to report whether they were able to integrate each standard into their study, and if not, explain what factors influenced their decisions and effort.

Suggestions for future research

Improving reporting standards. Future studies should aim for consistent and detailed reporting of VP characteristics and study procedures. This transparency can identify areas for enhancement in future simulations, ensuring comprehensive understanding and replication of effective practices. Once enough high-quality studies are published, this should also allow for sensitivity analyses on study characteristics when conducting meta-analyses.

Validation of outcome measures. Validation of outcome measures is crucial for accurately assessing the effectiveness of VP simulations in healthcare education. All studies primarily used quantitative measures to evaluate learning outcomes, with only three incorporating qualitative feedback. To strengthen the assessment of

learning outcomes and improve program effectiveness, we suggest to continuing to use validated pre- and post-test measures aligned with specific learning objectives. This approach allows for accurate assessment of the learning potential offered by virtual patient programs. Researchers should strive to incorporate both qualitative and quantitative measures to gather participant feedback and identify areas for program improvement.

Evaluating learning outcomes. Emphasis should be placed on evaluating learning outcomes using objective measures rather than relying solely on self-reported data. Incorporating assessments by experts or software evaluations can provide more robust insights into the effectiveness of virtual patient simulations in SUD training.

Limitations

Relevant publications may have been excluded from this scoping review because of language restrictions and the lack of a grey literature search, potentially overlooking valuable insights and perspectives outside of peer-reviewed publications. Additionally, the absence of dual screening may have caused us to miss some eligible studies. However, to ensure a thorough investigation, we used five databases covering a 14-year period.

Conclusions

This scoping review has identified 12 studies evaluating the influence of VPs with SUDs when training health professionals, yielding useful results. This scoping review identifies current gaps and challenges and highlights the promising role of VP simulations in advancing healthcare education, particularly in the context of SUDs. By emphasizing the positive learning outcomes and potential impact on real-world patient care, this study contributes to the ongoing evolution and improvement of educational strategies in healthcare

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