Effectiveness of a virtual simulation to train nursing students in suicide risk assessment: a randomized-controlled investigation

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Abstract

Background: Suicide is a leading cause of preventable death worldwide. Nurses play a critical role in suicide prevention, yet face significant obstacles. Improving the evaluation and management of patients at risk of suicide requires innovative training techniques that safely and effectively enhance nursing students' skills, knowledge, and confidence. Virtual simulation (VS) based training can be particularly effective because it allows interaction with patients without the risk of causing harm.

Objective: The purpose of this study was to assess the pedagogical effectiveness of a novel VS tool featuring an autonomous and emotionally reactive virtual patient in improving nursing students' ability in suicide risk assessment and intervention.

Methods: A randomized controlled intervention was conducted with 68 first-year nursing students divided into a control group receiving teaching as usual (TAU) and an intervention group receiving TAU plus VS. Outcomes were measured using Kirkpatrick's Training Evaluation Model, which focuses on knowledge, skills, confidence, empathy, and satisfaction.

Results: The VS group showed significantly higher confidence (p = 0.006) and a marginally better ability to respond appropriately to suicidal thoughts (p = 0.076) than the control group. However, there were no significant differences in knowledge acquisition or the general level of empathy. Satisfaction with VS was high, particularly concerning the authenticity of the virtual patient. Authenticity was perceived as higher when emotional prosody was included with facial emotions.

Conclusions: The use of VS showed promising results in improving nursing students' confidence and skills in detecting and counseling individuals experiencing a suicide crisis, suggesting its incorporation into routine teaching methods. Further research is needed to explore its long-term benefits for students and its impact on patient outcomes. Further development may also include more highly automated, dynamic, and flexible emotional reactions of the virtual patient.

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Abstract (word count 287)

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Results: The VS group showed significantly higher confidence ($p = 0.006$) and a marginally better ability to respond appropriately to suicidal thoughts ($p = 0.076$) than the control group. However, there were no significant differences in knowledge acquisition or the general level of empathy. Satisfaction with VS was high, particularly concerning the authenticity of the virtual patient. Authenticity was perceived as higher when emotional prosody was included with facial emotions.

Conclusions: The use of VS showed promising results in improving nursing students' confidence and skills in detecting and counseling individuals experiencing a suicide crisis, suggesting its incorporation into routine teaching methods. Further research is needed to explore its long-term

benefits for students and its impact on patient outcomes. Further development may also include more

highly automated, dynamic, and flexible emotional reactions of the virtual patient.

Keywords (3-10)

Nurse, simulation, virtual patient, suicide, depression, education, confidence, emotion, prosody,

facial expression

Word count 4029 (3000-6000)

Introduction

Suicide is among the leading causes of death worldwide, with 703,000 deaths by suicide in 2019,

which was more than deaths due to malaria, HIV/AIDS, breast cancer, war, and homicide [1]. One

important axis of suicide prevention is the education of healthcare professionals in recognizing

depression and managing suicidal crises. However, this aspect requires further investigation to assess

its possible benefits due to the small number of randomized-controlled investigations [2].

Nurses are ideally positioned to intervene and implement preventative measures toward suicide.

However, several obstacles in suicide risk evaluation and care by nurses have been identified. First,

negative attitudes and a stigma toward patients experiencing suicide crises are high among nurses,

although less frequent than among doctors [3]. Second, nurses do not usually use guidelines or

suicide assessment instruments when they evaluate suicidality [4,5], which may result from deficits

in skill and knowledge [6]. Gaps in the training of nurses have been reported by psychiatric nurses

associations in the management of suicidal individuals [7] and nursing students reported a lack of

education and knowledge in suicide prevention [8]. Some qualified nurses also experience not having

sufficient knowledge or skills to feel safe in suicide detection [9] and, sometimes, avoid asking

questions about suicidality for fear of what to do with the answer [10]. One of the major obstacles in suicide prevention may, thus, result from a lack of confidence. Health sciences students are afraid of talking about suicide with patients [11] in particular, asking direct questions about suicidal thoughts and intentions, as they believe such questions could embarrass or distress patients. To decrease such clinical anxiety, health students are usually taught that, according to the literature, talking about suicide within a screening interview does not increase distress or suicide ideation by patients [12,13] and may even improve their sense of well-being [14]. However, students often doubt that a patient with suicidal intent can feel relief when speaking about suicide until they experience it during a face-to-face interaction. There is, thus, a need for direct experience for students of patients' relief when interviewed about suicidal thoughts to support the nurses' ability in suicide prevention. It would also be safer if these first experiences did not occur with real patients.

Usual teaching methods have shown pedagogical effectiveness for suicide prevention in nursing studies. Short lectures and discussions of healthcare staff experiences and videotaped testimonials by experts on the lived experience of suicidal crises have been shown to be associated with an increase in self-perceived competence [15]. A 3.5-h suicide prevention training course with video clips, practicing skills, and group discussion was associated with a significant increase in general perceived self-efficacy compared to pre-intervention [16]. However, some data suggest that simulation may be more efficient than usual teaching methods to improve suicide risk detection and care [17]. In psychiatry, the most prominent simulation method involves standardized patients [18], who are played by professional actors, teachers, or carers. However, it is often difficult and costly to find, train, pay, and debrief standardized patients, thus limiting the spread of this teaching method. By contrast, simulation with fully autonomous virtual patients allows perfect standardization of the environment, a potentially infinite number of learners for one simulation, and remote learning. Randomized-controlled studies of the pedagogical efficiency of virtual simulation (VS) targeting suicide risk are scarce. Only one study involving second-year medical students reported that students

who benefited from VS inquired more frequently than students who benefited from a video-based intervention in several suicide risk areas during an interaction with a simulated patient [19]. However, no differences were found in communication skills, such as the learner's professional appearance, behavior, and empathy. The virtual patient consisted of an embodied conversational agent portrayed by a static image of her face, without any emotional reaction to the questions asked by the learner. This may have lacked realism, as interpreting subtle nonverbal cues a patient displays is a critical skill for health students. During a psychiatric interview, facial expressions can provide an understanding of the patient's affective processes [20]. Thus, autonomous and emotionally reactive virtual patients are needed to properly simulate nursing interviews in suicidology teaching.

The present study aimed to evaluate the pedagogical efficiency of a simulation using an autonomous and emotionally reactive virtual patient (SImulation with a VIrtual patient in PSYchiatry - SIVIPSY) in terms of the ability of nursing students to detect and evaluate a suicidal crisis and behave appropriately. The study also aimed to establish the degree of perceived realism of VS and the impact of the virtual patient's emotional reactions on the realism of SIVIPSY and learner satisfaction.

Methods

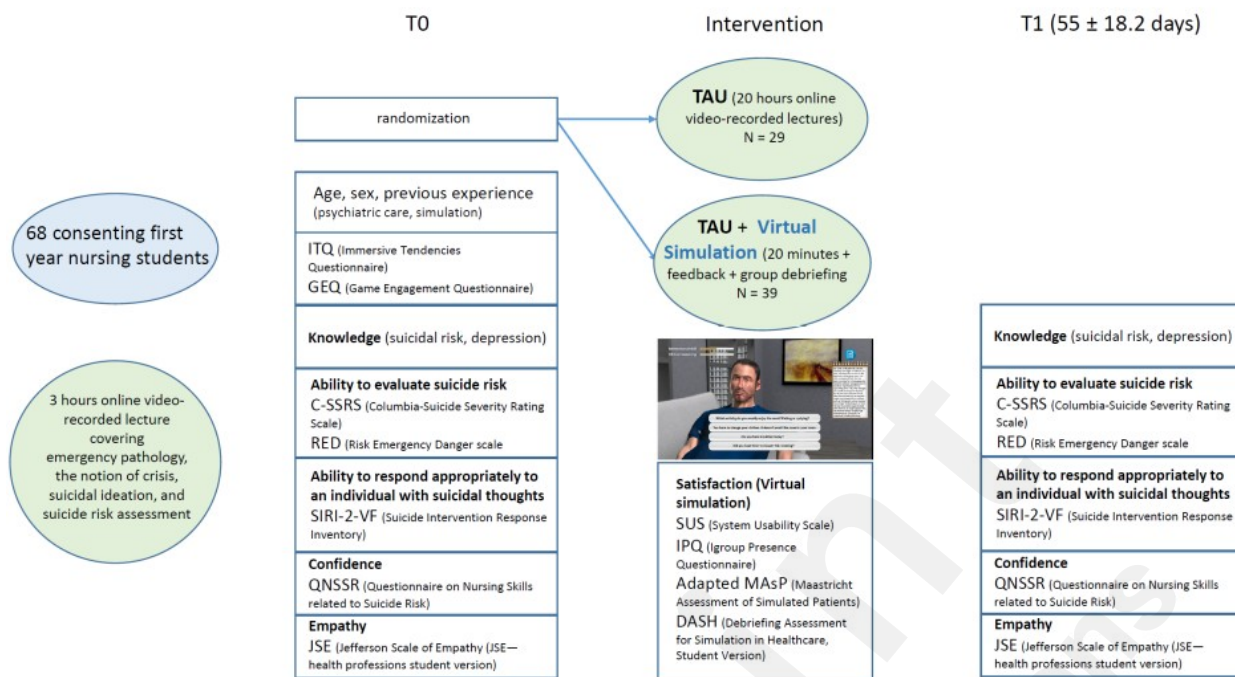The design of the study is presented in Figure 1.

Figure 1. Schematic representation of the study design

Recruitment

Nursing students were recruited from the nursing schools affiliated with Versailles Saint-Quentin-En-Yvelines University. The criteria for inclusion were being in the second semester of the first year of study and being above 18 years of age. It was approved by the local ethical review board (CER-Paris-Saclay-2020-087). Each participant provided written informed consent before inclusion. To ensure that the commitment was entirely voluntary, students were informed that whether or not they took part in the study would not influence the result of their psychiatry exam and, thus, their passage to the second year.

Intervention

Participants were randomized between two arms. All participants received the standard teaching program, consisting of 20 hours of online video-recorded lectures on psychiatry and mental health. Before starting the research and being randomized, participants were asked to attend a three-hour online course covering emergency pathology, the notion of crisis, suicidal ideation, and suicide risk

assessment. Randomized participants in the control arm received only the usual teaching program (Teaching As Usual - TAU arm). Randomized participants in the intervention arm received TAU plus VS with SIVIPSY. SIVIPSY consisted of a VS of a nurse interview with a patient experiencing severe depression with an imminent suicide risk. It was designed by nursing teachers, academic psychiatrists, and computer science researchers specializing in human-computer interactions. A complete description of the simulation is presented in Supplementary Information 1. In SIVIPSY, learners must dialogue with an emotionally reactive avatar according to an underlying decision-tree architecture: they have to select the best question to ask, which is then generated by vocal synthesis. The virtual patient reacts according to the learner's choices by displaying adaptative verbal and facial expressions of emotions. Two versions of SIVIPSY were developed. In the first version, the virtual patient spoke with a neutral prosody, whereas he spoke with a sad prosody in the second version. The two versions were compared to test the hypothesis that emotional prosody improved the perceived authenticity of the virtual patient with severe depression. All participants in 2021 were allocated to the neutral prosody version of SIVIPSY, whereas all participants in 2022 were allocated to the sad prosody version of SIVIPSY. Access to SIVIPSY was remote via an internet connection due to restrictions on movement due to the COVID-19 pandemic. The VS lasted approximately 20 minutes. Two types of feedback were provided to learners. The first type was automatic: the program gave three scores to the learners (clinical reasoning, interpersonal skills, and clinical effectiveness) and revealed what happened to the patient after the interaction with the learner according to the choices that were made (more information about the content of the automatic feedback are available in Supplementary Information 1). The second type of feedback consisted of a remote group debriefing, co-run by a nurse and a medical teacher, when possible. It followed the rules of debriefing with good judgment [21] and was preceded by an anonymous review of the learner log file to detect performance deficits that may have varied depending on the group. The debriefing groups consisted of 4.1 individuals on average (SD 2.7), resulting in eight different groups. Learners were grouped

based on their availability.

Sample baseline characteristics

Baseline characteristics were recorded at inclusion. Demographic data consisted of age, sex, and native language. We also evaluated self-reported previous experience in psychiatric care (none/(internship/employment)), previous simulation experience (no/yes), and participation in the prerequisite online course (no/yes). Finally, we evaluated the individual's disposition to be particularly receptive to the VS modality through two measurements. The first consisted of their immersive tendency, measured using the Immersive Tendencies Questionnaire (ITQ) [22]. Immersion gives individuals the impression that they have left the real world and are now present in the virtual environment. A greater sense of immersion results in higher levels of involvement in a virtual environment, which may increase the pedagogical effectiveness of the VS. The second baseline disposition was the psychological engagement in video game-playing, measured using the Game Engagement Questionnaire (GEQ) [23], which may increase the positive impact of VS on pedagogical outcomes.

Outcomes

SIVIPSY was assessed using Kirkpatrick's Training Evaluation Model [24]. This model establishes the impact of a learning intervention according to five levels: 1) reaction effect: satisfaction/dissatisfaction of participants, 2) learning effect: improvement of the participants' knowledge, 3) behavioral effect: changes in attitudes, skills, or learners' confidence, 4) patient results (i.e., whether the intervention improves the nurse diagnosis care plan) to approach operational effectiveness and reach patient-reported outcomes, and 5) return on investment. Only the three first Kirkpatrick levels were investigated in this study, using validated tools when available.

Knowledge

Knowledge was measured using a 10-item, five-choice questionnaire on the subject of suicidal risk and depression created for the study.

Skills, confidence, and attitude

Two skills were assessed in this study: the ability to evaluate suicide risk and the ability to respond appropriately to an individual with suicidal thoughts.

Ability to evaluate suicide risk

A specific tool was created to measure the ability to assess suicide risk in the current study. We filmed a psychiatric nurse interview of a patient with intermediate suicide risk [25]. Two academic psychiatry teachers portrayed the nurse and patient roles. The first scale used was the Columbia-Suicide Severity Rating Scale (C-SSRS), which has demonstrated good convergent and divergent validity in the international scientific literature [26].

The second scale was the Risk - Emergency - Danger (RED) scale, which is widely used in France in clinical and teaching settings [27] and recommended by the French health authorities [28]. The RED scale follows international recommendations concerning suicide risk assessment [29]. The reference for the evaluation of the suicidal crisis presented by the patient in the video was established by 11 experts, who used the two scales to rate the severity of the suicidal crisis (see Supplementary Information 3). We scored each item by computing an absolute z-score using the recruited expert panelist answers as the reference and summed them for each participant for each scale.

Ability to respond appropriately to an individual with suicidal thoughts

The learner's interpersonal skills in managing suicidal crises were assessed using the Suicide Intervention Response Inventory [30], French version 2 (SIRI-2-VF) [31]. The SIRI-2-VF includes 15 statements corresponding to exchanges between patients and caregivers taken from consultation

excerpts. Each exchange begins with patients' statements concerning an aspect of their situation. Then, two possible answers proposed by two different caregivers are presented. The participant is asked to judge the suitability or unsuitability of each proposed response by giving a score ranging from -3 (very inappropriate response) to +3 (very appropriate response) on a seven-point Likert scale. We scored each excerpt by computing the absolute z-score using published expert panelist answers [31] and summed them for each participant

Confidence

We measured another behavioral effect of VS: the improvement of learners' confidence. Confidence was measured using the Questionnaire on Nursing Skills related to Suicide Risk (QNSSR), which was adapted from a previous version initially developed for medical students [32]. It included 14 items rated on a visual analog scale ranging from the least possible confidence (coded 0) to the greatest confidence possible (coded 10, see the full scale in Supplementary Information 5).

Empathy

Empathy was measured using the Jefferson Scale of Empathy (JSE—health professions student version) [33].

Satisfaction

Satisfaction with the serious game system user-friendliness was assessed using the System Usability Scale (SUS), one of the most widely used questionnaires to measure the perceived ease of use of interactive systems [34]. Satisfaction with the immersive experience was assessed using the Igroup Presence Questionnaire (IPQ), which focuses on the subjective sense of being in a virtual environment [35].

Satisfaction with the authenticity of the virtual patient was measured using six items (see Supplementary Information 2) extracted from the Maastricht Assessment of Simulated Patients

(MAsP) [36], which evaluates the performance of actors simulating patients in an educational setting. These items were chosen to be compatible with the virtual nature of the patient, as no specific scale measuring virtual patient authenticity existed at the time of testing. We also measured satisfaction with the facial expression of emotions displayed by the VP using four items (see Supplementary Information 2).

Satisfaction with the remote group debriefing was assessed using the Debriefing Assessment for Simulation in Healthcare (DASH) Student Version [37]. This scale explores the climate, debriefing structure, ability to engage in exchange, and strengths and areas for improvement. Finally, a 10-item questionnaire was developed to measure satisfaction with overall simulation training [32]. This questionnaire explores various aspects of satisfaction, such as the preference for simulation over another pedagogical modality, the perceived realism of the situation, and the importance of being actively involved, etc. (see Supplementary Information 2). It was completed with a question about the difficulty of the simulation and with a global measure of satisfaction on an 11-point scale.

Statistical Analysis

Missing data were estimated using multivariate imputations by chained equations (50 imputations, mice package of R). The fraction of missing information (fmi) is reported in the results. Linear mixed-effects models were run with subjects as the random factors, skills, knowledge, confidence, and empathy as the successive dependent variables, and time (two modalities: before/after the intervention), arm (two modalities: VS/TAU), and time:arm interaction as the simultaneous dependant variables. All analyses were run as intention-to-treat to preserve randomization. All learners randomly assigned to one of the arms were analyzed together, regardless of whether they completed the VS. The required sample size was estimated based on a meta-analysis of the educational effectiveness of simulation tools with virtual patients [38], which reports Hedges' g effect sizes of 0.94 for knowledge improvement. The number of subjects was estimated to be 25 in

each arm, with a significance level α = 0.05 and power β = 90%. A linear mixed-effects model was also run to explore the effect of the SIVIPSY version (sad or neutral vocal emotion) on satisfaction with the authenticity of the virtual patient (MaSP adapted).

Results

Participants

Participants were recruited from seven nursing schools affiliated with the University of Versailles Saint-Quentin-En-Yvelines. The study began in February 2021 and was completed in July 2022. Participants were informed of the study by their nurse training manager and one author of the present study (PR) during back-to-school meetings involving all first-year students. Students also received an email to inform them about the study. Approximately 1200 students were approached but only 68 consented to participate in the study (response rate of 6%). We included 29 students in the TAU arm and 39 in the VS arm. Most students were female, approximately 25 years of age, and few had previous experience in the psychiatric care of patients (see Table 1).

	Teaching as usual (N = 29)	Virtual Simulation (N = 39)		
	Mean (sd) or %	Mean (sd) or %	Statistic	p
Age (years)	24.6 (7.9)	26.4 (10.5)	$t(66) = -0.85$	0.401
Sex	93.1 (female)	84.6 (female)	$Chi^2(1) = 0.48$	0.488
Native language	6.9 (Non-French)	10.3 (Non French)	$Chi^2(1) = 0$	0.959
Previous experience in psychiatric care (as an intern, as an employee, or with no experience)	37.9 (intern)	17.9 (intern)	$Chi^2(2) = 3.57$	0.168
	10.3 (employed)	10.3 (employed)		
Previous simulation experience	55.2 (No)	59 (No)	$Chi^2(1) = 0$	0.948

Participation in prerequisite online course	6.9 (No)	15.4 (No)	Chi²(1) = 0.48	0.488
Immersion (ITQ)	80.4 (13.3)	75.9 (17.2)	t(65.9) = 1.2	0.235
Implication (GEQ)	3.1 (1.4)	2.8 (1.5)	t(61.7) = 0.78	0.436

Table 1. Participant characteristics

By contrast, participants were familiar with simulation, with more than half having previous experience with this pedagogical method (either high fidelity, standardized patient, or VS). Very few participants did not study the online course before the evaluations. The average ITQ score corresponded to a moderate immersive tendency and the average GEQ score showed a slight lack of game engagement.

There were no significant statistical differences between participants in the TAU and VS arms in terms of demographic characteristics, previous psychiatric and simulation experience, participation in the prerequisite course, immersive tendency, or engagement in games (see Table 1). Four participants in the VS arm did not fully complete the intervention as intended; they were retained in the VS arm according to the intention-to-treat analysis. Among the participants in the VS arm, 18 interviewed the virtual patient with neutral prosody and 21 the virtual patient with sad prosody. No significant statistical differences were measured between participants interacting with the virtual patient expressing neutral vs sad prosody, although participants using the sad prosody version were marginally older and marginally more game-engaged (See Supplementary Table 1).

Effect of the simulation on performance

The descriptive statistics are presented in Table 2 and the test statistics in Supplementary Information 4.

		TEACHING AS USUAL				VIRTUAL SIMULATION			
		BEFORE		**AFTER**		**BEFORE**		**AFTER**	
	Theoretical range	**Mean (sd)**	**% missing**	**Mean (sd)**	**% missing**	**Mean (sd)**	**% missing**	**Mean (sd)**	**% missing**
-SSR (sum of absolute z-cores)	1.1 - 16.7	3.6 (1.6)	0	3.7 (2.4)	3	3.6 (1.7)	0	3. 3 (1.6)	8
ED (sum of absolute z-cores)	1.1 - 6.3	3 (1.4)	0	3.5 (1.8)	3	2.9 (1.5)	0	3.2 (1.5)	8
IRI (sum of absolute z-cores)	10.8 - 188	44.8 (15.8)	0	43.2 (15.9)	3	46.7 (14.1)	0	40.3 (11.9)	8
nowledge otal)	0-50	35.7 (4.8)	0	35.7 (4.4)	3	37.8 (3.9)	0	38.1 (4)	8
PCS (total)	0-100	56.7 (13.2)	0	59.7 (15.1)	3	51 (10.8)	0	61.6 (12.4)	8
SE (total)	20-140	108.1 (9.5)	0	107 (9.8)	3	110.3 (8.7)	0	110.7 (7.2)	8

Table 2. Performance (skills, knowledge, confidence, and empathy) in the two arms before and after the simulation

Outcomes were measured at an average duration of 55 days (SD 18.2 days) after inclusion.

Knowledge

The effect of the time:arm interaction on knowledge was nonsignificant (B = 0.2, SE = 0.8, t(119.7) = 0.2, p = 0.816, fmi = 0.084), suggesting that the intervention was ineffective in improving knowledge of suicidology.

Skills, attitude, and confidence

Ability to evaluate suicide risk

The effect of the time:arm interaction on the C-SSRS (B = -0.3, SE = 0.5, t(125.6) = -0.6, p = 0.582, fmi = 0.047) and RED scales (B = -0.3, SE = 0.5, t(124.8) = -0.5, p = 0.586, fmi = 0.052) was

nonsignificant, suggesting that the intervention was ineffective in improving the evaluation of suicide risk.

Ability to respond appropriately to an individual with suicidal thoughts

The effect of the time:arm interaction on the SIRI was marginally significant (B = -4.5, SE = 2.5, t(119.5) = -1.8, p = 0.076, fmi = 0.085). This interaction is plotted in Supplementary Figure 1: the time effect was nonsignificant for the TAU (B = -1.6, SE = 1.8, t(50.9) = -0.9, p = 0.355, fmi = 0.09), whereas it was significant for the VS (B = -6.2, SE = 1.8, t(64.9) = -3.5, p = 0.001, fmi = 0.136). The performance in response to suicidal thoughts improved after VS, suggesting a possible effectiveness of the intervention on how to interact with a patient experiencing a suicidal crisis.

Confidence

The effect of the time:arm interaction on the QNSSR was significant (B = 7.2, SE = 2.5, t(111.5) = 2.8, p = 0.006, fmi = 0.131). This interaction is plotted in Supplementary Figure 2: the time effect was marginally significant for the TAU (B = 3, SE = 1.8, t(50.9) = 1.7, p = 0.097, fmi = 0.091) and significant for the VS (B = 10.2, SE = 1.7, t(62.8) = 5.8, p < 0.001, fmi = 0.159), with a greater improvement in confidence after VS than TAU. This suggests the effectiveness of the VS in increasing confidence in one's ability to interact with a patient experiencing a suicidal crisis.

Empathy

The effect of the time:arm interaction on knowledge was nonsignificant (B = 1.2, SE = 2, t(122.9) = 0.6, p = 0.536, fmi = 0.065), suggesting that the intervention was ineffective in improving empathy.

Satisfaction

The satisfaction results are presented in Table 3.

Dimension	Variable	Theoretical range	Mean	SD	% missing data

User-friendliness	System Usability Scale	0-100	87.1	9.9	10.3
	Overall Friendliness	1-7	5.5	0.7	10.3
Presence	Igroup Presence Questionnaire (item average)	1-7	4.2	1	10.3
Satisfaction with the virtual patient	Authenticity (item average)	1-4	3.1	0.6	10.3
	Facial emotions quality (item average)	1-4	3	0.7	12.8
	Facial emotions quantity	1-5	3	0.9	12.8
Debriefing	DASH total (item average)	1-7	6.5	0.5	12.8
	DASH stage setting (item average)	1-7	6.5	0.5	12.8
	DASH learning context (item average)	1-7	6.6	0.4	12.8
	DASH organized debriefing (item average)	1-7	6.6	0.5	12.8
	DASH reflection on performance (item average)	1-7	6.3	0.6	12.8
	DASH performance identification (item average)	1-7	6.3	0.8	12.8
	DASH help to improve (item average)	1-7	6.4	0.7	12.8
Satisfaction with the overall simulation training	Questionnaire (item average)	1-4	3.4	0.3	12.8
	Perception of difficulty	1-5	2.9	0.3	12.8
	Global Rating	0-10	8.7	1	12.8

Table 3. Satisfaction with the virtual simulation

They suggest very high user-friendliness of SIVIPSY and a moderate sense of presence induced by the simulation. The avatar was considered relatively authentic, with appropriate natural facial expression of emotions, neither inhibited nor exaggerated. The debriefing was considered to be very good to excellent and satisfaction with the overall intervention was between good and very good. The difficulty of the scenario was considered appropriate.

Impact of emotional prosody on satisfaction with the virtual patient

The effect of Prosody on VP authenticity (MASP adapted) was significant (B = 0.4, SE = 0.2, t(71) = 2.2, p = 0.031, fmi = 0.065). Learners rated the VP as more authentic when he had a sad prosody than a neutral prosody (see Supplementary Figure 3). This difference became marginally significant when age and GEQ (which were marginally different between the two conditions) were entered as covariates in the model (B = 0.4, SE = 0.2, t(63.7) = 1.9, p = 0.064, fmi = 0.131).

Discussion

This exploratory study aimed to establish the effectiveness of VS in training nursing students in suicide risk assessment using a randomized-controlled investigation. Pedagogical effectiveness was measured for satisfaction, knowledge, skills, confidence, and empathy.

SIVIPSY was more efficient than usual teaching to improve confidence in nursing skills for the assessment and care of an individual experiencing a suicidal crisis. A previous study reported that nursing students had higher self-confidence after a simulated standardized patient session than those who watched a traditional video-recorded lecture on suicide [27]. Our results suggest that the beneficial impact of simulation involving actors playing simulated patients extends to VS. It is reasonable to assume that changes in attitudes with the improvement of confidence favored by VS may improve suicidal crisis detection, given that attitudes and self-efficacy have been shown to be associated with the intention to engage in suicide prevention behaviors [39]. Nursing students often feel anxiety and fear before they start their clinical practice in psychiatry [40]. One reason for them to avoid evaluating suicide risk is the anticipation of not knowing what to do in case of suicidal thoughts. Enhancing confidence may have a positive impact on practical behavior (with an increase in suicide risk assessment of actual patients) and lead to improvements in attitude and reduce stigma [3].

The picture was less clear in terms of the effectiveness of SIVIPSY in improving nursing skills related to suicidal crises. The ability to respond appropriately to an individual with suicidal thoughts significantly increased after the VS, whereas it did not after the usual teaching. However, the difference in improvement after VS and TAU was only marginally significant, suggesting that further studies are needed to confirm the greater effectiveness of VS in improving adequate nursing responses to individuals experiencing a suicidal crisis. Further simulation may benefit from increasing online feedback during the interaction with the virtual patient beyond the evolution of bar scores implemented in SIVIPSY. It has been reported that per-interview feedback increased clinicians' empathetic responses toward a patient experiencing a suicide crisis more than post-interview feedback during training with a virtual patient [41]. By contrast, SIVIPSY was not associated with an improvement in the ability to assess the severity of a suicidal crisis. SIVIPSY may thus be ineffective in improving the accuracy of suicide risk assessment. Another explanation could be a lack of sensitivity to change in the tool we have developed to measure this construct.

SIVIPSY was not associated with knowledge improvement. A previous study also reported that knowledge about suicide was comparable after simulation with a standardized patient and after a traditional lecture on suicide [29]. This suggests that the specificity of the pedagogical action of simulation does not appear to lie in improving theoretical nursing knowledge. A recent analysis confirmed this interpretation by reporting a lack of significant differences between simulation, in general, and controls in improving suicide risk assessment and intervention in RCTs, whereas non-RCT interventions with simulation and pre-post design were associated with knowledge improvement [42].

Neither VS nor TAU modified nursing students' general level of empathy. The average empathy score in the present sample was comparable to that reported in a US sample [33]. Empathy measured with the JSE may be a relatively stable personality disposition, even in the healthcare setting [43],

which is unlikely to change after a one-off intervention such as a simulation session. Changes in empathy have been observed in medical students, but only over several years, with a progressive decline, especially after having spent more time interacting with patients [44]. The existence of such a decline needs to be clarified concerning nursing students, for which there are conflicting results [45,46].

There was high satisfaction with SIVIPSY user-friendliness, the overall simulation, and the group debriefing, suggesting that SIVIPSY should be implemented in teaching as usual. A social desirability bias could explain the high level of satisfaction reported in this study, as academic teachers were involved in the debriefing. However, all questionnaires were anonymously completed, which should have limited such bias. The level of satisfaction was slightly less concerning the sense of presence, the authenticity of the virtual patient, and his emotional reactions. Our results suggest that authenticity was, as expected, improved using emotional prosody, although such improvement could be partially explained by the older age and greater game implication of the participants who used the sad prosody version of the VS. Future virtual patients in pedagogical settings should display vocal expression of emotions, as authenticity is a critical component of interactive multimedia mental health education programs for nurses [47]. The time dedicated to coding the verbal and emotional reactions of the virtual patient was substantial: further intervention should use a more dynamic approach to emotional expressions based, for example, on the appraisal theory of emotion [48,49] to automate the avatar reactions. This could increase the authenticity of the virtual patient and decrease the burden on the teacher who creates the simulation scenario.

Limitations

The main methodological limitation of this study was the lack of an active comparator (an additional pedagogical intervention in the control arm), which may have inflated the efficiency of VS. As previously reported, attitudes (ways of approaching patients with suicidal ideas, beliefs, self-efficacy,

confidence, and sense of preparedness regarding suicidal crises) improved significantly when simulation training was compared to an inactive comparator. By contrast, no significant difference was found concerning these attitudes when simulation training was compared to an active comparator [42]. Other methodological limitations were the lack of preregistration for this exploratory study, with no primary outcome selected, and the lack of a control for multiple comparisons. Despite randomization, groups were unbalanced in terms of the outcomes, with less confidence and a lower ability to respond appropriately to an individual with suicidal thoughts in the intervention group than the control group. Further studies should confirm the present results by stratifying learners based on these two outcomes. Finally, the expressiveness of the virtual patient is still limited, particularly postures and gestures.

Conclusion

In conclusion, VS shows encouraging results in improving the confidence and skills of nursing students to intervene in suicidal crises. Further studies are needed to assess the impact of VS on patient outcomes such as the prevention of death by suicide and suicide attempts and the return on training investment.

Acknowledgments

Conflicts of Interest

None declared

Abbreviations

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Supplementary Files

Supplementary Information 1. Design of the virtual patient for suicide risk assessment training (SIVIPSY).
URL: http://asset.jmir.pub/assets/f1514ef97795bf8cc18c26e9ef25a889.docx

Supplementary Information 2. Satisfaction questionnaires.
URL: http://asset.jmir.pub/assets/3932fa174afd41530f96dbc27a2a41e8.docx

Supplementary Information 3. Establishment of the scoring norms for the Columbia-Suicide Severity Rating Scale and the Risk-Emergency-Danger tool.
URL: http://asset.jmir.pub/assets/628e89513ae9940dd530c0495864dc46.docx

Supplementary Information 4. Test statistics of the effect of the simulation on performance.
URL: http://asset.jmir.pub/assets/00c5ef49bce375f15f9f67350ddcd094.docx

Supplementary information 5. Questionnaire on Nursing Skills related to Suicide Risk (QNSSR).
URL: http://asset.jmir.pub/assets/337e982eb8317d37026cb8cb23b2889a.docx

Supplementary Table 1. Participant characteristics according to the virtual patient's prosody.
URL: http://asset.jmir.pub/assets/d8acba2d6192d19ea0c882c1ead52748.docx

Figures

Schematic representation of the study design.