

Review article/Pregledni znanstveni članek

## The use of virtual simulation or virtual patients in nursing education: An integrative literature review

Uporaba virtualnih simulacij ali virtualnih pacientov pri izobraževanju študentov v zdravstveni negi: integrativni pregled literature

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**Keywords:** clinical decisions; students; nursing; simulated learning environment; critical thinking

**Ključne besede:** klinične odločitve; študenti; zdravstvena nega; simulirano učno okolje; kritično razmišljanje

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### ABSTRACT

**Introduction:** The Covid-19 epidemic has significantly compromised the practical training of nursing students. While in nursing, the use of simulation is not new, virtual simulation or virtual patients represent relatively new educational modalities. The aim of this literature review was to examine the most recent empirical evidence on the efficacy or effectiveness of using virtual simulation or virtual patients in nursing education around the world.

**Methods:** Scholarly articles published between 2016 and 2021 in the CINAHL, MEDLINE, ERIC and COBIB bibliographic databases were reviewed. The review included articles which focused on student nurses using virtual simulation or virtual patients as a method of learning rather than as a way of assessing students' knowledge acquired through a different learning method. A thematic analysis was used to synthesise the results.

**Results:** Twelve studies were included in the review, most of which were conducted in developed countries. The results showed that the use of virtual simulation or virtual patients has a positive effect on the acquisition of cognitive and affective knowledge, practical implementation of interventions, assessment of self-efficacy and competence, and student satisfaction.

**Discussion and conclusion:** In situations where clinical training is not possible for nursing students, the use of virtual simulation or virtual patients can replace the clinical setting for the purposes of practising clinical decisions, but it cannot replace the clinical education and experience students obtain when working with actual patients.

### IZVLEČEK

**Uvod:** Epidemija covid-19 je omejila praktično usposabljanje študentov zdravstvene nege. V zdravstveni negi simulacije niso novost, razmeroma novo področje izobraževanja pa so virtualne simulacije ali virtualni pacienti. Namen pregleda je bil preučiti najnovejše empirične ugotovitve o učinkovitosti oziroma uspešnosti uporabe virtualnih simulacij ali virtualnih pacientov pri študiju zdravstvene nege po svetu.

**Metode:** Pregledani so bili znanstveni članki, objavljeni med letoma 2016 in 2021 v bibliografskih bazah CINAHL, MEDLINE, ERIC ter v kataložno-bibliografski bazi podatkov COBIB. Proučevani so bili članki, ki so obravnavali študente zdravstvene nege, pri katerih sta bila virtualna simulacija ali virtualni pacient uporabljena za način učenja in ne kot način preverjanja usvojenega znanja druge učne metode. Sinteza rezultatov je bila narejena s tematsko analizo.

**Rezultati:** Vključenih je bilo 12 raziskav, ki so bile večinoma opravljene v razvitih državah. Rezultati so pokazali pozitiven vpliv virtualnih simulacij ali virtualnih pacientov na kognitivno in afektivno domeno znanja, praktično izvedbo intervencij, oceno samoučinkovitosti, kompetentnosti in zadovoljstva študentov.

**Diskusija in zaključek:** Kadar kliničnega usposabljanja za študente zdravstvene nege ni mogoče zagotoviti, so virtualne simulacije ali virtualni pacienti lahko eno izmed možnih okolij za trening kliničnih odločitev, ki bi jih študent sicer pridobil v klinični praksi, ne morejo pa nadomestiti kliničnega usposabljanja in izkušenj, ki jih študent pridobi ob pacientu.



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## Introduction

The Covid-19 epidemic has presented the field of nursing education with an unprecedented challenge. In Slovenia, a Bachelor's degree programme in nursing comprises a total of 4600 hours, of which 2300 hours are completed in direct contact with the clinical setting (Skela-Savič, 2015). At the beginning of the epidemic, as part of the governmental measures to prevent the spread of Covid-19, all activities related to the acquisition of practical skills in university offices and laboratories were temporarily suspended, and some clinical facilities were also closed for safety reasons.

The main objective of undergraduate nursing programmes is to facilitate students' acquisition of the competencies they need for professional practice as registered nurses (Díaz Agea, Megías Nicolás, García Méndez, Adánez Martínez, & Leal Costa, 2019). During their studies, students are therefore trained to make critical decisions in clinical practice and to function successfully within a complex and dynamic health system (Norman, 2012). Across the globe, institutions delivering nursing education have long faced increasing enrolment numbers and decreasing possibilities of securing relevant clinical settings where students can complete the prescribed number of hours of clinical training. Studies show that such settings can be successfully replaced by the use of simulations (Swenty & Eggleston, 2011; Karnjuš & Pucer, 2012).

The use of simulation in nursing education represents an active learning modality which provides students with the opportunity to experience various real-life scenarios in the clinical setting and develop their clinical skills in a safe and highly controlled learning environment (Oozageer Gunowa, Elliott, & McBride, 2018; Lugo et al., 2021). In nursing education, different plastic models (manikins) of patients and body parts (arm, leg, abdomen, buttocks, etc.) are typically used for performing simulations and teaching students the basic nursing skills. At present, manikins can be used in combination with specific types of computer software to represent different physical states and patient responses (Akaike et al., 2012; Cook et al., 2013). The disadvantages of such solutions include high purchasing and maintenance costs, the need for control by appropriately trained professionals, and the limitation on the number of users. Moreover, such training is often time-limited, which may result in potentially poorer knowledge retention (Ryall, Judd, & Gordon, 2016). The increasing number of simulation centres shows that the use of simulation in the training of future health professionals is also gaining importance in Slovenia (Karnjuš & Pucer, 2012). Slovenian nursing students are aware of the importance of simulated clinical training and have a positive attitude towards its implementation (Pajnič, 2016).

Virtual simulation represents a relatively new area of nursing education (Ryall et al., 2016). There are several types of virtual simulation. The so-called screen-based simulation can be implemented through the use of tablets, smartphones and PC screens, which are already widely used by nursing students as part of the study process. This technology offers new opportunities for teaching scenarios, critical thinking and reflection on what has been learned and applied in practice (Ryall et al., 2016). Virtual patients are a relatively new e-learning modality which incorporates multimedia, interactive elements and virtual simulations. They guide students through the treatment of specific clinical cases, including clinical pathways and treatment algorithms (Zdravković, Prunk, & Dinevski, 2013; Ryall et al., 2016). There are many advantages to the use of virtual simulations for the purposes of nursing education. The teacher and students are no longer dependent on live demonstrations of nursing skills and procedures, and students are thus able to repeat nursing procedures and scenarios without the risk of harming actual patients. This form of teaching allows for greater control over students' work and progress and provides students with immediate feedback on their performance (Tolarba, 2021). The use of virtual simulations or virtual patients is an effective way for students to improve their critical thinking and decision-making skills (Ryall et al., 2016). On the other hand, it should be noted that the costs of software installation and maintenance are quite high. Other weaknesses of such approaches include the lack of personal contact and interpersonal communication between the student and the teacher, and lack of ability to make modifications to the pre-programmed learning experience (Tolarba, 2021).

Despite certain shortcomings, the potential of virtual simulation and virtual patients, combined with the fact that the population of nursing students is increasingly technologically savvy, supports the future implementation of this teaching modality also in nursing education in Slovenia.

### *Aim and objectives*

The main purpose of this literature review was to examine the latest empirical evidence on the effectiveness and efficiency of using virtual patients or virtual simulation in nursing education around the world.

The study aimed to answer the following research question:

- How effective and efficient is the use of virtual simulation or virtual patients in nursing education?

## Methods

An integrative literature review was conducted to investigate the use of virtual simulation or virtual patients in nursing education.

## Review methods

The search for English-language articles was conducted in the following bibliographic databases: CINAHL, MEDLINE and ERIC, via the EBSCOhost information service. The search for Slovenian-language articles was conducted in the COBIB bibliographic/catalogue database. We used the following keywords and phrases to search for English-language articles: "virtual patient", "virtual simulation" and "student nurse", and the following keywords and phrases to search for Slovenian-language articles: "virtualni pacient", "virtualna simulacija", "študenti" and "zdravstvena nega". The decision to use this general set of keywords and phrases was made due to the low number of hits in our preliminary database

search. We also used the Boolean operators AND and OR. The search for relevant articles was conducted between January 2021 and June 2021.

We limited our search to only include English- and Slovenian-language articles published between 2016 and 2021. We decided on a five-year timeframe as the field of technology is constantly and rapidly evolving, which affects the usability of research results. Our inclusion criteria included availability of articles in full-text format, appropriate methodology used (qualitative, quantitative, mixed methods research), peer-reviewed studies, and use of virtual simulation or virtual patient for learning purposes rather than as methods of the assessment of knowledge acquired through a different learning method. The studies included in the literature review were conducted on

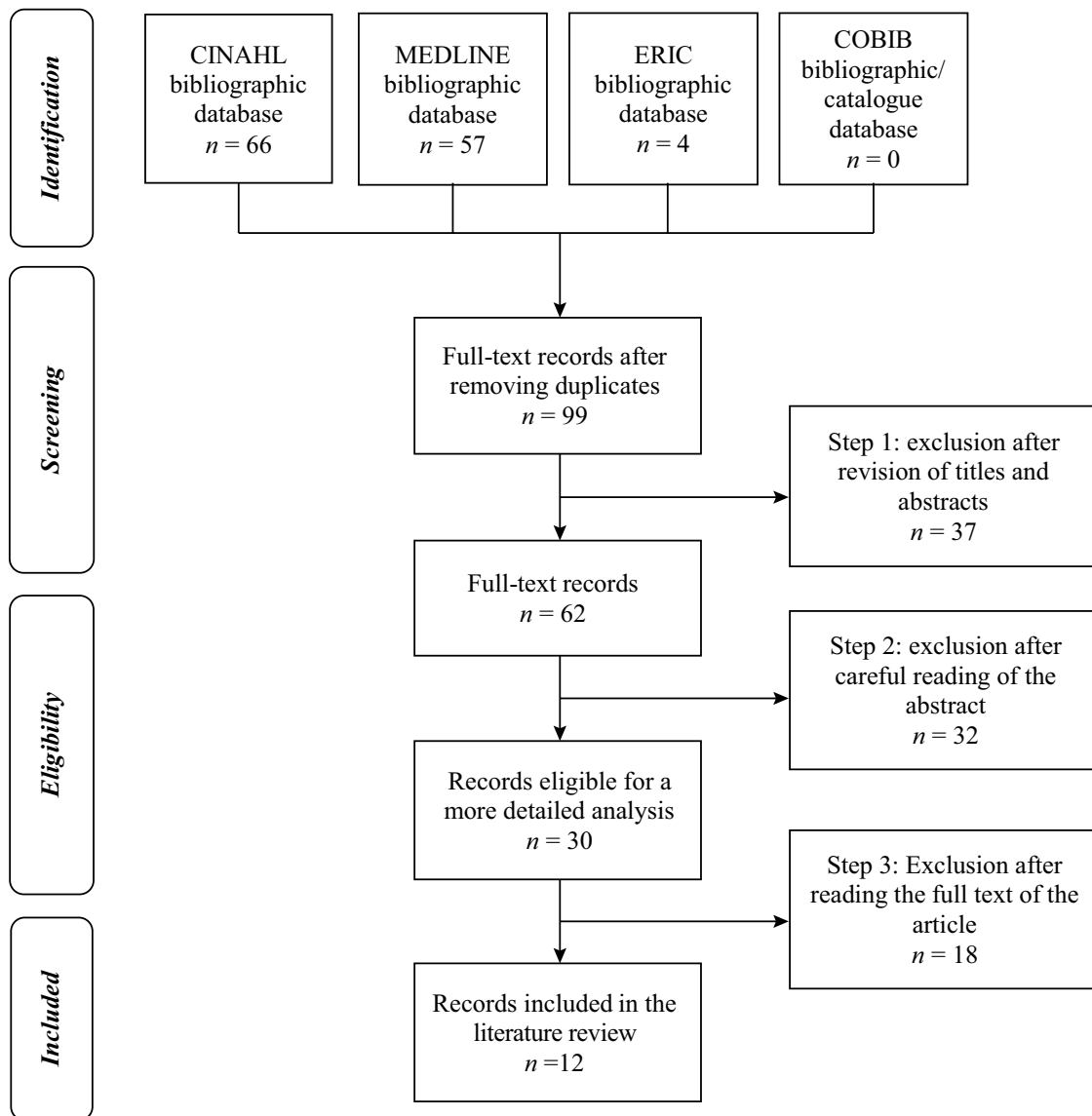


Figure 1: PRISMA flow diagram of literature review

populations of nursing students. We excluded articles which did not meet the eligibility criteria related to the field of research, as well as pilot studies, editorials, commentaries, protocols, reviews, letters to the editor, and reports.

### *Results of the review*

Our literature search yielded 127 electronic records (66 from the MEDLINE bibliographic database, 57 from the CINAHL bibliographic database, 4 from the ERIC bibliographic database). EBSCOhost excluded duplicate entries simultaneously located in the CINAHL, MEDLINE and ERIC bibliographic databases. After removing the duplicates, the number of records was reduced to 99 electronic sources. Our search in the COBIB bibliographic/catalogue database returned no suitable records in Slovenian. The process of article selection is illustrated by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram (Page et al., 2021).

### *Quality assessment of the review and description of data processing*

The quality assessment was based on the recommendations by Polit & Beck (2012), who list seven levels of the evidence hierarchy in scientific research. Of our search results, one study was classified as level 2a and the remaining 11 studies as level 2b in this evidence hierarchy. The critical appraisal and content analysis of the studies included in our review followed the Hart (2001) guidelines: we used the spreadsheet form to collect data on the design of the study, the sample used, the educational intervention implemented, the measurement instruments used, and the main findings obtained. For the final content analysis, we used the method of content aggregation and comparison of the findings of individual studies.

## **Results**

Table 1 shows the characteristics of the 12 studies which met our inclusion criteria. Our literature review included seven studies which contained (efficiency) assessments conducted before and after an educational intervention (Foronda, Hudson, & Budhathoki, 2017; Borg Sapiano, Sammut, & Trapani, 2018; Smith et al., 2018; Mabry, Lee, Roberts, & Garrett, 2019; Padilha, Machado, Ribeiro, Ramos, & Costa, 2019; Kang, Kim, Lee, Kim, & Kim, 2020; Kang, Hong, & Lee, 2020) and five studies which only included one assessment (William, Vidal, & John, 2016; Redmond et al., 2020; Lee, Kim, & Eom, 2020; Liu, 2021a; Liu, 2021b). Nearly half of all studies were conducted in the United States (USA), three in Korea (Kang et al., 2020; Kang, Hong, & Lee et al., 2020; Lee et al., 2020) and one in Malta (Borg Sapiano et al., 2018), Portugal (Padilha et al., 2019), Ireland (Redmond et al., 2020) and Kuwait (William et al., 2016), respectively.

al., 2019), Ireland (Redmond et al., 2020) and Kuwait (William et al., 2016), respectively.

In the studies included in the literature review, virtual simulations or virtual patients were used in different fields of nursing, mainly in mental health nursing (Lee et al., 2020; Liu, 2021a; Liu, 2021b), paediatrics (Kang et al., 2020; Kang, Hong, & Lee, 2020), postnatal and adult care (Padilha et al., 2019; Foronda et al., 2017; Kang, Hong, & Lee, 2020), emergency medicine (Borg Sapiano et al., 2018), and for learning specific skills or procedures (William et al., 2016; Smith et al., 2018; Redmond et al., 2020). In one study (Lee et al., 2020), virtual simulation was performed by means of virtual reality, and in two studies (Mabry et al., 2019; Kang et al., 2020) by means of high fidelity simulation.

## **Discussion**

There is a growing number of studies focusing on the use of virtual simulations or virtual patients in nursing education. As many as half of the studies included in this review were conducted in the last two years, which may also be related to the outbreak of the Covid-19 epidemic, which caused significant difficulties in conducting training in educational and clinical settings and triggered the search for practical solutions for the implementation of nursing programmes.

The studies included in our review were conducted in the United States, Korea, Malta, Portugal, Ireland and Kuwait. The observed lack of studies conducted in developing countries may be associated with high costs of software and hardware required for the implementation of this educational modality. Six of the studies reviewed examined the effectiveness or efficacy of virtual simulations or virtual patients in terms of cognitive knowledge acquisition. Two of the studies which compared learning through virtual simulations using control groups reported statistically significant differences between the two groups (Padilha et al., 2019; Liu, 2021b), while one study observed no statistically significant differences (Smith et al., 2018). This suggests that virtual simulations are as effective or even more effective than traditional learning methods in terms of cognitive knowledge acquisition. Two studies showed that students made statistically significant knowledge gains compared to the pre-intervention period, as assessed after the intervention (Foronda et al., 2017; Borg Sapiano et al., 2018). Two studies compared the effectiveness of different forms of virtual simulation (screen-based simulation and 3D simulation using VR glasses) or other forms of virtual education (high fidelity simulation). While the first study reported that the cognitive knowledge attained through virtual simulation was statistically significantly better than that attained through high fidelity simulation (Kang et al., 2020), the second study detected no statistically significant differences

**Table 1: Integrative literature review – characteristics of the studies included in the review**

<i>Author, State</i>	<i>Research design</i>	<i>Sample</i>	<i>Intervention</i>	<i>Measuring instrument</i>	<i>Main findings</i>
Borg Sapiano et al., 2018, Malta	Pre-test/post-test	$n = 166$	VS (virtual simulation) with three scenarios of rapid patient deterioration (cardiac, shock, respiratory).	Pre-scenario and post-scenario knowledge assessment. Performance in the VS was assessed automatically by the VS software with feedback provided after task completion.	Students showed statistically significant improvement ( $p < 0.001$ ) in post-scenario knowledge. The highest mean performance scores were obtained in the third VS, indicating progress and learning efficiency. Prior knowledge was found to have no effect on students' performance in the VS. The VS was shown to improve both student knowledge and performance in scenarios of rapid patient deterioration.
Foronda et al., 2017 USA	Pre-test/post-test	$n = 108$	A one-hour lesson on hypertension, followed by a 30-minute group VS, in which students guided a faculty member operating an avatar in a scenario with a VP (virtual patient).	A five-item pre- and post-intervention questionnaire to assess students' cognitive knowledge, and a questionnaire on their affective changes in relation to the VS. A questionnaire on students' satisfaction with the use of VS in nursing education.	Compared to their pre-test scores, students made statistically significant progress ( $p < 0.001$ ) in their cognitive knowledge after the VS. The VS experience was described as useful and 82% of the respondents wanted to use VS in the future. The VS promoted in-depth and problem-based learning experiences and evidence-based decision-making training for nursing students.
Lee et al., 2020 Korea	Post-test research design	$n = 60$	Five VR scenarios simulating clinical symptoms of schizophrenia and related tasks (use of head-mounted displays/VR glasses).	Usability and usefulness of VR scenarios: a 17-item quantitative questionnaire and a 7-item qualitative questionnaire (open-ended questions).	VR simulations are useful and effective alternatives compared to conventional nursing simulations. Nursing students rated VR as useful and interesting and confirmed its usability for educational purposes.
Kang et al., 2020 Korea	Quasi-experimental pre-test/post-test research design	The sample was divided into three groups: Group 1 ( $n = 54$ ), Group 2 ( $n = 69$ ) and Group 3 ( $n = 69$ ).	After theoretical training, students caring for children with asthma were divided into three groups: Group 1 completed a VS activity, Group 2 completed a HFS activity and Group 3 completed a combination of both methods.	Pre-intervention and post-intervention knowledge assessment (including assessment of practical skills) on nursing care for children with asthma and assessment of confidence in practice (self-evaluation which included assessment, planning, intervention and evaluation). After the intervention, students' practical performance (assessment of the situation, implementation of the intervention) was also assessed.	Group 3 scored highest in all assessment categories. Statistically significant differences ( $p = 0.026$ ) were observed in knowledge assessment between the groups (post/pre scores average). Groups 1 and 3 (with VS) obtained higher scores than Group 2. Differences between the groups were also observed in students' confidence in practice ( $p < 0.001$ ). Group 2 assessed their self-confidence in practice as lower due to the lack of self-learning opportunities after completing the theoretical training. Groups 2 and 3 scored statistically significantly ( $p < 0.001$ ) higher in performing nursing procedures.

Continues

<i>Author, State</i>	<i>Research design</i>	<i>Sample</i>	<i>Intervention</i>	<i>Measuring instrument</i>	<i>Main findings</i>
Kang, Hong, & Lee, 2020 Korea	Pre-test/post-test	$n = 47$	In the first week of the study, preparations were made for the VS and in the remaining three weeks VS lessons were held once a week, consisting of five phases (introduction, pre-VS activity quiz, VS activity, post-VS quiz, debriefing). VS from maternity nursing, child nursing and adult nursing.	Pre-simulation and post-simulation surveys: a 27-item questionnaire assessing critical thinking skills and a 45-item questionnaire assessing independent learning, divided into seven subthemes. Post-simulation survey: a 13-item questionnaire assessing the effectiveness of the VS and open questions about the impressions of learning through VS.	No statistically significant differences were observed in the assessment of critical thinking ( $p = 0.872$ ) and independent learning ( $p = 0.881$ ) before and after the VS, but statistically significant differences were observed in the assessment of the subtheme of independent learning (selection of learning resources) through VS ( $p = 0.032$ ). Students confirmed that the VS activities improved their assessment of patient status, critical thinking, decision-making, and grasp of the topic, and that the VS activities were useful prior to clinical training. While students felt safer and more relaxed at home, they missed the human contact and would have preferred the VS to be available in their native language.
Liu, 2021a USA	Prospective cohort study	Sample divided into two cohorts: simulation cohort ( $n = 149$ ), non-simulation cohort ( $n = 150$ ).	The simulation cohort participated in five VS activities (severe anxiety and depression, alcohol withdrawal syndrome, bipolar disorder, schizophrenia) before attending the lecture on mental health nursing.	The Australian National Mental Health Literacy Survey instrument	After the VS, the simulation cohort reported greater compassion and better insight into the prognosis of people with depression ( $p = 0.003$ ). The VS improved students' optimism regarding the long-term outcomes for patients with depression and reduced their pessimism about the long-term outcomes for patients with schizophrenia. The simulation cohort assessed patient outcomes more optimistically than the non-simulation cohort ( $p < 0.01$ ).
Liu, 2021b USA	Prospective cohort study	Sample divided into two cohorts: simulation cohort ( $n = 149$ ), non-simulation cohort ( $n = 150$ ).	The simulation cohort participated in five VS activities (severe anxiety and depression, alcohol withdrawal syndrome, bipolar disorder, schizophrenia) before attending the lecture on mental health nursing.	One year after the VS intervention, the Australian National Mental Health Literacy Survey instrument was used.	Students in the simulation cohort showed a significant increase in the knowledge of available treatment options for managing depression and schizophrenia after one year ( $p < 0.05$ ). These findings support the use of VS in undergraduate mental health nursing education with active faculty involvement.
Mabry et al., 2019 USA	Quasi-experimental cross-sectional pre-test/post-test research	Sample ( $n = 151$ ) divided into three cohorts.	All cohorts performed repetitions of VS scenarios up to a certain score, with the same scenario subsequently repeated using HFS.	An anonymous modified 10-item self-efficacy survey pre-VS and post-HFS.	The VS followed by HFS statistically significantly increased student self-efficacy scores in all three cohorts ( $p = 0.001$ , $p = 0.037$ , $p = 0.005$ ). According to the results, the use of VS increased student engagement in HFS, which included teamwork, collaboration and communication and clinical skills.

Continues

<i>Author, State</i>	<i>Research design</i>	<i>Sample</i>	<i>Intervention</i>	<i>Measuring instrument</i>	<i>Main findings</i>
Padilha et al., 2019 Portugal	A randomised control trial with a pre-test and 2 post-tests	Students treating a patient with hypoxia: experimental group ( $n = 21$ ), control group ( $n = 21$ ).	The experimental group learned with the help of VS, and the control group processed the same content in the same timeframe using a low-fidelity simulator in a realistic environment.	Assessment of knowledge and clinical reasoning (before intervention, immediately after the intervention, and two months after the intervention), assessment of students' level of satisfaction with the learning modality and of their self-efficacy after completion of the educational intervention.	The experimental group showed statistically significant progress in knowledge immediately after the educational intervention ( $p = 0.001$ ) and also in the follow-up assessment two months after the intervention ( $p = 0.02$ ), as well as a higher level of learning satisfaction ( $p < 0.001$ ). No statistically significant differences in the assessment of self-efficacy were observed between the groups ( $p = 0.9$ ).
Redmond et al., 2020 Ireland	A cross-sectional study	$n = 148$	A VP which required students to assess, plan and manage the care of a chronic venous leg ulcer.	Post-intervention Reusable Learning Object GETLQuestionnaire, Wound Care Competency Outcomes Questionnaire, open-ended questions about learning with the use of the VP.	Analysis of the questionnaires showed that students assessed the VP-based simulation as an effective educational method for increasing wound care competency. It enabled students to practice their nursing skills and consolidate the theoretical content in a safe environment that was not affected by lack of resources or availability of clinical practice, space and qualified staff.
Smith et al., 2018 USA	A quasi-experimental study with repeated measurements	Sample ( $n = 197$ ) randomised to three groups: intervention groups A ( $n = 59$ ) and B ( $n = 58$ ) and control group C ( $n = 55$ ).	Students learned how to perform decontamination through an online module and were then divided into three groups: Group A – 3D VS using head-mounted displays/VR glasses, Group B – VS using computer and mouse, Group C – traditional printed instructions.	A pre-intervention demographic questionnaire and 20-item test to assess cognitive learning. A post-intervention and at 6-months follow-up assessment of cognitive knowledge and practical skills. The experimental groups were invited to participate in focus groups to discuss their satisfaction and overall experience with the VS.	Significant progress in all post-intervention assessments in all three groups (all three groups $p < 0.001$ ), retained also after six months (Groups A and C: $p < 0.001$ ; Group B: $p = 0.006$ ). The students were satisfied with the VS. The 3D VS using VR glasses was described as a more interesting and interactive learning experience. VS represents an alternative learning method for simulated learning, but the development of best practice approaches requires further research.
William et al., 2016 Kuwait	A quasi-experimental study, control group.	Sample ( $n = 62$ ) divided into a control group ( $n = 33$ ) and an experimental group ( $n = 29$ ).	The intervention group learned phlebotomy using VR simulations, while the control group used a traditional approach using a simulated plastic arm.	A questionnaire on participants' socio-demographic data and a standardised checklist of skills for the implementation of phlebotomy assessing the procedure by steps and the overall accuracy of performance.	Both methods were shown to be effective. There were no statistically significant differences in performance between the two groups ( $p < 0.005$ ). Both groups achieved high results in the assessment of the phlebotomy procedure using a skills checklist for individual steps of the procedure.

*Legend: n – number; VS – virtual simulation; HFS – high fidelity simulation; VR – virtual reality; USA – United States of America; p – statistical significance*

in cognitive knowledge (Smith et al., 2018). It can thus be summarised that a screen-based virtual simulation is equally or more effective at cognitive knowledge acquisition than more expensive virtual simulation methods or high fidelity simulations which require additional hardware and computer software.

Three studies investigated the effectiveness or efficiency of learning with virtual simulations or virtual patients. There were no statistically significant differences in student performance in nursing procedures between the experimental and control groups (William et al., 2016, Smith et al., 2018). Interestingly, one study (Kang et al., 2020) found that although learning through virtual simulation did result in higher scores on knowledge assessments, participants scored statistically significantly lower on practical performance of nursing procedures than when using other learning methods (virtual simulation combined with high fidelity simulation, or high fidelity simulation only). We found that the efficiency of virtual simulation in performing nursing procedures is comparable to that of traditional learning methods. However, it is also advisable to combine them with high fidelity simulation, as in one of the studies reviewed (Kang et al., 2020), the group which learned through a combination of virtual simulation and high fidelity simulation achieved the highest scores in all assessment sets. Similar results were also reported by Mabry et al. (2019), namely that virtual simulation followed by high fidelity simulation resulted in statistically significant increases in student engagement, teamwork, collaboration, and communication and clinical skills. It is therefore reasonable to consider integrating the two modalities, as virtual simulation allows for the repetition of learning activities in a safe environment, while high fidelity simulation provides a realistic representation of the clinical environment and practical nursing procedures.

Five studies investigated the effects of virtual simulation or virtual patients on the affective domain of knowledge, self-efficacy ratings and sense of competence. Two studies assessing self-efficacy reported no statistical differences in self-perceived efficacy between participating groups, regardless of learning modality. Mabry et al. (2019) observed statistically significant differences in students' perceptions of self-efficacy when high fidelity simulation was used after virtual simulation. This again confirms the aforementioned recommendation to combine virtual simulation with high fidelity simulation. It is also important to note that in one of the studies reviewed, participants who had learned through virtual simulations showed statistically significantly higher levels of compassion, better insight into the prognosis of people with depression, and more optimistic assessment of patient outcomes compared to the control group (Liu, 2021a). In one study, students reported that virtual simulation

provided in-depth and problem-based learning experiences (Foronda et al., 2017), while in another study students described the use of a virtual patient as an effective method to increase their competency in wound care (Redmond et al., 2020).

Students were found to rate education through virtual simulation or a virtual patient as positive in all studies which focused on student feedback (Foronda et al., 2017; Smith et al., 2018; Kang, Hong, & Lee, 2020; Lee et al., 2020). Students felt more confident and relaxed in their home environment; virtual simulation improved their understanding of the content, and they rated it as a useful educational method before undertaking clinical training (Kang, Hong, & Lee, 2020).

Learning in a virtual environment is safe compared to the real environment and does not pose a threat to patients. It allows students to practice their skills repeatedly and revise the theoretical content in an environment that is not affected by lack of resources or availability of clinical practice, space constraints or lack of specialist staff. In addition, the virtual environment can effectively replicate real-life nursing situations that students will encounter in the clinical setting, and can thus effectively replace the practice of clinical decision-making in existing simulation environments in university laboratories. Virtual simulations or virtual patients are not limited by the number of repetitions a student can complete, which increases their learning efficiency. This was also confirmed in the study by Borg Sapiano et al. (2018), who highlighted the gradual approach to learning, progression and attainment, as students obtained the highest scores after the last repetition.

The effects of education through virtual simulations are long-lasting. This was confirmed in a study by Liu (2021b), who investigated long-term effects of virtual simulation one year after the intervention. Students in the simulation cohort showed a significant increase in knowledge and acceptance of available treatments for managing depression and schizophrenia (Liu, 2021b). Similarly, two other studies reviewed found that the group using virtual simulation retained their knowledge to a statistically significant degree after two months (Padilha et al., 2019) and six months (Smith et al., 2018). It is also necessary to highlight the shortcomings of this learning method. Students (Kang, Hong, & Lee, 2020) pointed out that they missed real human contact when learning through virtual simulations and that they wanted virtual simulations to be delivered in their native language.

A systematic review of the literature on the use of virtual simulations in nursing education, which included 23 studies published between 2010 and 2020, reached similar conclusions to our research. The author of this systematic review recommends that all nursing educators support the possibility of integrating virtual simulations into the nursing curriculum (Tolarba, 2021).



Nursing education would benefit greatly from educational approaches that use virtual simulation or virtual patients for both learning and research purposes (Foronda et al., 2017). However, to reach more robust conclusions in this field, more high-quality longitudinal research should be conducted on larger samples. It will also be a challenge for future nursing education providers to determine which contents of the curriculum virtual simulation or virtual patients can complement, which they can completely replace, and which contents cannot be transferred to the virtual environment due to the nature and specificities of the field.

We see the limitations of our study in the selected five-year timeframe, the inclusion of articles in full-text and the decision to search for records only in the selected databases. This resulted in a limited number of studies included in the review. These studies were also conducted on small samples and included brief educational interventions. This may have led to broader conclusions and generalisation of the research findings. When interpreting the results, the subjectivity of participants' self-assessment should also be taken into account. The quality of the studies reviewed was assessed using evidence hierarchy, and the results of our literature review might have been different if we had used assessment tools for this purpose.

## Conclusion

The Covid-19 epidemic has posed a challenge to nursing education and prompted researchers to consider the possibility of introducing new and innovative learning methods. One such possibility is the introduction of virtual simulation or virtual patients. Through this literature review, we have demonstrated the effectiveness of this learning method in nursing education for the acquisition of both cognitive and affective knowledge, the practical implementation of nursing procedures, and the assessment of self-efficacy and competence. According to our results, students are satisfied with this form of training and evaluate it positively. This area of research is a fertile field for conducting further research and, based on new findings, also for redesigning current learning environments. We can conclude that virtual simulation or virtual patients have the potential to complement the existing educational methods by helping students to make more confident clinical decisions and shortening the time they need to put them into practice.

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*Slovenian translation/Prevod v slovenščino*

## Uvod

Epidemija koronavirusne bolezni (covid-19) je postavila nov izziv na področju izobraževanja

študentov zdravstvene nege. Študij zdravstvene nege v Sloveniji obsega 4600 ur, od tega kar 2300 ur v neposrednem stiku s kliničnim okoljem (Skela-Savič, 2015). Ob začetku epidemije so se zaradi vladnih ukrepov za preprečevanje širjenja covid-19 dejavnosti, povezane s pridobivanjem praktičnega znanja v kabinetih in laboratorijih fakultet, začasno prekinile, vrata pa so zaradi varnosti zaprle tudi določene klinične ustanove.

Pridobitev ustreznih kompetenc za opravljanje poklica diplomirane medicinske sestre/zdravstvenika je glavni cilj študija zdravstvene nege (Díaz Agea et al., 2019). Med študijem je študente treba usposobiti, da bodo kritično sprejemali klinične odločitve ter bodo po študiju uspešno delovali v kompleksnem in dinamičnem zdravstvenem sistemu (Norman, 2012). Institucije, ki izvajajo učne programe s področja zdravstvene nege, se tako v tujini kot tudi pri nas že dalj časa soočajo z vse večjim številom vpisanih študentov in vedno manjšim številom ustreznih kliničnih okolij, v katerih študenti lahko opravljajo predpisano število ur kliničnega usposabljanja, kar se uspešno nadomešča s pomočjo izvajanja simulacij (Swenty & Eggleston, 2011; Karnjuš & Pucer, 2012).

Uporaba simulacij pri izobraževanju študentov zdravstvene nege je aktivna oblika poučevanja, pri katerem so študenti izpostavljeni različnim scenarijem resničnega življenja in kliničnega okolja. Ob tem razvijajo svoje klinične veščine, hkrati pa je učno okolje varno in dobro nadzorovano (Oozageer Gunowa, Elliott, & McBride, 2018; Lugo et al., 2021). V zdravstveni negi se za izvajanje simulacij in učenje osnovnih kliničnih spretnosti večinoma uporabljajo različni plastični modeli (lutke) pacientov ter posameznih delov telesa (roka, noga, trebuh, zadnjica ...). Danes so nekatere lutke v povezavi z drugo računalniško in programsko opremo sposobne prikazati različna fizična stanja in odzive pacientov (Akaike et al., 2012; Cook et al., 2013). Njihova slabost je, da so stroški nakupa in vzdrževanja visoki, njihovo uporabo in scenarije morajo nadzirati ustrezno usposobljene osebe, sočasno pa jih lahko uporablja majhno število ljudi. Usposabljanje ima največkrat omejen čas, kar lahko vpliva na manjšo zmožnost pomnjenja sodelujočih (Ryall, Judd, & Gordon, 2016). Naraščajoče število simulacijskih centrov dokazuje, da tudi v Sloveniji simulacije v izobraževanju bodočih zdravstvenih delavcev dobivajo vse večji pomen (Karnjuš & Pucer, 2012). Prav tako se slovenski študenti zdravstvene nege zavedajo pomena simuliranega kliničnega usposabljanja in imajo pozitiven pristop k izvajanju slednjega (Pajnič, 2016).

Razmeroma novo področje izobraževanja v zdravstveni negi je virtualna simulacija (Ryall et al., 2016). Obstaja več vrst virtualnih simulacij. Izvajanje tako imenovane zaslonke simulacije lahko poteka na zaslonih tabličnih računalnikov, telefonov in osebnih računalnikov, ki jih študenti zdravstvene nege znotraj

študijskega procesa v veliki večini že uporabljajo. Ta tehnologija ponuja nove možnosti za poučevanje scenarijev, kritično razmišljanje ter razmišljanje o pridobljenih izkušnjah in praksi (Ryall et al., 2016). Virtualni pacienti so relativno nova e-izobraževalna tehnologija, ki v učnem procesu uporablja multimedijske, interaktivne elemente in virtualno simulacijo. Študente lahko vodijo skozi obravnavo specifičnih kliničnih primerov, vključujoč klinične poti in terapevtske algoritme (Zdravković, Prunk, & Dinevski, 2013; Ryall et al., 2016). Uporaba virtualnih simulacij z namenom izobraževanja v zdravstveni negi ima številne prednosti. Študent in izvajalec učnega procesa nista več vezana na prikaz negovalnih veščin in izvajanje postopkov v živo, prav tako pa ta oblika v primerjavi z učenjem na pravem pacientu dovoljuje študentovo ponavljanje postopkov in scenarijev brez kakršne koli škode. Ta oblika poučevanja omogoča večji nadzor nad delom in napredovanjem študenta ter mu nudi takojšno povratno informacijo o njegovi uspešnosti (Tolarba, 2021). Z uporabo virtualnih simulacij ali virtualnih pacientov študenti dobro krepijo spretnost kritičnega mišljenja in odločanja (Ryall et al., 2016). Pri tem je treba izpostaviti, da so stroški namestitve in vzdrževanja programov visoki. Kot glavni slabosti se izpostavljata še pomanjkanje osebnega stika in medosebne komunikacije med študentom in izvajalcem učnega procesa ter nezmožnost sprotnega spreminjanja učne izkušnje, ki je že vnaprej programirana (Tolarba, 2021).

Kljub določenim pomanjkljivostim se zaradi potenciala, ki ga imajo virtualne simulacije in virtualni pacienti, ter dejstva, da populacija študentov zdravstvene nege postaja vse bolj tehnološko spretna in izobražena, večajo možnosti implementacije te pedagoške metode pri izvajanju študija zdravstvene nege v prihodnosti tudi v Sloveniji.

### *Namen in cilji*

Namen pregleda literature je bil preučiti najnovejše empirične ugotovitve o učinkovitosti oziroma uspešnosti uporabe virtualnih pacientov ali virtualnih simulacij pri izobraževanju študentov zdravstvene nege po svetu.

Cilj raziskave je bil odgovoriti na raziskovalno vprašanje:

– Kakšna je učinkovitost oziroma uspešnost izobraževanja s pomočjo virtualnih simulacij ali virtualnih pacientov pri študiju zdravstvene nege?

### **Metode**

Uporabljen je bil integrativni pregled literature, ki obravnava uporabo virtualnih simulacij ali virtualnih pacientov pri izobraževanju študentov zdravstvene nege.

### *Metode pregleda*

Iskanje člankov v angleškem jeziku je potekalo po objavah iz bibliografskih baz CINAHL, MEDLINE in ERIC, z uporabo informacijske storitve EBSCOhost. Iskanje slovenskih člankov je potekalo v kataložno-bibliografski bazi podatkov COBIB. Iskanje člankov je potekalo s pomočjo ključnih besed in besednih zvez v angleškem jeziku: »virtual patient«, »virtual simulation« in »student nurse«, za iskanje v slovenskem jeziku pa smo uporabili ključne besede in besedne zveze: »virtualni pacient«, »virtualna simulacija«, »študenti« in »zdravstvena nega«. Za splošen nabor ključnih besed in besednih zvez smo se odločili zaradi majhnega števila zadetkov po predhodnem pregledovanju podatkovnih baz. Pri iskanju smo si pomagali tudi s pomočjo Boolovih operatorjev AND (IN) in OR (ALI). Iskanje literature smo izvedli v obdobju od januarja 2021 do junija 2021.

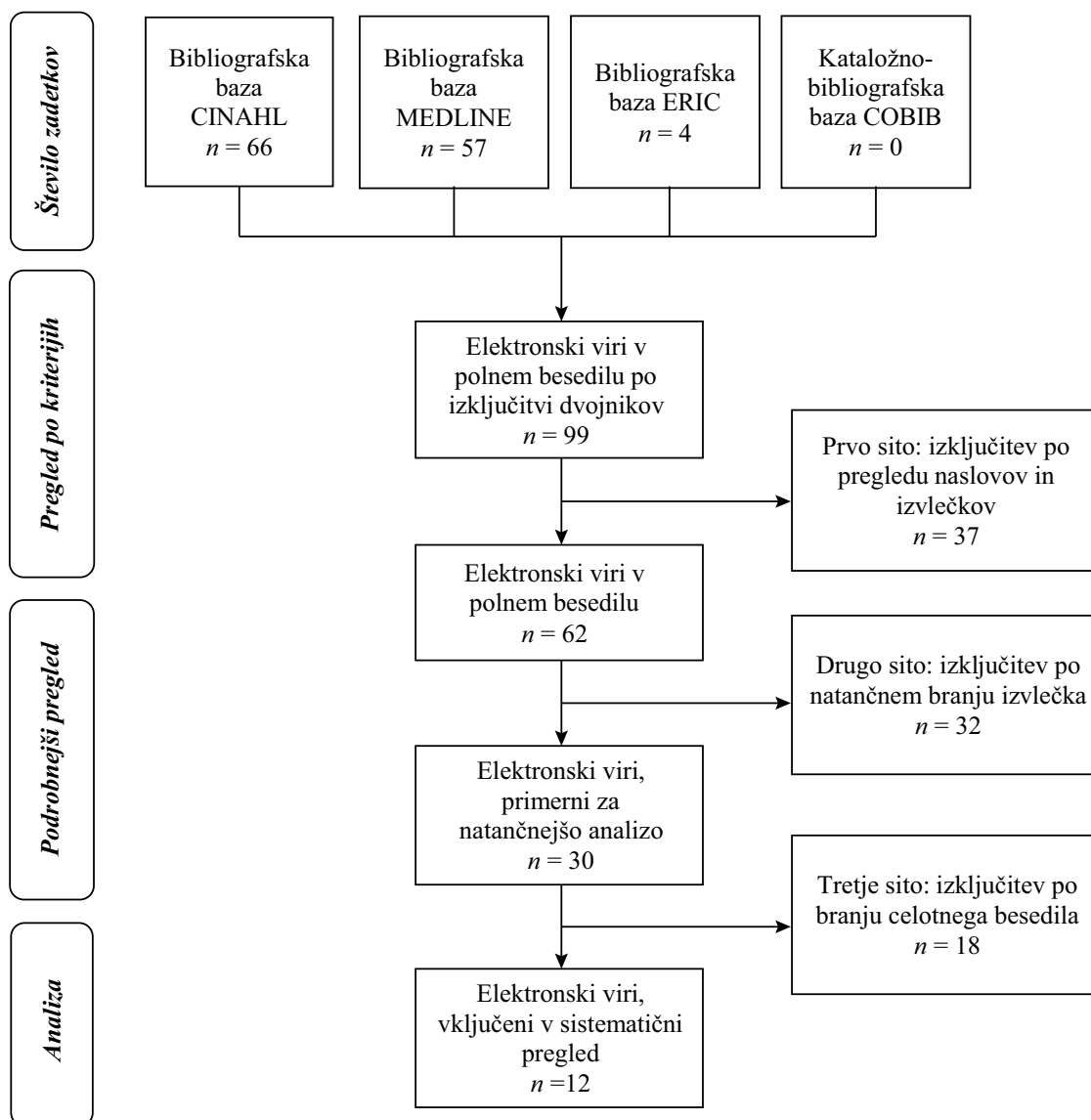
Rezultati so bili omejeni na angleški in slovenski jezik ter obdobje objave vira med letoma 2016 in 2021. Za časovno okno petih let smo se odločili, ker področje tehnologije nenehno zelo napreduje, zato tudi uporabnost rezultatov tovrstnih raziskav hitro zastara. Vključitveni kriteriji so bili še dostopnost celotnega besedila člankov, ustreznost metodologija člankov (kvalitativne, kvantitativne, mešane metode), recenzirane publikacije ter to, da sta bila v raziskavi virtualna simulacija ali virtualni pacient uporabljena za način učenja, ne pa kot način preverjanja usvojenega znanja neke druge učne metode. Opazovana populacija v raziskavah so bili študenti zdravstvene nege. Izključeni so bili članki, ki se vsebinsko niso skladali s področjem našega raziskovanja, pilotne študije, uvodniki, komentarji, protokoli, pregledi, pisma uredniku in poročila.

### *Rezultati pregleda*

Z iskanjem smo pridobili 127 elektronskih zadetkov (66 iz bibliografske baze MEDLINE, 57 iz bibliografske baze CINAHL, 4 iz bibliografske baze ERIC). EBSCOhost je izključil podvojene zadetke, ki bi se nahajali v bibliografskih bazah CINAHL, MEDLINE in ERIC hkrati. Po izločitvi dvojnikov nam je ostalo 99 elektronskih virov. V kataložno-bibliografski bazi podatkov COBIB nismo našli primernih virov v slovenskem jeziku. Proces izbire člankov je prikazan s pomočjo diagrama PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Page et al., 2021) (Slika 1).

### *Ocena kakovosti pregleda in opis obdelave podatkov*

Oceno kakovosti smo določili po Politu & Becku (2012), ki navajata sedem nivojev hierarhije dokazov v znanstvenoraziskovalnih delih. Eno enoto literature smo uvrstili v nivo 2a, ostalih 11 enot pa v nivo 2b



**Slika 1:** Diagram PRISMA poteka raziskave

hierarhije dokazov. Pregled virov in analiza vsebine sta sledila smernicam Harta (2001), pri čemer smo pri posameznih raziskavah najprej tabelarično izpisali podatke o zasnovi raziskave, vključenem vzorcu, intervenciji izobraževanja, ki je bila del raziskave, uporabljenih merskih instrumentih ter temeljnih ugotovitvah. Končno analizo vsebine smo dobili z metodo vsebinskega združevanja in primerjave ugotovitev posameznih raziskav.

## Rezultati

Tabela 1 prikazuje značilnosti 12 raziskav, ki so ustrezale našim vključitvenim kriterijem. Vključenih je bilo sedem raziskav z meritvami pred intervencijo izobraževanja in po njej (Foronda, Hudson, &

Budhathoki, 2017; Borg Sapiano, Sammut, & Trapani, 2018; Smith et al., 2018; Mabry, Lee, Roberts, & Garrett, 2019; Padilha, Machado, Ribeiro, Ramos, & Costa, 2019; Kang, Kim, Lee, Kim, & Kim, 2020; Kang, Hong, & Lee, 2020) ter pet raziskav, ki so vključevale samo eno meritev (William, Vidal, & John, 2016; Redmond et al., 2020; Lee, Kim, & Eom, 2020; Liu, 2021a; Liu, 2021b). Skoraj polovica raziskav je bila opravljenih v Združenih državah Amerike (ZDA), tri v Koreji (Kang et al., 2020; Kang, Hong, & Lee et al., 2020; Lee et al., 2020), po ena pa na Malti (Borg Sapiano et al., 2018), Portugalskem (Padilha et al., 2019), Irskem (Redmond et al., 2020) in v Kuvajtu (William et al., 2016).

V vključenih raziskavah so se virtualne simulacije ali virtualni pacienti uporabljali na različnih področjih zdravstvene nege, največ na področju

**Tabela 1:** Integrativni pregled literature – značilnosti vključenih raziskav

<i>Avtor, država</i>	<i>Zasnovna raziskave</i>	<i>Vzorec</i>	<i>Intervencija</i>	<i>Merski instrument</i>	<i>Temeljne ugotovitve</i>
Borg Sapiano et al., 2018, Malta	Raziskava tipa prej/potem (pre-test/post-test)	$n = 166$	VS (virtualna simulacija) s tremi scenariji hitrega poslabšanja zdravstvenega stanja (srčni, šokovni, respiratorni).	Preizkus znanja pred začetkom VS in po zaključku vseh VS. Uspešnost opravljene VS je bila ocenjena avtomatsko s pomočjo programa, v katerem so se izvajale VS, ter podana po zaključku.	Študenti so dosegli statistično pomemben napredek ( $p < 0,001$ ) v znanju po opravljenih VS. V povprečju so bile najvišje ocene opravljanja VS dosežene v tretji VS, kar kaže na napredek in učni učinek. Rezultati predznanja niso bili napovednik uspešnosti opravljanja VS. VS je izboljšala tako znanje kot tudi ukrepanje študentov ob poslabšanju zdravstvenega stanja.
Foronda et al., 2017 ZDA	Raziskava tipa prej/potem (pre-test/post-test)	$n = 108$	Enourna lekcija o hipertenziji, po njej pa tridesetminutna skupinska VS, znotraj katere so študentje z odločitvami usmerjali zaposlenega, ki je upravljal z VP (virtualnim pacientom).	Pred intervencijo in po njej petdelni vprašalnik za oceno kognitivnega znanja, vprašalnik o občutenju afektivne spremembe v povezavi z VS. Po intervenciji še vprašalnik o zadovoljstvu z VS.	Študenti so v primerjavi s testom pred intervencijo dosegli statistično pomemben napredek ( $p < 0,001$ ) v kognitivnem znanju po opravljenih VS. Izkušnjo z VS so opisali kot koristno in 82 % vključenih je želelo VS uporabiti tudi v prihodnje. VS je spodbujala poglobljene in problemske učne izkušnje študentov ZN (zdravstvene nege) in trening odločitev, utemeljenih na dokazih.
Lee et al., 2020 Koreja	Raziskava tipa potem (post-test)	$n = 60$	Pet scenarijev VR, ki so posnemali klinične simptome shizofrenije in z njimi povezane naloge (uporabljen glavni zaslon/očala).	Enostavnost uporabe in uporabnost scenarijev VR: sedemnajstdelni kvantitativni točkvalnik in sedemdelni kvalitativni vprašalnik (odprti tipi vprašanj).	Simulacije VR so koristne in smiselne pred običajnimi simulacijami na področju ZN. Študenti ZN so VR ocenili kot uporabno in zanimivo ter so jo sposobni uporabljati v izobraževalne namene.
Kang et al., 2020 Koreja	Kvazieksperimentalna Raziskava tipa prej/potem (pre-test/post-test)	Vzorec, razdeljen v tri skupine: skupino 1 ( $n = 54$ ), skupino 2 ( $n = 69$ ) in skupino 3 ( $n = 69$ ).	Študenti, ki so skrbeli za otroke z astmo, so bili po teoretičnem izobraževanju razdeljeni v tri skupine: skupina 1 je izvajala VS, skupina 2 simulacijo HFS, skupina 3 pa kombinacijo obeh metod.	Pred intervencijo in po njej ocena znanja (tudi praktičnega) o skrbi za otroke z astmo in zaupanja v prakso (samooocena, ki je zajemala oceno stanja, načrtovanje, intervencijo in evalvacijo). Po končani intervenciji se je ocenjevala tudi praktična izvedba (ocena stanja, izvedba intervencije).	Skupina 3 je dosegla najvišje ocene v vseh sklopih ocenjevanja. Prisotne so bile statistično značilne razlike ( $p = 0,026$ ) v oceni znanja med skupinami (povprečje post/pre točk). Skupini 1 in 3 (z VS) sta imeli višje ocenjeno znanje kot skupina 2. Razlike med skupinami so bile tudi v samozaupanju v prakso ( $p < 0,001$ ). Skupina 2 je ocenila nižje samozaupanje v prakso zaradi pomanjkanja samoučnih priložnosti po končanem teoretičnem izobraževanju. Skupini 2 in 3 sta dosegli statistično značilno ( $p < 0,001$ ) boljše ocene v izvajanju posegov.

Se nadaljuje

<b>Avtor, država</b>	<b>Zasnovna raziskava</b>	<b>Vzorec</b>	<b>Intervencija</b>	<b>Merski instrument</b>	<b>Temeljne ugotovitve</b>
Kang, Hong, & Lee., 2020 Koreja	Raziskava tipa prej/potem (pre-test/post-test)	$n = 47$	Prvi teden je potekala priprava na VS, v ostalih treh tednih pa enkrat tedensko izvedba VS, ki je zajemala pet faz (uvod, kviz pred izvedbo VS, izvedbo VS, kviz po izvedbi VS, debriefing). VS so bile s področja ZN otročnic, otrok in odraslih.	Pred intervencijo in po njej: sedemindvajsetdelni vprašalnik za oceno stopnje kritičnega razmišljanja in petinštiridesetdelno orodje za oceno samostojnega učenja, razdeljeno na sedem podtem. Po intervenciji: trinajstdelno orodje za oceno učinkovitosti VS in odprta vprašanja o vtisih učenja z VS.	V oceni kritičnega razmišljanja ( $p = 0,872$ ) in samostojnega učenja ( $p = 0,881$ ) pred izvedbo VS in po njej ni bilo statistično značilnih razlik, bile pa so v oceni podteme samostojnega učenja (izbiranje virov za učenje) po VS ( $p = 0,032$ ). Študenti so potrdili, da VS izboljšajo oceno stanja, kritičnega razmišljanja, spretnost odločanja, boljše razumevanje vsebine in da so bile VS koristne pred kliničnim usposabljanjem. Doma so se študenti počutili bolj varno in sproščeno, pogrešali pa so človeški stik ter to, da bi VS potekale v njihovem materinem jeziku.
Liu, 2021a ZDA	Prospektivna kohortna raziskava	Vzorec, razdeljen v dve kohorti: simulacijsko kohorto ( $n = 149$ ), nesimulacijsko kohorto ( $n = 150$ ).	Sim. kohorta je pred izobraževanjem ZN mentalnega bolnika opravila še pet VS (huda tesnoba in depresija, alkoholni odtegnitveni sindrom, bipolarna motnja, shizofrenija).	Avstralski nacionalni instrument za oceno pismenosti mentalnega zdravja (ang. <i>The Australian National Mental Health Literacy survey instrument</i> ).	Simulacijska kohorta je po VS opisovala večje sočutje in boljši vpogled v prognozo ljudi z depresijo ( $p = 0,003$ ). VS je izboljšala optimizem vključenih glede dolgoročnih izidov pacientov z depresijo ter zmanjšala pesimizem o dolgoročnih izidih shizofrenih pacientov. Simulacijska kohorta je izide pacientov ocenjevala bolj optimistično kot nesimulacijska kohorta ( $p < 0,01$ ).
Liu, 2021b ZDA	Prospektivna kohortna raziskava	Vzorec, razdeljen v dve kohorti: simulacijsko kohorto ( $n = 149$ ), nesimulacijsko kohorto ( $n = 150$ ).	Sim. kohorta je pred izobraževanjem ZN mentalnega bolnika opravila še pet VS (huda tesnoba in depresija, alkoholni odtegnitveni sindrom, bipolarna motnja, shizofrenija).	Eno leto po intervenciji VS uporabljen avstralski nacionalni instrument za oceno pismenosti mentalnega zdravja (ang. <i>The Australian National Mental Health Literacy Survey Instrument</i> ).	Študenti v simulacijski kohorti so pokazali znatno povečanje znanja in sprejemanja razpoložljivih možnosti zdravljenja za obvladovanje depresije in shizofrenije po enoletnem obdobju ( $p < 0,05$ ). Ugotovitev podpira uporabo VS v dodiplomskem izobraževanju o duševnem zdravju ob aktivni vključenosti fakultete.
Mabry et al., 2019 ZDA	Kvazieksperimentalna presečna raziskava tipa prej/potem (pre-test/post-test)	Vzorec ( $n = 151$ ), razdeljen v tri kohorte.	Vse kohorte so opravljale ponovitev scenarijev s pomočjo VS do določene števila točk, nato so kohorte isti scenarij ponovile še v HFS.	Desetdelni anonimni prilagojeni vprašalnik za merjenje samoučinkovitosti (ang. <i>Modified Self-efficacy Survey</i> ) pred VS in po končani simulaciji HFS.	VS, ki ji je sledila tudi HFS, je statistično značilno povečala oceno samoučinkovitosti študentov v vseh treh kohortah ( $p = 0,001$ , $p = 0,037$ , $p = 0,005$ ). Rezultati so pokazali, da je VS povečala angažiranost študentov pri HFS, ki zajema timsko delo, sodelovanje ter komunikacijske in klinične veščine.

Se nadaljuje

<i>Avtor, država</i>	<i>Zasnova raziskave</i>	<i>Vzorec</i>	<i>Intervencija</i>	<i>Merski instrument</i>	<i>Temeljne ugotovitve</i>
Padilha et al., 2019 Portugalska	Randomizirana kontrolna raziskava s testiranjem pred intervencijo izobraževanja in dvema postestoma.	Študenti, ki so obravnavali pacienta s hipoksijo: eksperimentalna skupina ( $n = 21$ ), kontrolna skupina ( $n = 21$ ).	Eksperimentalna skupina se je učila s pomočjo VS, kontrolna skupina pa je enako vsebino v enakem časovnem obsegu obdelala s simulatorjem nizkega posnemanja resničnosti in učenjem v realnem okolju.	Test ocenjevanja znanja in klinične presoje (pred intervencijo, takoj po intervenciji, dva meseca po intervenciji), ocenjevanje stopnje zadovoljstva z učenjem in samoučinkovitostjo po zaključeni intervenciji izobraževanja.	Eksperimentalna skupina je pokazala statistično značilen napredek v znanju takoj po izobraževalni intervenciji ( $p = 0.001$ ) in tudi po dveh mesecih ( $p = 0.02$ ), prav tako pa je pokazala tudi večjo stopnjo zadovoljstva z učenjem ( $p < 0.001$ ). Statistično značilnih razlik v oceni samoučinkovitosti med skupinama ni bilo zaznati ( $p = 0.9$ ).
Redmond et al., 2020 Irska	Presečna raziskava	$n = 148$	VP, pri katerem so študenti morali oceniti, načrtovati in voditi oskrbo kroničnega venskega ulkusa na nogi.	Po intervenciji vprašalnik za oceno učil za večkratno uporabo (ang. <i>Reusable Learning Object CETL questionnaire</i> ), vprašalnik o kompetentnosti oskrbe rane (ang. <i>Wound Care Competency Outcomes Questionnaire</i> ), odprta vprašanja o učenju z VP.	Analiza vprašalnikov je pokazala, da so študenti simulacijo s pomočjo VP ocenili kot učinkovito pedagoško metodo za povečanje kompetentnosti pri oskrbi rane. Študentom je omogočila, da so ponavljajoče vadili veščine in utrjevali teoretične vsebine v varnem okolju, na katerega ne vplivata pomanjkanje virov ter razpožljivost klinične prakse, prostora in usposobljenega kadra.
Smith et al., 2018 ZDA	Kvazieksperimentalna raziskava ponavljajočih se meritev	Vzorec ( $n = 197$ ), randomizirano razdeljen v tri skupine: intervencijski skupini A ( $n = 59$ ) in B ( $n = 58$ ) ter kontrolno skupino C ( $n = 55$ ).	Študenti so se učili dekontaminacije s pomočjo spletnega modula, nato pa so bili razdeljeni v tri skupine: skupino A – 3D VS s pomočjo naglavnega zaslona/očal, skupino B – VS s pomočjo računalnika in miške, skupino C – klasična pisna navodila.	Pred intervencijo demografski vprašalnik in test z dvajsetimi vprašanji za merjenje kognitivnega učenja. Po intervenciji in po šestih mesecih test kognitivnega učenja in praktični test. Eksperimentalni skupini sta bili povabljeni v fokusne skupine za razpravo o zadovoljstvu in splošni izkušnji z VS.	Pomemben napredek v vseh meritvah po izvedbi intervencije pri vseh treh skupinah (vse tri skupine $p < 0.001$ ), ki se je obdržal tudi po šestih mesecih (skupini A in C; $p < 0.001$ ; skupina B; $p = 0.006$ ). Študenti so bili zadovoljni z VS. 3D VS s pomočjo očal so opisali kot bolj zanimivo in interaktivno učno izkušnjo. VS je alternativna učna metoda za simulirano učenje, a oblikovanje najboljšega pristopa za prakso zahteva še dodatno raziskovanje tega področja.
William et al., 2016 Kuvajt	Kvazieksperimentalna raziskava, kontrolna skupina	Vzorec ( $n = 62$ ), razdeljen v kontrolno ( $n = 33$ ) in eksperimentalno skupino ( $n = 29$ ).	Intervencijska skupina se je flebotomije učila s pomočjo simulacij VR, kontrolna skupina pa na tradicionalen način s pomočjo plastičnega modela roke.	Vprašalnik o sociodemografskih podatkih udeležencev in standardizirani kontrolni seznam večšin za izvedbo flebotomije, ki je po korakih ocenjeval uspešnost in pravilnost izvedbe.	Obe preučevani metodi sta se izkazali za učinkoviti. Med obema skupinama ni bilo statistično značilnih razlik ( $p < 0.005$ ) v uspešnosti. Obe skupini sta dosegli visoke rezultate pri ocenjevanju izvedbe flebotomije s pomočjo kontrolnega seznama korakov postopka.

*Legenda: n – število; ZN – zdravstvena nega; VS – virtualna simulacija; HFS – simulacija visoke stopnje posnemanja resničnosti; VR – virtualna resničnost; ZDA – Združene države Amerike; p – statistična značilnost*

obravnave psihiatričnega pacienta (Lee et al., 2020; Liu, 2021a; Liu, 2021b), pediatričnem področju (Kang et al., 2020; Kang, Hong, & Lee, 2020), področju zdravstvene nege otročnic in odraslih (Padilha et al., 2019; Foronda et al., 2017, Kang, Hong, & Lee, 2020), urgentne medicine (Borg Sapiano et al., 2018), ter za učenje specifičnih veščin oziroma postopkov (William et al., 2016; Smith et al., 2018; Redmond et al., 2020). V eni raziskavi je bila za izvedbo virtualnih simulacij uporabljena virtualna resničnost (ang. *Virtual Reality*) (Lee et al., 2020), v dveh raziskavah pa tudi simulacija visoke stopnje posnemanja resničnosti (ang. *High Fidelity Simulation*) (Mabry et al., 2019; Kang et al., 2020).

## Diskusija

Ugotovili smo, da so raziskave s področja uporabe virtualnih simulacij ali virtualnih pacientov pri izobraževanju študentov zdravstvene nege vse pogostejše. Kar polovica vključenih raziskav je nastala v zadnjih dveh letih, kar bi lahko povežemo tudi s pojavom epidemije covid-19, težavo z izvedbo usposabljanj v učnih in kliničnih okoljih ter iskanjem praktičnih rešitev za izvedbo študijskega programa zdravstvene nege.

Vključene raziskave so nastale v Združenih državah Amerike, Koreji, na Malti, Portugalskem, Irskem in v Kuvajtu. Odsotnost raziskav, ki bi bile opravljene v državah v razvoju, lahko povežemo z visokimi stroški programske in strojne opreme, ki je potrebna za izvedbo preučevanega načina izobraževanja. Šest vključenih raziskav je preverjalo učinkovitost oziroma uspešnost virtualnih simulacij ali virtualnih pacientov glede na pridobljeno kognitivno domeno znanja. Dve raziskavi sta poročali o statistično značilnih razlikah med skupinami, ki so se izobraževale s pomočjo virtualnih simulacij, in njihovimi kontrolnimi skupinami (Liu, 2021b; Padilha et al., 2019), v eni raziskavi statistično značilnih razlik med skupinami ni bilo (Smith et al., 2018). Iz tega lahko povzamemo, da so virtualne simulacije enako ali celo bolj učinkovite v uspešnosti pridobivanja kognitivne domene znanja kot tradicionalna učna metoda. Dve raziskavi sta pokazali, da so študenti v primerjavi z obdobjem pred izobraževanjem statistično značilno napredovali v znanju, ki se je ocenjevalo po končani intervenciji (Foronda et al., 2017; Borg Sapiano et al., 2018). V dveh raziskavah so primerjali učinkovitost različnih oblik virtualne simulacije (zaslonska in 3D z očali) ali drugih načinov virtualnega izobraževanja (simulacija visoke stopnje posnemanja resničnosti). V prvi raziskavi so bili rezultati kognitivnega znanja skupine z virtualno simulacijo statistično značilno boljši kot v skupini samo s simulacijo visoke stopnje posnemanja resničnosti (Kang et al., 2020), v drugi raziskavi pa statistično značilnih razlik v kognitivni domeni znanja nismo zaznali (Smith et al., 2018).

Tako lahko povzamemo, da je zaslonska virtualna simulacija v pridobivanju kognitivne domene znanja enako oziroma celo bolj učinkovita kot dražje oblike virtualne simulacije ali simulacija visoke stopnje posnemanja resničnosti, za katere se potrebuje več dodatne strojne in programske računalniške opreme.

Tri raziskave so preverjale učinkovitost oziroma uspešnost učenja s pomočjo virtualnih simulacij ali virtualnih pacientov glede na praktično izvedbo. V dveh raziskavah ni bilo statistično značilnih razlik v uspešnosti izvedbe posegov med eksperimentalnimi in kontrolnimi skupinami (William et al., 2016, Smith et al., 2018). Zanimive so bile ugotovitve raziskave (Kang et al., 2020), ki so poročale, da je virtualna simulacija sicer res vplivala na višjo oceno znanja, vendar so udeleženci dosegali statistično značilno slabše ocene pri izvajanju posegov v praksi v primerjavi z drugimi oblikami izobraževanja (virtualna simulacija, kombinirana s simulacijo visoke stopnje posnemanja resničnosti, ali samo simulacija visoke stopnje posnemanja resničnosti). Ugotovili smo, da so virtualne simulacije sicer primerljivo uspešne v izvajanju posegov kot klasičen način izobraževanja, a jih je priporočljivo kombinirati tudi s simulacijo visoke stopnje posnemanja resničnosti, saj je v eni izmed raziskav (Kang et al., 2020) skupina, ki se je učila s kombinacijo virtualne simulacije in simulacijo visoke stopnje, dosegla najvišje ocene v vseh sklopih ocenjevanja. Do podobnih ugotovitev so prišli tudi Mabry et al. (2019), ki so poročali, da je virtualna simulacija, ki ji je sledila tudi simulacija visoke stopnje posnemanja resničnosti, statistično značilno povečala angažiranost študentov, timsko delo, sodelovanje ter komunikacijske in klinične veščine. Smiselno je torej razmišljati v smeri združevanja, saj virtualna simulacija omogoča ponavljajoče samoučne možnosti v varnem okolju in jo je priporočljivo kombinirati s simulacijo visoke stopnje posnemanja resničnosti, ki omogoča realistično predstavo kliničnega okolja in izvajanja praktičnih posegov.

Pet raziskav je preverjalo učinek virtualnih simulacij ali virtualnih pacientov na afektivno domeno znanja, oceno samoučinkovitosti in občutek kompetentnosti. V dveh raziskavah, v katerih se je ocenjevala samoučinkovitost, so poročali, da med vključenimi skupinami ne glede na način izobraževanja ni bilo statističnih razlik v samooceni učinkovitosti. Mabry et al. (2019) so poročali, da so bile statistične razlike v samoučinkovosti prisotne po simulacijah visoke stopnje posnemanja resničnosti, ki so sledile virtualnim simulacijam. To spet potrjuje že zgoraj navedeno dejstvo o smiselnosti združevanja virtualnih simulacij in simulacij visoke stopnje posnemanja resničnosti. Pomembno je izpostaviti tudi, da so v eni izmed raziskav po virtualnih simulacijah kazali statistično značilno večje sočutje, boljši vpogled v prognozo ljudi z depresijo, izide pacientov pa so prav tako ocenjevali bolj optimistično kot kontrolna skupina (Liu, 2021a).

V eni izmed raziskav so študenti poročali o tem, da je virtualna simulacija pri njih spodbujala poglobljene in problemske učne izkušnje (Foronda et al., 2017), v drugi pa so opisovali, da je uporaba virtualnega pacienta učinkovita pri povečanju kompetentnosti oskrbe rane (Redmond et al., 2020).

Odzivi študentov na izobraževanje s pomočjo virtualne simulacije ali virtualnega pacienta so bili v študijah, ki so to preverjale, pozitivni (Foronda et al., 2017; Smith et al., 2018; Kang, Hong, & Lee, 2020; Lee et al., 2020). Študenti so se v domačem okolju počutili bolj varno in sproščeno, virtualne simulacije so izboljšale razumevanje vsebine, študenti pa so jih ocenili kot koristne pred začetkom kliničnega usposabljanja (Kang, Hong, & Lee, 2020).

Učenje v virtualnem okolju je v primerjavi z resničnim okoljem varno in ne ogroža pacientov. Študentom omogoča, da ponavljajoče vadijo veščine in utrjujejo teoretične vsebine v okolju, na katerega ne vplivata pomanjkanje virov ter razpoložljivost klinične prakse, prostora in usposobljenega kadra, hkrati pa se virtualno okolje lahko približa resničnim situacijam v zdravstveni negi, s katerimi se študenti srečujejo v praktičnem okolju, in lahko učinkovito nadomesti trening kliničnih odločitev obstoječih kabinetnih simulacijskih okolij na fakulteti. Virtualne simulacije ali virtualni pacienti niso omejeni s številom ponovitev, ki jih lahko naredi študent, kar nadgrajuje učni učinek. To potrjuje tudi raziskava Borga Sapijana et al. (2018), ki je izpostavila stopenjsko učenje, napredek in učni učinek, saj so bile najvišje ocene po opravljanju virtualnih simulacij dosežene po zadnji ponovitvi.

Učinki izobraževanja s pomočjo virtualnih simulacij so dolgoročni. To so potrdili v raziskavi (Liu, 2021b), kjer so preučevali dolgoročne učinke virtualne simulacije, ki so jih merili leto po intervenciji. Študenti v simulacijski kohorti so pokazali znatno povečanje znanja in sprejemanje razpoložljivih možnosti zdravljenja za obvladovanje depresije in shizofrenije (Liu, 2021b). Podobno sta ugotovili tudi drugi dve vključeni raziskavi, kjer se je statistično značilno boljše znanje skupine z virtualno simulacijo obdržalo po dveh (Padilha et al., 2019) oziroma šestih mesecih (Smith et al., 2018). Treba je izpostaviti tudi pomanjkljivosti tovrstnega učenja. Študenti (Kang, Hong, & Lee, 2020) so izpostavili, da so pri učenju s pomočjo virtualnih simulacij pogrešali pristen človeški stik ter da si želijo, da bi virtualne simulacije potekale v njihovem maternem jeziku.

O zelo podobnih ugotovitvah, kot smo jih pridobili z našim raziskovanjem, je poročal tudi sistematični pregled literature s področja uporabe virtualnih simulacij pri izobraževanju v zdravstveni negi, ki je vključeval 23 raziskav, objavljenih med letoma 2010 in 2020 (Tolarba, 2021). Avtor sistematičnega pregleda na podlagi ugotovitev priporoča vsem, ki delujejo na področju izobraževanja v zdravstveni negi, da v

prihodnosti odpirajo možnost vključevanja virtualnih simulacij v učne načrte študijskih programov zdravstvene nege (Tolarba, 2021).

Za izobraževanje v zdravstveni negi je lahko razvijanje pedagoškega pristopa s pomočjo virtualnih simulacij ali virtualnih pacientov zelo koristno tako v učne kot raziskovalne namene (Foronda et al., 2017), vendar pa bi za bolj konkretne zaključke s tega področja potrebovali več longitudinalnih kakovostnih raziskav z večjim številom vključenih preiskovancev. Prav tako bo izziv za izvajalce učnih procesov zdravstvene nege v prihodnosti, da bodo znali prepoznati, katere vsebine virtualne simulacije ali virtualni pacienti lahko dopolnijo, katere popolnoma nadomestijo, katerih vsebin pa se v virtualno okolje zaradi narave in posebnosti poklica ne more prenesti.

Omejitev našega raziskovanja vidimo v izbrani časovni omejitvi petih let, vključevanju člankov v polni dostopnosti besedila ter v pregledu samo nekaterih podatkovnih baz. Tako smo dobili omejeno število vključenih raziskav. Vključevale so majhne vzorce in kratke intervencije izobraževanja. Rezultat slednjega je omejeno sklepanje in posploševanje ugotovitev raziskav. Pri interpretaciji rezultatov je treba upoštevati subjektivnost samoocene sodelujočih. Kakovost vključenih raziskav smo ocenjevali s hierarhijo dokazov, morda bi bili rezultati pregleda literature drugačni, če bi za to uporabili ocenjevalna orodja.

## Zaključek

Epidemija covid-19 je izobraževanje študentov zdravstvene nege postavila pred izziv in marsikomu porodila razmišljanje o vpeljavi novih, modernih učnih metod. Eno izmed možnosti predstavljajo virtualne simulacije ali virtualni pacienti. S pregledom literature smo prikazali, da je ta način lahko učinkovit pri izobraževanju študentov zdravstvene nege tako na področju kognitivne in afektivne domene znanja, praktične izvedbe postopkov, pri oceni samoučinkovitosti in kompetentnosti. Študenti so po naših ugotovitvah s tem načinom izobraževanja zadovoljni in so ga ocenjevali pozitivno. Preučevano področje ponuja pestre možnosti nadaljnega raziskovanja ter na podlagi novih ugotovitev tudi preoblikovanje trenutnih učnih okolij. Zaključimo lahko, da virtualne simulacije oziroma virtualni pacienti koristno dopolnjujejo obstoječi način izobraževanja, saj z njihovo pomočjo študenti samozavestneje sprejemajo klinične odločitve in skrajšujejo čas, ki ga potrebujejo za njihovo sprejemanje v praksi.

## Conflict of interest/Nasprotje interesov

The author declares that no conflict of interest exists./Avtorica izjavlja, da ni nasprotja interesov.



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## Author contributions/Prispevek avtorjev

The author designed and conducted the research and wrote the article on her own responsibility./Avtorica je sama zasnovala in izvedla raziskavo ter pripravila članek.

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