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Virtual patient simulation method for learning and assessment in cardiology field



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ABSTRACT

Virtual patient simulation (VPS) is an online computer simulation system that contains patients' clinical situation to train and realistically assess clinical abilities with supplemental animation, demonstration of anatomy, ECG tracing, etc. It can be used for teaching, learning, and assessment supports learning. Until now, it is difficult to ascertain how many VPS systems have been used today in the world, both for learning and assessment, especially

in cardiology medicine field. We searched for all research using the term "virtual patient in medical education, virtual patient in cardiology & virtual patient simulation in cardiology" in the title or research abstract from 2014 until 2019. In this current review, we will describe the use of VPS for learning and assessment purposes in cardiology medicine field.

Keywords: virtual patient simulation, learning, assessment, cardiology, medical education

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The Potency of Virtual Patient Simulation (VPS) in This Era: Is It Compatible for Students?

Simulation-based learning (SBL) is a learning method that has recently increased its use for education.¹ This learning method began to develop since the 1980s and in the field of cardiology intervention itself since the 2000s.² It is one of the alternatives for traditional learning methods that are currently considered less compatible and have risks to patient safety. The simulation includes patient simulations, role play, virtual reality devices, electronic manikins and many more. Along with the development of technology, there are several simulators currently available, ranging from low fidelity simulators to high fidelity simulators. Among the high fidelity simulators and standardized patients currently used, low fidelity simulation (for example virtual reality simulation) also benefits participants' abilities. Besides, because the technological tools are more suitable for the current environment and the purpose of the learning session, the method is also known to be more cost-effective in its use.³

Virtual reality simulation (i.e., virtual patient simulation) as one part of the simulation-based learning method has a role in increasing clinical reasoning skills. Virtual patient simulation (VPS) is an online interactive computer simulation system that contains patients' clinical situation to

train and assess clinical abilities in a realistic way through learning with virtual patients and learning problems.⁴ This method can train students in handling doctor-patient virtual scenarios that may be difficult to find or face in real clinical situations so it is expected that with more cases being studied can result in a better performance in real life.

VPS is not only useful for undergraduate learning but continuing postgraduate medical education as well. VPS can be used for teaching, learning, and assessment supports learning. It is difficult to ascertain how many VPS systems have been used today in the world, both for learning and assessment.⁶ However, some education centers have used this method for learning, and part of the United States Medical Licensing Examination (USMLE Step 3).¹

The average literature shows the use of VPS for learning, and there are still very few studies or reviews that describe the use of VPS for assessment purposes especially in the field of cardiology. Thus, we summarized research on a virtual patient (VP), focusing on the use of VPS in medical education. We searched for all articles or research using the term "virtual patient in medical education, virtual patient in cardiology & virtual patient simulation in cardiology" in the title or research abstract. We did search on Google Scholar, Medical Teacher Journals, Cochrane, Proquest and Journal of

Medical Education from 2014 until 2019. We also take a similar topic from the citation of the journal that included in this review. This review also identifies the use of the VPS method for learning and assessment in the field of cardiology.

The Role of Virtual Patient Simulation (VPS)

There is widespread acceptance of simulation as a training modality across in many medical and surgical specialties including in cardiology medicine. It is defined as a technique to replace or amplify real experiences with guided experiences to study something which possible in real life. Fox et al.² recently published a report on the role of SBL in cardiology. It is stated that SBL has some benefits include immediate feedback, the learning process without exposing the patient to risk, an opportunity for training management of potential complications, and it can be adapted to the learner flexibly. The simulation includes simulated patients, role play, virtual reality devices, electronic manikins and many more.²

VPS is one part of SBL learning that is now often used to improve clinical reasoning skills. This method began to enter into medical education since 2009.⁶ In 2010, VPS was increasingly recognized where publications and research were presented at the conferences.^{7,8} VPS is usually a computer program that uses the scenario of the patient's condition as in a real situation with supplemental animation, demonstration of anatomy, or ECG tracing.⁹ VPS also can be used for health care and medical training, education or assessment.¹⁰ It can also simulate a realistic doctor-patient interaction, see the outcome of a clinical decision, and stimulate better clinical reasoning for the student.¹¹

VPS training can also improve analytic reasoning skills. The analytic reasoning skills are obtained from a stepwise approach that is based on case solving and patient follow-up from the beginning to the end of the case. Also, VPS can be used to evaluate knowledge or as an assessment tool. This method is known to be better as an assessment tool than traditional exams because it is presented with more interest both with animation or anatomical demonstration so that the assessment is felt not like being tested.⁶ It also provides a broader situated learning matrix that is low cost and the present virtual patient that experiences illness trajectories in a longitudinal context core.¹¹ Thus, it may be concluded that VPS use for learning and assessment is a good alternative way of supporting student learning.

VPS Method for Learning in Cardiology Medicine

The VPS is known to be able to enhance learning efficiency in several ways. The medical field has been the biggest adopter of this technology.¹² Until now research or literature that shows the use of VPS methods for learning and assessment in cardiology medicine is not found much compared to other simulation methods. According to the research of Pereira et al.¹³ who evaluates the pedagogical impact of using the virtual patient simulation for medical students in a short workshop format. The study trained medical students to detect cardiac pathologies through cardiac auscultation with IS4Learning Web Technology. The results of the study showed significant improvement from medical students in distinguishing between normal and pathological cases even though the study was conducted with very short duration workshop format.

On the same year, Nedungadi and Raman convinced that medical virtual patient simulator (MedVPS) could integrate real-life images, animation, and simulations of the entire learning process of respiratory and cardiology domain into a virtual patient case. The study included 15 participants from the Government Medical College at Trivandrum and found that MedVPS is medically accurate and interactive simulations to provide a learning experience for the student because it offered a game like situation.¹⁴

The next studies which discussed VPS are from Trifonove et al.¹⁵ and Lumens et al.¹⁶ who use the CircAdapt biophysical model of the human heart and circulation to create virtual patient for the study of the cardiovascular system. It makes both the medical student and residents in cardiology analyze complex situations of the patient, improve their understanding of cardiology medicine and facilitate future clinical practice. Another research from Chiastra et al.¹⁷ evaluates computational replication of the patient-specific stenting procedure for coronary artery bifurcations. The study has found structural analysis of stent expansion, and underscore important stent design features. Besides, it concluded that virtually simulate stent implantation is real to do, but still considers the possibility of intrinsic error and assumptions related to image reconstruction. From the studies above, it seems that VPS can be introduced as part of self-study scenarios, problem-based learning or post-graduate education. VPS has the potential to increase clinical reasoning skill with more time and flexible opportunities for learning.¹⁸

VPS for Assessment Purposes in Cardiology Medicine: How Far Does It Go?

The assessment as a part of the learning process needs to be done to predict the future performance of the doctor in medical education especially cardiology medicine. As technology develops, assessment using virtual patients gain interest to test the knowledge of the health professional. VPS could represent a comprehensive and integrated assessment in a more realistic context than paper-based assessment. This method has been applied in Italy and Sweden National Medical Examination. Stanford University and University in Sweden used assessment virtual patient (AVP) for OSCE stations using adoptions of Web-SP.¹⁹ Moreover, based on the Gunning and Fors study found that the use of virtual patient for assessing medical student ability is beneficial. It integrates the medical student's knowledge to render differential diagnoses, guide their approach to clinical reasoning and also decision making.²⁰

VPS method used for assessment in cardiology medicine itself shows a condition that is the minority and rarely found in the literature. There is a study by Criley et al.²¹ that uses a virtual patient to improve cardiac examination skills in medical students. The study included 24 medical students for inspection, auscultation, knowledge, and integration of audio and visual capabilities. Criley et al.²¹ stated that the virtual patient could increase cardiac examination inspection, auscultation, and knowledge to the level of cardiology fellow. Moreover, a recent study from Botezatu et al.⁵ conducted a randomized controlled study of the role of VP compared to regular learning activities on learning and examinations of hematology and cardiology topics of 49 students. The study stated that students in groups with VP showed better-delayed retention compared to

traditional learning methods and accompanied by frequent assessment would provide better retrieval of knowledge.

VPS consider having some benefits for the assessment purposes. It evaluates knowledge differently, improving the clinical reasoning process, and also known as a better evaluation tool than the traditional exam. The VPS method gave a less stressful situation of the exam because the evaluation process usually does not feel like an exam and more like a game in a natural way. However, until now, the software is rare and not all medical school can access or use it because of the cost and computer availability factor.¹⁹ The superiority educational results with VPS require the careful and some adjustment of many variables over a long period. Further studies that evaluate the transferability of the method to the clinical practice, the cost-effective of VPS application in cardiology medicine curricula and another report of its application with different examination format need to be conducted.²² We also should take into consideration that this method should be applied for a different learning objective according to the context, especially in cardiology medicine. Intended learning goals and assessment are aligned with each other. This method should be implemented both for teaching and assessment because of its flexibility used and well adapted to the emergent reality of the simulation-based curriculum medical education.

CONFLICT OF INTEREST

The author declares there is no conflict of interest regarding publication of this review.

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Practice points

- VPS is an interactive computer program that uses the scenario of the patient's condition as in a real situation with supplemental animation, demonstration of anatomy, or ECG tracing.
- It considers as an alternative learning method for clinical reasoning and problem solving in condition where there are no other suitable learning tools.
- VPS can be introduced as part of self-study scenarios, problem-based learning or post-graduate education in an interactive way to increase clinical reasoning and analytic skill.
- As in any educational assessment setting, VPS could represent a comprehensive and integrated assessment in a more realistic context than paper-based assessment.
- This method gave a less stressful situation of the exam because the evaluation processes more like a game in a natural way.

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