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VIRTUAL PATIENT: CONCEPT ANALYSIS

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Abstract

This concept analysis explores the definition, attributes, and application of the "Virtual Patient" (VP) within the context of nursing education and clinical training. Despite its growing use in medical and nursing curricula, the concept of the virtual patient remains ambiguously defined across disciplines. Using Walker and Avant's eight-step concept analysis method, this study identifies the defining attributes of virtual patients—such as interactivity, realism, safe learning environments, diversity, assessment utility, tactile interaction, and behavioral simulation. The analysis includes related concepts, model, borderline, and contrary cases, as well as antecedents, consequences, and empirical referents. Results highlight that virtual patients serve as an effective educational tool for enhancing clinical reasoning, decision-making, communication skills, and overall confidence in learners. They bridge the gap between theoretical knowledge and clinical practice, providing standardized, immersive, and safe training environments without risk to actual patients. The findings reinforce the importance of virtual patient simulations in modern nursing education, contributing to the development of competent and confident healthcare professionals.

INTRODUCTION

Virtual patient (VP) is a word which has been used since many years in learning and knowledge domain in institutions and health organization, however still its accurate meaning and concept is not clear and transferred to many advanced nursing professionals in many countries. This topic was chosen because this word provide variety of meaning in nursing education, practice, and research setting for example the flexible and rich digital content, human like appearance and behavior, auditory cues like verbal response-like heart or breathing sounds said by {Daher et al., 2020}. Therefore, this word is require to define in different ways to identify their unique characteristics. Virtual patient is important tool for clinical skills acquisition such as clinical reasoning and accurate diagnosis for medical students. {Isaza-Restrepo et al., 2018}.

Not even virtual patient just facilitate medical clinical skills but it improve communication skills and teamwork attitude for nurses while providing care to patient working in multi discipline.{Liaw et al., 2020}. There are different types of simulators based on fidelity which means accuracy to provide real world situations. {Isaza-Restrepo et al., 2018}. High fidelity simulators include mannequins or dummies to prepare students for clinical environments and low fidelity simulators include virtual patient tool which is interactive computer-based clinical scenarios, seeking to promote an alternative learning environment and the development of necessary medical skills such as clinical reasoning in students of medicine. It most

validate in the situation where human actors as patient cannot change their physiology. Therefore, it is exact model or tool for real learning. Daher et al., 2020.

Background

{Mestre et al., 2022} defined virtual patient is a computerized static clinical information or patient case in written form, diagram and image format that enforce students to make diagnosis and care plan. Virtual patient is a computer based real world simulation that allows students or learners to interact with it as a health care provider and virtual patient display various real clinical scenarios related to different disease and in different discipline of health. {Sezer et al., 2023}. It could be utilized as tool in health department including therapeutic decision-making, diagnosis, physical examination, and history-taking. According to {Rouleau et al., 2022} virtual patient is computerized simulation which depends on real world patient scenarios to train and educate the learners and also it serves for assessment of the clinical competencies of students. Furthermore, it is an opportunity for nursing students to practice multiple time make error without any stress of harm to real patient.

The concept of virtual patient evolved with time and with the help of technology for instance, virtual patient simulation evolved from virtual patient therefor virtual patient simulation is a moving graphical form of real patient that interact with learner as a patient in real clinical environment and students deal it as nurse, doctor and other medical professional. It is called high fidelity simulator because it mimic the real clinical environment. {Mistry et al., 2023} mentioned in his article 3 dimension for virtual reality including haptic device , screen based which previously considered standard but had limitation and head set which is tool of immersive and interactive experience of present in real environment like 3D interactive environment.

{Daher et al., 2020} introduced physical virtual patient simulator which is a new type with tangible characteristics of a human-shaped physical form with the flexibility and richness of a virtual patient. Students can experience multisensory cues, including visual cues (capillary refill, facial expressions, appearance changes), auditory cues (verbal responses, heart sounds), and tactile cues (localized temperature, pulse).

Methodology

This concept 'virtual patient' is defined by using Walker and Avant s method for analysis. (Walker & Avant, 2005). This process involve 8 steps which are mentioned below.

- selecting a concept.
- defining the purpose of the concept analysis.
- identifying all uses of the concept.
- determining the defining attributes of the concept.
- describing borderline, related, contrary, and illegitimate examples.
- articulating antecedents and consequences.
- defining empirical referents.

Data Sources

Literatures for this concept analysis was searched by using electronic database and search engine, PubMed and Google scholars were preferred to utilize and approximately 18 articles was downloaded but some of them was eliminated from the consideration.

The keywords 'virtual patient, nursing profession, virtual patient simulation, clinical reasoning in nursing, decision making, internet learning' were used in the search. English language and peer reviewed of nursing, aviation and medical research article published from 2015 to up to date. Oxford dictionary was utilized for the analysis of this concept as well.

Result

Uses of Concept

Cambridge dictionary defines virtual patient is a learning style for healthcare professionals including doctors and nurses for medical care interaction with simulation of patient using technology , such as computers and video, instead of in person vests.

{Hege et al., 2018} found that, it is a systematically designed computer based program for assessment, history taking purpose, making diagnosis and interventions in specific disease or situation in medical and nursing education system. VP allows students to have real experience prior to enter the actual real hospital settings that what to do in this specific situation. Another definition is explained in this article is VP is a multiple choice option by using

multimedia to develop the concept on different topics. You have describes uses in nursing profession only. What about in aviation, driving and medical education?

Physical virtual patient simulation PVPS is updated simulator in which learner experience interaction with real human. Furthermore, it provides different sensation including visual cues e.g. facial expressions, skin mottling, auditory cues e.g., breathing, verbal responses, and tactile cues e.g. localized temperature and pulse. Its basic purpose is to change the old software based, moving images based simulation and provide realism. {Daher et al., 2020}.

{Isaza-Restrepo et al., 2018}. Found that this is computer based learning that can be in simple text form cases to complex. It helps in clinical reasoning, diagnosis and management planning.

VR-based virtual patient training differs from traditional screen-based or mannequin-based simulation by offering a fully immersive, adaptable, and replicable learning experience. {Mistry et al., 2023}.

VP is categorized under virtual patient including patients, healthcare professionals, and other simulation of human that make it real and it is called as 3D animated, interactive agent to train the learner for healthcare purposes. {Sezer et al., 2023}.

It delivers asynchronous and standardized clinical simulations for nursing students, incorporating 3D patient avatars that dynamically respond to student inputs. This technology enables learners to engage in medical inquiries. Additionally, it generates objective performance metrics, facilitating comprehensive evaluation and analysis. {Schultze et al., 2019}.

It is found by {An et al. 2021} that VP in nursing education, it provides different complex situations to students for their experience and it is sometimes based on hospitals care and sometimes communities centered. It is a computer-assisted instructional method.

Virtual reality is also being used in aviation to train pilots in recognizing and managing visual and vestibular illusions. It provides a cost-effective and safe environment for practice. Furthermore, pilots can train in dangerous scenarios, which improves their knowledge and self-confidence. It offers an immersive experience that is flexible and supports sustainability. Explained by {Thomas et al., 2023}.

{Barjis et al., 2012} shares that virtual environments provide a comprehensive understanding and engage students with processes and systems for a long time. They help students identify objects and concepts related to their studies. Moreover, virtual environments offer a better understanding of complex topics in science compared to traditional case-based studies.

Related Concept

Surrogate words or related concepts can be defined that are similar to the main concept but these concepts have subtle differences, (Walker & Avant, 2005). Some mentioned words below are found in peer review which are related concept.

Medical simulation training
Digital patient
Virtual reality
Computerized patient simulation
Augmented reality patient
Electronic patient case

Defining Attributes

This concept analysis follows the guidelines of Walker and Avant method to determine defining attribute. Although these above terms distinguee this concept with other similar words but sometimes they overlap with each other.

Interactivity

It engage the students with computer screen for a long duration and grab the complete concentration of the learner into real world. {Hege et al., 2018.

Realism

This attribute make it unique because learners feel actual setup which they are dealing with including moving images, videos, communication with patient. {Daher et al., 2020}

Safe Environment for Learning

It is safest development in academia and clinical area to provide real life learning without any contact with real patient. It exclude the chance of ethical damage and physical damage of patient by mistake. {Botezatu et al. 2009}, {Daher et al., 2020},

Diversity

This virtual patient method of education is based on different situation along with multiple cultures to increase the knowledge and experience to deal the same situation in different cultures with different values and beliefs. {Daher et al., 2020}, {Isaza-Restrepo et al., 2018}.

Tool for Assessment

It is evaluating tool and helps the beginners to assess the circumstances carefully and multiple time because it allows students to reattempt, if they feel their assessment is going wrong to make nursing and medical diagnosis. So it could be utilized as real assessment tool for patient history from assessment to interventions. {Hege et al., 2018}.

Tactile Interaction

While using this PVPS learners have opportunities to touch the patient as real world offer situation to assess the vital signs including, patient skin, temperature, pulse and capillary refill. {Daher et al., 2020},

Speech and Behavioral

Now a days many VPs servicing in terms of verbal and behavior characteristics that help students to interact in real health care situation. {Isaza-Restrepo et al., 2018}, {Lee et al., (2020}. Good work!

Model Case

According to walker and Avant's method model case example illustrate all critical attributes related to concept. Rumman, a first semester, MSN student. He is using virtual patient simulation for his clinical training. The real time case of respiratory distress presents him. He interact with virtual patient based on his previous experience by asking different clinical assessment questions. He takes vital sign and makes decision about what intervention is needed to virtual patient. In response of AI algorithm, rumman, observe changes in the condition of virtual patient. He communicate with VP for further assessment for therapeutic relationship. These experience enhances her clinical reasoning and decision-making skills before she engages with real patients in the hospital.

Borderline Case

According to walker and Avant's method a borderline case includes some, but not all, of the defining attributes of the concept. This case may contain attributes that are close to the concept but do not fully represent it. Sana ullah, a 1st semester, MSN student, is using a computer-based patient case study. The program presents a static scenario where sana ullah reads the patient's history, reviews lab results, and selects answers from multiple-choice options to determine a diagnosis. However, the software lacks interactive elements and does not provide real-time patient responses based on sana ullah actions. Although this tool aids in learning, it does not fully engage the student in an immersive, real-world simulation as a VP system would.

Contrary Case

According to walker and Avant's method a related case is one that is similar to the concept but differs in significant ways. It may share some attributes but does not meet the core criteria of the concept. Shehnaz, a nursing student, participates in a mannequin-based simulation in the lab. She perform and practice on high-fidelity manikin for CPR and intubation for emergency situation. It does response physiological because it is programed but does not interact and have a visual screen. But it help in learning like clinical decision and nursing intervention.

Antecedents

(Walker & Avant, 2005) describe it that factors must be presented prior to the concept of interest and help to define the concept. VP concept influenced by different factors which are mentioned and explain below.

Advancements in Medical Education

Basic multimedia teaching strategy already being should in the system to develop it as a virtual patient technique. {Isaza-Restrepo et al, 2018}

Need for Standardized Training

Some experts would be needed to provide education sessions to nursing students that how they can utilize it in multi purposes. Weather experts have to bring from outside the country or send the learner to master the virtual patient system to optimize the standard. {Sezer et al, 2023}

Patient Safety Considerations

This is another issue that must be considered to louche virtual patient web for clinical learner that they can have maximum exposure of real scenario without any harm to patient. It minimize the risk of patient while learning. {Isaza-Restrepo et al, 2018}

Limitations of Traditional Clinical Rotations
Students complain about less time for clinical rotation to variety of cases to deal. These situations reflects the need of virtual patient simulation for clinical students. {Mestre et al, 2022}.

Case Developer
This factor is crucial for virtual patient tool that continue updatation and make a scenarios according to different department like cardiac, respiration and neuro surgery to cover the each aspect of clinical learning and even in various different discipline like nursing and medical.{Hege et al, 2018}.

Technological Competence of Learners and Trainers
The need for specific technical expertise during development of virtual patient and for installation of software and recovering from any corruption of file in this system. It also important to train the further operator and learner to hoe deal with it. {Sezer et al, 2023}

Consequences
Walker and Avant's method for concept analysis tells us that consequences occur as result of the concept of interest. Therefore, these all are below mentioned terms and their definition are consequences of virtual patient. Some of them are negative consequences and rest of them are positive outcomes.

Improved Clinical Decision-Making
VP process improves cognitive thinking by variety of cases and it leads to effective decision making skills in better diagnostic and intervention to provide treatment. {Mistry et al, 2023}

Enhanced Retention and Recall
Students remember virtual cases more than textbook material because its different type of simulation left prolong and durable impact on students mind and it increases student's memory to recall all events while performing real intervention in the clinical area.{Mestre et al, 2022}.

More Confidence in Real-Life Practice
Exposure to a variety of cases reduces anxiety in real-world settings pressure for the first time of attempt of task by clinical professionals. {Mestre et al, 2022}.

Accessibility
It is easy to make availability of VP for students to learn by launching training center in different location and even no need any authority from any organization, any time. {Liaw et al. 2020.

Patient safety
This VPS make it place for best learning style to reduce the error before real medical practice. {Hege et al, 2018}.

Need for Continuous Improvement
It requires to be updated with new scenario and it is negative consequence of comparison of real clinical with virtual simulation. {Mistry et al, 2023}.

Lack of emotional component and reliance on VP
Over-reliance on virtual patient simulations can make it challenging for some students to adapt to real-world patient variability. Additionally, VPs have limitations in replicating genuine human emotions and non-verbal cues, which are essential in nursing interactions. {Isaza-Restrepo et al, 2018}

Empirical referent
Walker and Avant define empirical referents are observable phenomena that relate directly to the defining attributes of the concept of interest that could be used to measure the potential of learner's training. Whether the claimed consequences are true or falls.
Although the concept virtual patient is abstract, however it describe in various articles as a concrete to measure through empirical referents that allow researchers and educators to assess the defining attributes, effectiveness, and impact of VP tools, bridging the gap from theory to practice.

Performance Improvement and skills development

Clinical skills assessment score is a referent provide us numbers to measure the performance of Learners. This referent include, interviewing, physical examination, clinical judgment, relevance of medical exams, and case presentation. {Isaza-Restrepo et al., 2018} reported that statistically significant advance ($p < 0.01$) in all aspects of referents mentioned above. The evaluation matrix is developed for compare the skills of students before and after the exposure of virtual patient. Students stated that virtual patient is motivational tool, stress free and easy to use.

Diagnostic Accuracy and Clinical Reasoning Indicators

Visualize concept map is used as virtual patient tool by {Hege et al, 2018} to evaluate the ability of learners connect the right elements and predict the accurate diagnose. Different element were problem/finding, differential diagnosis, tests/ labs and treatment options.

Confidence Level

{Rouleau et al., 2022} explained that one student did high level of performance with real patient in the hospital and when he asked how it become possible. He replied that multiple exposure by virtual patient tool on MI disease, I got confidence expertise.

Satisfaction Levels

This referent can be utilized to see the effect of virtual patient.{Isaza-Restrepo et al., 2018} asked students after learning through virtual patient and perception of students was it is easy to use and helps us to develop critical thinking without harming patient with repeatedly attempt.

System Performance and Fidelity

This referent measure the realistic and technical aspect of virtual patient that how virtual patient replace reality and act like reality. {Sezer et al., 2023} that scores of learner was high and support to high fidelity of virtual patient.

DISCUSSION / IMPORTANTANCE IN NURSING

Our nursing skills and clinical strategy were used to teach by the traditional methods of learning including books and making a notes. It was very successful for that time, due to increase population and its impact on medical and nursing community to push in crisis of shortage of staff. Emergence of VP pace the thinking ability in different situation where fast decision fulfill the requirement of nurses. {Botezatu et al. 2009}. Theory based knowledge was difficult to implement and it created confusion for many learner. However, VP develops the sense of transfer phase in the beginning of the study of virtual patient simulation that how theory based procedure will be applied in real situation.

It is significantly related to healthcare professionals, due to lack of proper knowledge and skills, patients become victim of untrained staff and get harm, therefore VP reduce the chances of error and improve patients recovery. Inter professional Training the PVPS can be used in team-based scenarios, helping nurses practice communication and collaborative decision-making {Daher et al., 2020}. Virtual patients (VPs) are extensively utilized in both undergraduate and postgraduate nursing education to enhance communication skills, empathy, and diagnostic reasoning. Researches indicate that most VP systems emphasize patient history-taking and the delivery of bad news, both of which are essential in nursing practice. It ensures all nursing students receive the same level of exposure to essential cases.{Isaza-Restrepo et al., 2018}. The instant result in the shape of completion rate and feedback enhance the knowledge along with all steps in procedure make students efficient in their profession. PVPS promotes situation training, means it can be implemented in variety of healthcare real world preparation. {Daher et al., 2020}. It supports continuous professional development, as nurses can revisit simulations to refine their skills. {Liaw et al., 2020}.

Conclusion

The meaning and application in nursing education of virtual patient is clarify and explained in this concept analysis by using Walker and Avant's method. Many defining attributes identified in this concept analysis including interactivity, realism, safe learning environment, diversity, assessment utility, tactile interaction, and speech/behavioral simulation and digital patient or mannequin-based simulation are related term which are using by medical and nursing departments. This concept analysis is focused on

various antecedents like, advances in technology, the demand for standardized training, and limitations in traditional clinical rotations and these all antecedents reflect the value of concept in nursing education and practice. As a consequences, enhanced decision-making, improved retention, greater confidence, and patient safety confirm the value of VP in bridging theory and practice, these all are identified. For empirical referent as an indicator were performance assessments, OSCE outcomes, feedback from learners, and integration into curricula for observable behavior that support the presence and effectiveness of virtual patient concept in nursing education. Overall, this analysis of concept virtual patient provide clear understanding of its need and importance in nursing education. Virtual patient contribute as effective learning tool for clinical education which enhance clinical expertise, clinical reasoning. It offers a foundation for further research, curriculum development, and clinical application aimed at preparing competent, confident, and safe healthcare professionals.

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