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Can Human Patient Simulators be used in Physiotherapy Education?

Anne Jones, BSc, MPhty[1]
Lorraine Sheppard, BAppSc, MBA, PhD[1,2]

1. School of Public Health, Tropical Medicine and Rehabilitation Sciences
   James Cook University
2. University of South Australia, School of Health Sciences

Australia

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Abstract
Purpose: The purpose of this study was to review the evidence for the use of human patient simulators in physiotherapy education. **Method:** A review of the physiotherapy literature was undertaken. Due to the lack of studies found the search was expanded to include health professional education. Exclusion criteria were then applied to the identified literature and critical appraisal undertaken. **Results:** Due to the differences in methodology employed in the studies identified a meta-analysis could not be performed. The studies identified repeat practice and the ability to control the learning environment as positive aspects for learning using human patient simulators. In medical education psychomotor skills improved when simulators where used. **Conclusions:** Conclusions were not able to be drawn regarding whether the use of human patient simulators leads to improved patient management in a clinical environment especially in the field of physiotherapy. A controlled study investigating cardiorespiratory physiotherapy clinical performance is recommended to determine whether human patient simulators should be used in physiotherapy education.

Introduction

Allied health has the opportunity to consider human patient simulators in their education programs. Human patient simulators were first used in medical education nearly fifty years ago.[1] Since then the use of simulation has grown and is now used for training undergraduate and postgraduate medical practitioners and nurses.[2-7] Recently human patient simulators have been used as an educational method for training in the area of cardiorespiratory physiotherapy.[8-9] The potential of this medium for allied health is not well explored.

Clinical simulation has been used to describe many different forms of simulators. Simulators range from part task trainers through different fidelity human patient simulators and standardised patients.[10] Part task trainers are simulators which only replicate part of the environment, such as for intra venous cannulation.[11] Computer based systems allow learners to use information to make treatment decisions or learn knowledge, for example physiology.[4] Virtual reality and haptic systems present virtual objects to learners in a way that is identical to their natural environment. Haptics uses touch feedback to produce a feeling of resistance. These systems tend to be teamed with part task trainers such as laparoscopic or endoscopic trainers.[12-13] Simulated patients, also known as standardised patients, are actors trained to portray a person with a certain condition.[14-15] The final type of simulator is the human patient simulator, which ranges from low to high fidelity. Low fidelity simulators provide the learner with a small amount of feedback, for example Resusi Anne which "clicks" when the chest is compressed and the chest rises during cardiopulmonary resuscitation training. Medium fidelity simulators are driven by computer programs and allow the instructor to manipulate physiological parameters. High fidelity simulators are computer driven and allow the learner to interact with the patient as if in real life. This includes pre-programming of critical events, for example asystole, and through the use of a microphone the patient can speak. In reading the

literature the different terms used to describe simulators is very varied with little standardisation in definitions.

Educational methods need to be investigated to determine the reliability and validity of the approach. For health professional education in general, and physiotherapy in particular, student learning must transfer into competent performance in clinical situations. What evidence is there that human patient simulators are beneficial for physiotherapy student learning? A review of the literature regarding the use of human patient simulators in health professional education was undertaken to determine the evidence for its inclusion as a training method for physiotherapy students.

Search strategy

The search initially aimed to identify research relating to physiotherapy education using medium fidelity simulators but due to the lack of studies, the search was then expanded to other health professions. The use of the term medium fidelity resulted in a total of 6 studies being identified. The search was then expanded to include all levels of simulator fidelity. The search timeframe was from 1940 to May 2006. The search language was limited to English. The databases searched were: Medline, CINAHL, Informit, Proquest, PEDro, and Web of Science. The search terms used, with Boolean combinations were: simulation, simulator, physiotherapy, physical therapy, cardiorespiratory, cardiothoracic, cardiopulmonary, and skill acquisition.

Not all databases allowed the search terms to be used due to variations in the way searches can be conducted. For example, the PEDro database-(Physiotherapy evidence database) allows searches to be conducted by key word as well as by area of interest. In this case, not only was a search conducted using the key terms, but also by looking at all studies listed under the area of cardiothoracics. A search was performed on the internet using the search engine "Google Scholar" which contributed no further new studies. A review of the references in each article was also done to identify new studies which had not been identified using the search strategy.

This strategy identified a total of 119 studies once duplicates were removed. A review of the studies was then undertaken with the following exclusion criteria applied:

- Commentary, qualitative research or opinion studies
- Studies which were in abstract form only
- Research looking at the reliability or validity of a simulator and
- Research which did not involve human patient simulators as defined above.

After applying the exclusion criteria, a total of eighteen studies were found to be suitable. These studies were appraised for quality using the method outlined by Harden et al (1999). Harden et al recognise that the methodology of the study does not guarantee quality. They outlined variables by which the quality of the research should be assessed and considered when appraising research the following need to be evaluated:

- Background
- Sample
- Data collection
- Data analysis
- Validity, reliability and generalisability and
- Conclusions

The quality scores were graded on a sixteen point scale based on the number of positive responses. Therefore, a score of ten out of sixteen meant that ten of the questions had positive responses with regards to the research reported. As well, all studies were coded using the Best Evidence Medical Education (BEME) coding sheet. [16] This allowed the research to be grouped so that similarities and differences in methodology and outcomes could be easily identified. Due to the differences in methodologies, a meta-analysis could not be performed and thus a qualitative comparison of the studies was undertaken based on the quality scores and BEME coding.

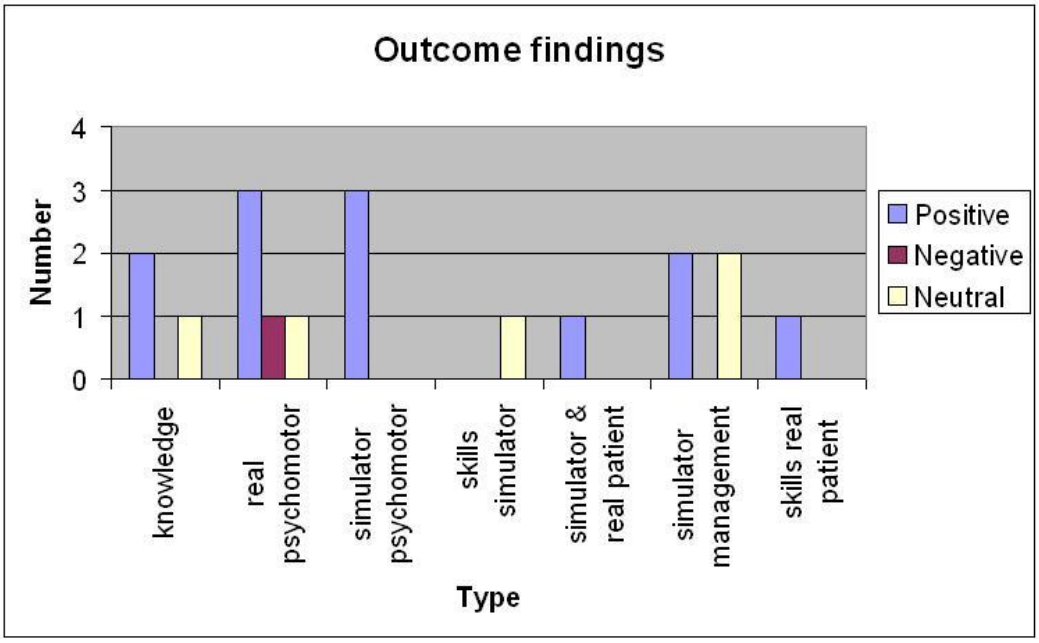
Methodological findings

The current scope of research investigating the use of simulation as a learning tool is limited. The use of simulation in health education originally was investigated in the late 1960s.[1] Since that time, the use of simulators has gradually increased with much more evaluation of the possible educational benefits of simulator training occurring since 2000.

The strength of the findings from the research was scored on the BEME with one being no clear conclusions, not significant, and five being unequivocal.[16] The most frequent finding was a score of three which equated to the conclusions could probably be based on the results. The correlation between the quality score and the strength of the findings was calculated to be 0.72. This indicates a fair relationship between the quality of the reported research and the findings stated in the article.

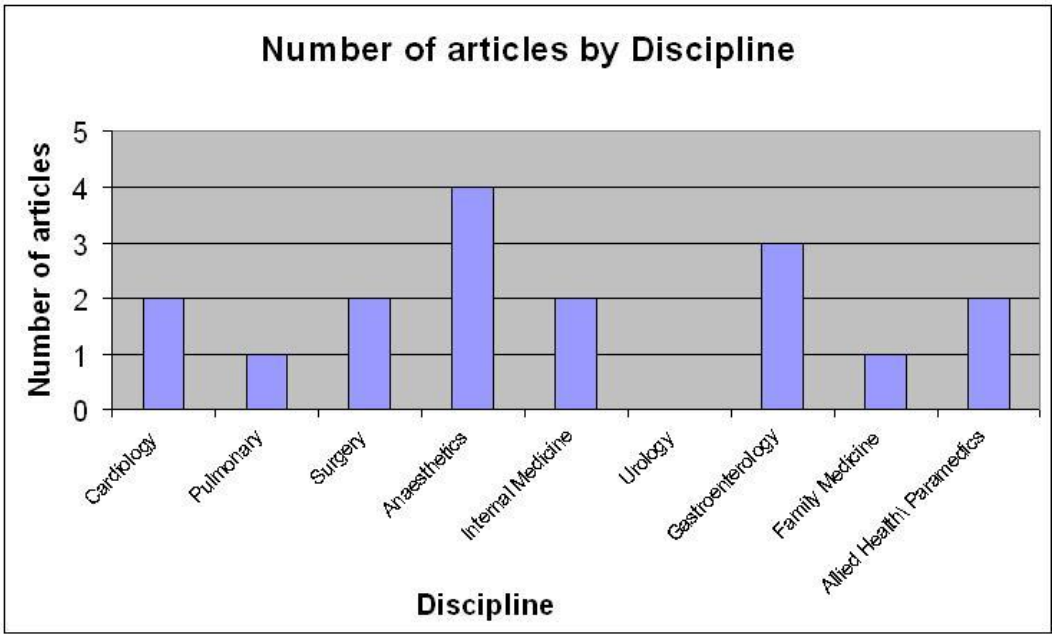
Sixty-seven percent of the studies found positive results in favour of the use of simulators as training method (figure 1). Twenty-eight percent found no difference between the use of simulators and another method of training.[4,17-19] It is interesting to note that those studies which found no difference between the methods of training all were scored at high quality on critical appraisal. Only five of the twelve studies with positive findings were appraised as high quality. [20-24]

Figure 1: Nature of the results



The subjects in the studies where mainly from the medical field with anaesthetics and gastroenterology being the most numerous (Figure 2). There was only one article from physiotherapy which was of very poor quality, scoring two out of sixteen. Findings from this article were unclear.

Figure 2: Discipline of subjects



With any study into the effect of an educational method, the exposure needs to be adequate to allow for learning to occur. Of the studies identified, five did not specify how many sessions the participants trained on the simulator. Eight of the reported studies used the simulator only once for training the participants. Thirteen

of the studies reported that the participant received less than ten hours of training using the simulator. Two of the studies did not report how many hours of training the participants received. Without the knowledge of how much training was received, it is difficult to determine if the educational method was the reason for the training outcome or if the training time was inadequate. In all the studies in which participants received only one simulator session less than ten hours of training time occurred. The results from the eight studies, that had only one simulator session, were conflicting in that four of the studies found positive outcomes with simulation whilst the other four studies found that simulation equal to of worse than other educational methods.[4,11,17,18,23-26]

Research has identified numerous aspects of simulators which potentially aid learning. Two-thirds of studies cited the ability for repeated practice as a positive learning feature of simulators. Over forty percent of the studies found that the realism of the simulator was beneficial for learning. This included low, medium, and high fidelity simulators. Di Giulio et al (2004) found that the participants in their study stated that the simulator was not realistic enough.[27] This may have adversely affected the results as the lack of realism may have decreased the potential benefit for learning. Over one quarter of the studies stated that positive educational aspects included the ability to control the learning environment and that the simulators were user friendly for the learner. Less than one quarter of the studies identified the fact that a variety of clinical conditions could be simulated and that the use of a simulator allowed independent learning. This may have been due to the type of simulator used and the need for supervision to provide feedback to the students on their performance.

Discussion

In undertaking a review of the identified studies, it can be seen that there is a range in the quality of the reported research. There is some evidence demonstrating that the use of human patient simulators is a useful training method for health professional students. However, the transferability of the findings to physiotherapy is limited due to the nature of physiotherapy clinical practice. Physiotherapy practice involves assessing and treating patients with a range of different conditions. As well, the physiotherapist may see the patient over a number of different occasions where the patient's condition is likely to have changed. This results in the physiotherapist needing to continually reassess and manage the patient appropriately. This differs from how simulators have been used in medical and nursing education. In these fields, the simulator is used for training team work, communication, and management of a specific problem, such as an emergency cardiac arrest. The other main area that simulation has been used is in teaching a specific procedural skill such as endoscopy or intravenous cannulation. These skills are psychomotor tasks and once learned can be applied to many different people under similar conditions. Although physiotherapy performance has some psychomotor skills which are learned, a large component of practice is clinical reasoning. From the literature review, there is little research to indicate whether clinical reasoning and performance is improved with the use of human patient simulators.

As the aspects of repeat practice and the ability to control the learning environment appear to be positive benefits of using a human patient simulator, their use in cardiorespiratory physiotherapy education may be beneficial. For example, when learning auscultation, human patient simulators could be employed. Students can practice the skill repeatedly and be introduced to different case scenarios before assessing and treating real patients. This may aid learning through developing student confidence in their ability to perform auscultation and differentiate auscultation sounds. Students can also practice their reasoning skills regarding why the sounds were heard and develop appropriate treatment strategies for the patient's condition. This can all be achieved without the time constraints which can be imposed on students in a clinical setting.

Conclusion

The use of human patient simulators may be beneficial in aiding students to learn psychomotor skills which could be a useful teaching tool prior to clinical placements. Although it may be beneficial for students to repeatedly practice the management of different conditions in a safe environment, there is little evidence at this stage. By assessing the clinical performance of students, a transfer of learning effect could be determined. This has rarely been investigated in other health professional educational studies. The evaluation of improvement in clinical performance following training using human patient simulators is worthy of further consideration. Due to the design, cost, and fidelity of current simulators, an appropriate area of research could be cardiorespiratory skills and management. It is recommended that a controlled study be undertaken to compare clinical performance of a group of students who have received simulator training with those who have not. If research into the use of human patient simulators in cardiorespiratory education confirmed their educational benefit, then development of new simulators in other areas of physiotherapy practice may be justified.

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