High-fidelity patient simulation in physiotherapy education

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Over the last 30 years, the medical profession has been following in the foot steps of the aviation industry by developing equipment and teaching styles to recreate, or simulate, patient scenarios for educational purposes. One of the first mannequins in simulation education was the cardiopulmonary resuscitation mannequin, used with nurses and medical professionals for basic life support training since the 1970s. The popularity and positive learning outcomes noted from the use of such an education tool stimulated the medical profession to develop a vast assortment of simulators, ranging from simple part task trainers through to technologically advanced medium-to high-fidelity human patient simulators. 'Part task trainers' refers to modelled segments of the body, eg, the pelvis or knee, designed to teach specific skills such as intra-articular injection, scopic surgical procedures, or pelvic examinations. 'Medium-to high-fidelity human patient simulators' are full body mannequins that mimic precisely physiological responses to medical intervention such as drug administration or invasive procedures. The high-fidelity mannequin is linked to a computer system that drives physical changes in the mannequin such as respiratory rate, and opening of eyes, as well as physiological responses displayed on the 'patient' monitor such as heart rate, blood pressure, and oxygenation. This technology allows medical educators to simulate patient cases and provide students with the opportunity to refine practice away from real patients, in a safe and supportive learning environment. Integration of simulation education into medical curricula has been shown to facilitate the acquisition of technical skills such as resuscitation and invasive procedures (Gaba et al 1998, Issenberg et al 2003, Pittini et al 2002) as well as development of higher level processes such as cognitive analysis, clinical decision making, self efficacy, and communication skills in medical students (Blum et al 2005, Gaba et al 1998, McMahon et al 2005, Steadman et al 2006, Weller et al 2004, Zirkle et al 2005).

In more recent years the exponential increase in interest in simulation has not been confined to the medical profession. There are increasing numbers of studies that report positively on the potential for simulation to prepare nursing and allied health students with high level cognitive, psychomotor, and procedural skills to meet the demands of increasingly complex patient presentations and health care system (Hall et al 2005, Henneman and Cunningham 2005, Quinn et al 2003).

This interest in simulation for education has largely been driven by the financial, ethical, and organisational challenges inherent in traditional models of health professional education (Winslow et al 2005, Haskvitz and Koop 2004). Those responsible for education are finding that traditional educational models, involving extensive clinical time, are not sustainable and health organisations, health managers and clinicians reportedly view students on clinical placement as a burden (Health Professions Council of Australia 2004). Yet there are significant healthcare workforce recruitment and retention issues driving an increase in the number of students requiring training in health professional fields (Heath Professions Council of Australia 2004). The physiotherapy profession is not immune to these challenges, and has stated widely that there is a 'clinical education crisis'. The burgeoning number of physiotherapy schools being established around Australia has raised concerns amongst the profession that the constrained health care sector cannot continue to deliver an appropriate level of experience to provide safe and effective graduates (McMeeken et al 2005).

Positive clinical exposure contributes to the development of a sound knowledge base, improved professional socialisation, enhanced clinical decision making skills, and effective clinician client relationships (Heath Professions Council of Australia 2004, Australian Institute for Primary Care 2004). Therefore, clinical education should not be removed from health professional curricula. The suggestion is that simulation may be used to enhance clinical experience and possibly decrease the clinical education burden by removing initial therapeutic practice from the clinical setting.

High-fidelity simulation for physiotherapy education

Simulation is not a new concept in physiotherapy education. In some form it has already been integrated into many curricula. For example, simple plastic mannequins have been used to train basic skills such as airway suctioning, and lungs have been used to teach manual hyperinflation techniques. Preliminary studies using these basic mannequins have resulted in effective learning of clinical skills and decision making in physiotherapy (Hassam and Williams 2003, Kinney La Pier 1997).

There is the potential for greater opportunities in physiotherapy education through the use of new generation high-fidelity human patient simulation. High-fidelity simulation allows educators to create an environment for repeated practice of both skills and decision making, with support and guidance where the learner is the complete focus of attention. In the clinical setting, the patient must remain the focus at all times, with the potential result a limited learning experience for students. This is particularly evident in areas where education is occurring with the support of hospital clinicians seeing the sickest and most vulnerable patients, specifically in the emergency department and critical care unit. The tendency of clinicians supervising students in these areas is to limit the amount of practice students undertake in order to limit the potential for serious adverse events. Simulation would allow student experience and learning whilst maintaining safety and reducing the potential for adverse events as practice does not occur on 'real' patients. It is important that physiotherapy graduates are 'work ready', safe, and confident beginning practitioners,

and high-fidelity simulation may help to achieve this requirement for all students.

Another advantage of simulation is that patient scenarios can be produced on demand, giving students guaranteed exposure to a wide variety of clinical situations. This overcomes some of the limitations of the clinical setting where training is dependant on which patient cases literally 'walk through the door'. Scenarios can also be progressed in complexity and be repeated until students reach competency on the simulator. Students can then proceed to establish competency on real patients in the clinical environment, potentially reducing the number of 'hands on' clinical hours required to achieve competency.

In light of the current clinical education challenges faced by the profession and educational institutes, and given the positive research (albeit in its infancy) demonstrating the efficacy of simulation for physiotherapy education, we believe that it is now time to consider embracing and evaluating some of the new technology. In the area of cardiorespiratory training, highly realistic acute care environments can be created using the medium-high-fidelity human patient simulators developed for medical education. These simulators can be intubated, ventilated, have a multitude of invasive lines inserted, and are ideally suited to training physiotherapists in the management of critical care and emergency patients. In other areas of practice the options for physiotherapy training are currently limited to a small number of part task trainers. These devices could be coupled with standardised patients (actors trained to behave as a specific patient presentation and respond appropriately to student interaction) to create a high-fidelity environment, whereby the student can practice not only the skill associated with the part task trainer, but also the interview, the clinical decision making, and the interpersonal processes needed to become a competent clinician. It is very likely that more technology will be developed as the need for devices relevant to physiotherapy practice becomes apparent. There is potential to create mannequins that mimic spasticity, allow palpation of joints and testing of joint movement and ligamentous stability, and eventually cervical, thoracic, or lumbar manipulation.

Simulation technology may not be limited to University physiotherapy training. In the cardiorespiratory field, simulation has been found to enhance the learning experience in professional development courses (Thomas and Walker 2006). There is also enormous potential for simulation training to facilitate the process of extended scope and physiotherapy consultancy. Part task trainers and full body mannequins are already available to teach techniques such as intra-articular injection, bronchoscopy, and blood sampling, and there is no reason why such technology could not be utilised by physiotherapists should practice encompass these techniques in the future.

Limitations to high-fidelity simulation

The first potential limitation is that the mannequin used in simulation can never replace a human being and the participant is essentially learning in an artificial environment (Flanagan, Nestel and Jospeh 2004). Transfer of skill from the simulated environment to the clinical setting cannot yet be assumed; however, Australian research is currently under way to evaluate this transfer of skill within physiotherapy. At present it is recommended that to facilitate learning and transfer of skills it is necessary to enhance the realism of the scenario with physical props and psychosocial interactions, and to allow a reflective group debrief at the conclusion of the simulation (Flanagan, Nestel and Jospeh 2004). Video replay of the scenario may also facilitate learning, giving students the opportunity to view their practice and reflect.

As the environment is artificial, another potential limitation is human behaviour during the simulation. Learners know that they are practising on a simulator and this can lead to behavioural changes that would otherwise not occur in the clinical setting. Some learners become hypervigilant; that is, they anticipate an adverse response and are overly cautious with their actions (Flanagan, Nestel and Jospeh 2004). Others demonstrate cavalier behaviour where they become overly casual with their interactions as there is no human life in the balance or 'real' consequences (Flanagan, Nestel and Jospeh 2004). A comprehensive orientation to the simulation environment, genuine team interactions, plausible social cues such as pagers and phone calls, and verbally cuing the students to any additional plausible physiological cues such as changes in skin colour that the simulator cannot mimic, will all assist in improving the learning experience and minimise these behaviours (Flanagan, Nestel and Jospeh 2004).

The greatest potential barrier to embracing new simulation technology is cost and infrastructure to conduct simulations. Significant equipment purchases are required to create a simulated environment that is of sufficient realism to mimic clinical practice. Each simulation scenario requires access to appropriate physiotherapy and medical equipment. Appropriate mannequins and part task trainers need to be purchased and maintained. The initial outlay for each part task trainer or mannequin can be anywhere from AUS $1000 to AUS $500 000 depending on the fidelity and functions required. Finally, staffing costs (such as actors filling any standardised patient roles, educators to facilitate the learning process, and some form of technical support for mannequin operation) also need to be considered. To rationalise these costs, the common practice worldwide is to construct a designated site for simulation, often labelled a Skills or Simulation Centre. One medium sized Australian Skills Centre, which opened in 2004, estimated infrastructure establishment costs at US$876 000 and yearly fixed costs at US$370 000 (McIntosh et al 2006). However, this particular skills centre caters for learning needs across medical, nursing, and allied health disciplines, including surgery and anaesthesia, resulting in the purchase of the highest fidelity equipment available. More widespread and intensive use of such centres is likely to defray costs across more users which should contribute to lowering user fees and increased cost-effectiveness of this medium. Interdisciplinary simulation scenarios may also decrease hourly costs as students across disciplines learn simultaneously in the one scenario.

The international experience has also cautioned against the adoption of simulation without the development of 'educational infrastructure' to support its use (Henneman and Cunningham 2005, Hravnak et al 2005). There is the potential to invest considerable funds purchasing technologically impressive, medium- and high-fidelity equipment without developing complementary teaching materials, integrating simulation into the curriculum, or evaluating the outcomes of such an education medium appropriately (Seropian et al 2004). Implementing a simulation model into existing curricula is a labour-intensive process that requires considerable investment in

academic time (Haskvitz and Koop 2004, Feingold et al 2004). This, too, needs to be considered in the discussion on simulation for physiotherapy education and points to the need for educators to work collaboratively to develop learning objectives, simulation scenarios, and supportive educational infrastructure.

Conclusion

New simulation technology is likely to be the way of the future for training health professionals across all disciplines and, as is evidenced by the establishment of the international Society for Simulation in Healthcare (www.ssih.org), is being rapidly embraced world wide. Collaborative development of physiotherapy-specific simulation equipment, educational infrastructure, and studies examining the efficacy and cost of simulation for physiotherapy education are required. A network of Australian University physiotherapy educators is currently planning randomised controlled trials comparing clinical time plus simulation to clinical time alone to evaluate student learning outcomes with particular focus on clinical competency.

This new technology is not limited in application to University education. Physiotherapy departments and professional development educators may also consider implementing simulation technology into training programs, particularly if considering extended scope and physiotherapy consultancy. It is important that the profession looks to the future and does not shy away from this exciting new educational medium. The profession requires an open mind to evaluate the potential of high-fidelity patient simulation to enhance the clinical education experience, increase the capacity for training physiotherapists, and provide Australia with exceptional physiotherapy clinicians and services.

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