PREHOSPITAL CARE

Contemporary simulation education for undergraduate paramedic students

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In recent years there has been an emphasis on the reduction of medical errors in patient management, especially in the hospital setting. There is no identified reporting structure for the prehospital setting like that used in some hospitals in Australia. The Australian Incident Monitoring Study (AIMS) has been developed and used predominantly by anaesthetists and in the intensive care unit to report actual management errors, near misses, and positive events.[1]

The main identifier of prehospital errors in Victoria has been the Consultative Committee on Road Traffic Fatalities (CCRTF). This group identified that 76 (84%) of prehospital problems (n = 90) in 2002/2003 contributed to the patient's death, with 67 (75%) being actual patient management problems. It was noted that between the 1997/1998 and the 2002/2003 review there was a 20% increase in rural road traffic incidents and fatalities.[2–7]

With total Victorian road traffic fatalities decreasing by 28% over the last 5 years and a smaller decrease in other road traffic related injuries, including serious injuries, paramedics are being exposed to significantly less trauma, especially in rural and remote areas of the state.[8]

The Victorian prehospital data suggest that there is a need for simulation training, especially in trauma management, for undergraduate students before their employment in rural Victoria as their exposure to some trauma types will be infrequent.

The Department of Community Emergency Health and Paramedic Practice (DCEH&PP) at Monash University, Australia, is one of the major providers of undergraduate paramedic education. To assist undergraduate students with authentic medical and trauma experiences we utilise two simulation centres.

This paper about the simulation centres is intended to be descriptive; the efficacy, role and evaluation of simulation as an educational resource is beyond its scope. We describe how the indoor simulation centre and the outdoor road trauma simulation centre provide a more realistic experience for undergraduate paramedic students in managing a variety of clinical scenarios.

HISTORY OF PARAMEDIC EDUCATION IN VICTORIA, AUSTRALIA

Paramedic education and training in Victoria, Australia had been conducted for the previous 38 years by the Ambulance Officers' Training Centre (AOTC). Following the closure of the AOTC in 1999, and the relocation of paramedic education into mainstream higher education, Monash University, Faculty of Medicine, Nursing and Health Sciences was contracted by the Victorian state government to provide the necessary education programmes to meet the workforce needs of the two ambulance services in Victoria. The DCEH&PP now provides both pre-employment (students complete their course before seeking employment with an ambulance service) and post-employment (students employed by an ambulance service before commencing their course of study) education to undergraduate paramedic students, to other health orientated industries as well as postgraduate studies to PhD level. The department is located in a purpose built building, which includes the indoor and outdoor simulation centres constructed on the peninsula campus of Monash University at Frankston in Victoria. The building was commissioned in February 2000. Academic programmes currently offered as Monash University awards by the department range from diploma to PhD.

The department also provides professional development programmes in basic life support, advanced life support and prehospital care for Monash University undergraduate students in medicine, nursing, dietetics, and radiography. Continuing education programmes are also offered to general practitioners and registered nurses, and components of training for the Royal Australian Army and Royal Australian Navy Advanced Medic Corp. Additional professional development for ambulance service personnel is conducted in association with the Australian College of Ambulance Professionals (ACAP).

THE SIMULATION CENTRES

The simulation centres are primarily used by the undergraduate students to provide them with exposure to lifelike trauma and medical situations. This is especially useful for the Bachelor of Emergency Health (BEH) students who receive minimal on-road experience during their studies and who therefore potentially have suboptimal capacity to link theoretical information to clinical practice. This reduced capacity for undertaking clinical placements is caused by several factors, including reducing actual teaching time during academic semesters and the ambulance sector's inability to meet pre-employment clinical placement demands.

The underpinning educational theories of constructivism and social constructivism are used throughout the BEH programme and are based upon the theoretical work of Bruner,[9] Dewey,[10] and Vygotsky.[11] These theories refer to the notion that students construct meaning and scaffold learning objectives based upon personal and social learning network experiences. These theories are integrated and modelled through case based learning (CBL).[12 13] CBL is founded upon a student centred approach, whereby students use the following learning model: discovery, responsibility, empowerment, emancipation and motivation (DREEM) and rely less on teachers simply dispensing knowledge, or in other words, learning material is delivered in a dialectic fashion as opposed to didactic. Using a CBL approach allows seamless and pragmatic integration of simulations for several reasons: firstly, both CBL and simulations rely on imitating clinical behaviour (in both theory and

Abbreviations: ACAP, Australian College of Ambulance Professionals; AIMS, Australian Incident Monitoring Study; AOTC, Ambulance Officers' Training Centre; CCRTF, Consultative Committee on Road Traffic Fatalities; BEH, Bachelor of Emergency Health; CBL, case based learning; DCEH&PP, Department of Community Emergency Health and Paramedic Practice; DREEM, discovery, responsibility, empowerment, emancipation and motivation

Figure 1 Bedroom—indoor simulation centre.

practice); and secondly, educational theory harmony is ensured with constructivism and social constructivism both being well supported in CBL and simulation literature.[12–16] Having analogous teaching approaches reinforces clinical concepts and supports clinical practice in a safe and non-threatening environment.

Indoor centre

The indoor centre is contained within the department and was included in the construction of the building. The complex was designed similar in scale to a small flat with an entrance, off which a corridor runs in two directions to a kitchen, lounge, bedroom and bathroom areas. This convincing setting reinforces the notion of authentic clinical simulations allowing faculty and students to undertake realistic simulations—for example, difficult egress from bathroom secondary to a patient collapse.

Each room has been provided with appropriate furnishings so that it is as practical as possible. At the end of each set of rooms is a briefing area that has a glass wall so that students not involved with the actual simulation session can observe (fig 1). Each room has a dedicated microphone allowing students behind the glass to hear the interaction between the student paramedic crew and the patient. There is also the ability to video student performances for review and debrief after the simulation session is completed. This setup allows faculty to run two separate simulations at either end of the flat utilising one of two rooms, maximising the utility of the facility and hence allowing students to gain as much simulated experience as possible during limited practical time.

Outdoor centre

The outdoor simulation centre was constructed 2 years ago following a $A20 000 (£8700, €14 000, US$17 770) grant from the Royal Automobile Club of Victoria Sir Edmund Herring Memorial Scholarship.

The outdoor simulation centre contains two cars purchased from a local car wrecking business following separate significant accidents (fig 2). Both vehicles have distinct damage from each other (front impact versus side impact). This allows multiple simulations to be created by either using one or both vehicles at any given time—for example, a ''T'' bone collision between two vehicles or a single vehicle accident suffering front end damage. The damage to the vehicles allows simulations involving patients with frontal chest, abdominal, pelvic, and head injuries; and injuries involving the right side of the pelvis, abdomen, chest and head. There is also a damaged pushbike and motorbike that can be placed within the complex. These two types of bikes allow a range of injuries normally sustained by their riders to be used in the simulation, including multiple limb, pelvic, chest, abdominal, and head injuries. These damaged vehicles allow students to see and manage injury patterns to patients that they will be presented with in the ''real world''. With several vehicle types available a combination of vehicle accidents can be presented to the student; this includes multiple patient incidents. This ''real world'' simulation assists the student to consolidate knowledge and enhance practical experience that includes decision making and overall patient and scene management. This provides faculty with the capacity to develop different and authentic simulations based upon realistic damage to particular vehicles—for example, an airbag being deployed (fig 3). The outdoor area also allows accurate egress and extrication opportunities with ample space to park emergency service vehicles such as ambulances, fire trucks and road rescue units. The outdoor centre is secured during non-teaching hours and offers faculty and students protection from the elements by a large weather canopy.

DISCUSSION

From our understanding, the suite of simulation centres that is incorporated into actual building infrastructure and its environment is the first for prehospital undergraduate education within Australia. The only other prehospital specific simulation complex has been described by Langran and Carlin.[17] They

Figure 2 Outdoor road trauma simulation centre.

Figure 3 Students undertaking a trauma simulation.

illustrate the use of a mobile simulation vehicle for the trauma education of prehospital care providers in Scotland.

With the development of the new health sciences programmes at Monash University Peninsula Campus, namely the BEH, it has provided exciting opportunities for creating innovative and contemporary ways of providing prehospital and interprofessional education. It is anticipated this will enable BEH graduates to have ongoing relevant ''trauma awareness'' and to be able to provide quality trauma care in a broader primary health care context. Even though the simulation centre is primarily for student paramedic use, the indoor centre is able to be used by other students from related health disciplines or in conjunction with paramedic students to enhance the opportunities for interprofessional education and to foster the interaction between the student groups.

Trauma and medical education is an integral part of undergraduate prehospital education and training. A significant proportion of the undergraduate BEH preparation and reinforcement of clinical theory and practice involves clinical trauma/medical experiences to be provided in a variety of innovative and simulated clinical settings. The simulation centres provide BEH students with the capacity to practise their clinical trauma problem solving skills, psychomotor competencies and clinical practice integration.

Simulated trauma cases are used in the outdoor trauma simulation centre during teaching semester time and use human actors and medium fidelity mannequins to provide increased trauma authenticity. The medium fidelity mannequins, while not obviously having the benefits of high fidelity mannequins, provide students and faculty staff with durable, flexible and realistic simulations. High fidelity mannequins provide ''patient simulation with real physical inputs and real environmental interactivity''—that is, it provides the student with real clinical features and reacts appropriately to treatment given.[18] Medium fidelity mannequins allow assessment of cardiovascular, respiratory and gastrointestinal systems, while providing multiple electrocardiogram and airway management opportunities. Data logging capabilities importantly allow accurate and effective assessment, debriefing, and feedback. When the mannequins are not used, all attempts are made by using ''real'' people—for example, fellow BEH students to impersonate a patient for the simulation. This has two advantages: firstly, the students are able to refer to realistic physical signs—for example, palpable pulse and realistic blood pressure; the second advantage, and perhaps more important for the ''actor'', is the understanding they will have developed by participating as the ''patient''. In other words, if a student is asked to simulate an irritable head injured patient, they will invariably have to make the conceptual linkage between the clinical manifestations they have to exhibit and underlying physiology, anatomy and pathophysiology. This in turn reinforces the pathophysiology and clinical presentation of the condition and assists in the linkage of theory to practice. The student acting as a patient also allows examination and the interactions and communication required between the paramedic and patient for the specific condition, and setting.

The simulation centres provide the capacity for faculty staff to script scenarios that ensure a broad cross-section of emergency and non-emergency incidents are covered in a relevant clinical context. Cases are undertaken with a paramedic care focus; however, given the physical structure of both centres, medical and especially trauma simulations can be undertaken with an interprofessional or multi-agency dimension. This is not only important, but is also unique in Australia, as it ensures that students from a variety of health disciplines (for example, medicine or nursing) can visualise and participate in simulated scenarios.

The simulations make explicit links to clinical settings and clinical management learning objectives. Case simulations are moderated by faculty and clinical staff from DCEH&PP who provide theoretical and practical support where required. Application of theory and a connection to practice is made, emphasising the importance of connecting the theory to the practice and recognising the importance of critical self-reflection as a sound basis for ongoing professional development in the pursuit of lifelong learning.

Clinical simulations centres are an essential link for health care educators between the virtual world of medical and trauma based pedagogy and the visceral world of the patient and clinical care. The simulation centres provide a teaching and learning resource that has the capacity to increase students' ''clinical trauma/medical learning'' that supplements and reinforces clinical placement exposure to real patients. Many health disciplines face barriers to obtaining adequate numbers of clinical placements for students. Where students do obtain clinical placements, their learning experiences and opportunities for patient contact are heterogeneous and unreliable. In this context simulations complement actual patient care contact, and provide alternative opportunities to develop clinical skills.

These simulation centres offer teaching staff the necessary resources to provide students with an improved learning environment in which to learn and safely rehearse psychomotor skills, team coordination and communication skills, and other patient care skills. To reinforce these skills, students are offered timely and meaningful feedback following each simulation in an open and transparent environment. The importance of appropriate feedback in student learning is well documented in the literature.[19–22] This in turn identifies potential management errors early so they can be rectified before on road practice. They also offer the opportunity for students to view the roles of other health care professionals and emergency services in action in clinical contexts, as well as enabling different health care disciplines to collaborate in multidisciplinary health care teams. As McFetrich and Gordon *et al*[23 24] highlight, simulations also offer advantages including:

- identification and management of patient and student safety issues
- logistical ease and demonstrated cost savings
- student centred: providing self directed learning
- standardised and reproducible clinical simulation
- easily upgraded
- measurable
- scenarios can be presented, including uncommon but critical situations in which a rapid response is needed
- identical scenarios can be presented to different clinicians or teams.[23 24]

CONCLUSION

Clinical simulations are seen as being a valid educational resource to improve and reduce prehospital errors via virtual trauma/medical simulated clinical scenarios. Clinical simulations of a clinical trauma/medical orientation will potentially reduce and improve prehospital clinical practice. Given the current education health care constraints, and the sound educational basis for clinical simulation, an alternative model of workforce education is warranted, and all paramedic students should expect to have a simulation capacity integrated into their curricula. These innovative simulation centres will continue to facilitate contemporary clinical management principles, while utilising innovative strategies that allow interdisciplinary and multi-agency clinical learning opportunities for undergraduate education and practising paramedics across Victoria, Australia.

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