An evaluation of high fidelity simulation training for paramedics in Ireland

The requirement for pre-hospital practitioners such as emergency medical technicians, paramedics and advanced paramedics, to perform additional interventions is ever-increasing. In Ireland, the training of pre-hospital practitioners is currently developing and evolving to meet this demand.

Simulated scenarios during basic paramedic training focus mainly on teaching practitioners how to implement the Pre-Hospital Emergency Care Council Clinical Practice Guidelines (PHECC, 2012). These scenarios are normally of low fidelity reflecting a low level of realism and often delivered in a classroom environment. Road traffic collisions and other outdoor scenarios are conducted in car-parks or other outdoor spaces using student paramedic peers as role-players. The training of advanced paramedics ideally requires the use of simulators with the capability to simulate more advanced interventions including; advanced airway management, intravenous administration of medication and fluids, and intraosseous catheter insertion (Figures 1 and 2).

At present, there is no formal allocation of continuous professional development points awarded to any paramedical training in Ireland. Other than mandatory up-skilling to changes in PHECC Clinical Practice Guidelines, there is no opportunity for pre-hospital practitioners to enter a simulated learning environment and, in general there is a lack of any continuous, structured post-graduate training.

Although paramedic training has used simulation for many years as a training tool, it has mainly focussed on acquisition of clinical skills using part-task trainers and not high-fidelity team-based

Abstract

- Introduction: The requirement for pre-hospital practitioners to perform additional interventions is ever increasing. In Ireland the training of pre-hospital practitioners is currently developing and evolving to meet this demand. This requires the use of simulators with the capability to simulate more advanced interventions.

- Objectives: We wished to explore the views of pre-hospital care practitioners post participation in a pilot high fidelity simulation in emergency care, to gauge its acceptability, relevance and application.

- Method: Pre-hospital care practitioners’ participated in 12 full immersion high-fidelity simulated scenarios, over three consecutive days. Live video recording was during the scenarios and replayed during debriefing sessions. The participants completed a voluntary and anonymous evaluation of the training using six statements on a five point Likert scale and free text written comments to three open-ended questions.

- Results: The overall response to the training was overwhelming positive with 94.4% of the participants either strongly agreed or agreed that the course met their learning needs. All agreed that they found the course relevant to their stage of training and that the course will impact beneficially on their clinical practice.

- Conclusion: This pilot study has shown that high-fidelity simulation is both applicable and relevant to pre-hospital practitioner.

Key words
- Education ● Emergency medicine ● High-fidelity ● Pre-hospital ● Simulation

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Clinical Examinations (OSCE) (Jones et al, 2011). Elliot et al (2011) systematically reviewed post-graduate simulation with doctors, nurses and midwives and has found that educational simulation programmes are consistently effective in enhancing teamwork and communication. It is reasonable therefore to presume that paramedic professionals could also benefit from high-fidelity simulation. That is, simulation that has high face validity and enables participants to become fully immersed in the process. This may improve clinical skills teamwork, communication, decision making, and ultimately improve patient safety (Jones et al, 2011).

**Background**

Simulation does not merely focus on procedural skills or performance; rather it has a much broader perspective incorporating the affective, cognitive and behavioural domains. Simulation may involve a wide range of techniques and approaches applicable to learners at all levels. Simulation is a means of skill development, transfer, and maintenance that can support the learner on the path from novice to expert; from the classroom to the workplace in a safe and controlled manner. There are many definitions of simulation; two such definitions that encompass simulation are those of Gaba and McGaghie:

‘..a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion. “Immersive” conveys the sense that participants have of being immersed in a task or setting as they would if it were the real world.’ (Gaba, 2004)

‘In broad, simple terms a simulation is a person, device, or set of conditions which attempts to present (education and) evaluation problems authentically. The student or trainee is required to respond to the problems as he or she would under natural circumstances. Frequently the trainee receives performance feedback as if he or she were in the real situation.’ (McGaghie, 1999)

**Historical perspective on simulation**

Simulation as a form of teaching and learning has been used in healthcare education in one form or another for many centuries. Simulators date to 18th century France; where models of foetuses and pelvises were used to train midwives (Buck, 1991). The use of simulation in the modern era commenced in the 1960s and has been gathering...
momentum ever since. The modern use of simulation began when the Norwegian toy manufacturer, Åsmund Lærdal, worked in collaboration with anaesthetists to develop the ‘Resusci-Anne’ a task trainer for mouth-to-mouth resuscitation (Tjomsland and Baskett, 2002). This model, a very basic mannequin with low level of sophistication, radically changed resuscitation training by providing a low-cost and effective simulator that became widely available. This was followed by the development of the highly sophisticated Sim One simulator (Abrahamson et al, 1969). This simulator enabled trainee anaesthetists to practise intubation and management of the anaesthetised patient. This mannequin had a number of sophisticated features including simulating breathing, heartbeat, pulses, and blood pressure. It also responded to drugs intravenously in real-time. The further design and production of high-fidelity simulators continued in the 1980s at Stanford University where Gaba, developed the Comprehensive Anaesthesia Simulation Environment (CASE) and at the University of Florida where Good and Gravenstein, developed the Gainesville Anaesthesia Simulator (GAS) (Gaba and DeAnda, 1988; Good and Gravenstein, 1989). The Stanford team placed significant emphasis on the development of team-based working within a realistic simulated environment. They incorporated much of the aviation model of Crew Resource Management (CRM) into their simulation training.

Why use simulation?
Simulation provides an environment in which learners can successfully comprehend and master clinical skills without undue risk to learners, staff members or patients. Simulation permits errors to occur, develop, and follow through to their natural conclusion. Its advantages include; decreased patient risk, ensuring that learning outcomes are addressed; enabling deliberate practice, and immersion in learning tasks. It enables tasks to be structured in staged learning segments, and provides a controlled environment in which it is safe to learn from errors (Maran and Glavin, 2003). Continuous practice involving simulation is
linked with better quality-learner outcomes and this relates to diverse levels of learners from a broad spectrum of clinical specialties. It appears to deliver a dose–response relationship in terms of accomplishing desired learning outcomes (McGaghie et al, 1999). Simulation has a broad spectrum of fidelity and the level can vary from high to low. Rehmann et al (1995) describes three types of fidelity including psychological fidelity, which is the degree to which a real task is captured in the environment, and the degree of reality perceived by the student. Environmental fidelity reflects on the degree to which the simulation duplicates sensory cues. Equipment fidelity reflects the degree to which the simulator reflects reality (Rehmann et al, 1995). Simulation gives the learner the opportunity to experience a learning environment that is immersive, contextualised and experiential. Simulation is a means of providing safe, experiential, and an educationally sound method of learning procedural skills, clinical skills, and communication skills for trainees and indeed established practitioners.

Context
Outside of compulsory up-skilling there is no forum for pre-hospital care practitioners in Ireland to enter into a non-threatening simulated learning environment to practise teamwork and crisis management.

Aims
We wished to undertake a pilot study of pre-hospital care practitioners who participated in a number of high-fidelity simulation scenarios, to explore their views with respect to its acceptability, relevance, and applicability. These participants were paramedics and advanced paramedics who had not previously participated in high-fidelity simulation.

Methods
In this pilot self-selected pre-hospital care practitioners participated in 12 fully immersive high-fidelity simulated scenarios, which ran over three consecutive days. The 18 participants comprised of both paramedics and advanced paramedics with varying experience, who then worked in either teams or isolation during their scenarios. On average, each participant directly engaged in three high fidelity scenarios. The participants consented to the use of live video during the scenarios and replay during the debrief sessions. This study was exempt from ethical approval as it was an evaluation of an educational method. Following the pilot the participants were then invited to complete a voluntary and anonymous evaluation of the training. They were asked to rate six statements on a five-point Likert scale ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (5) and provide free text written comments to three open ended questions. The questionnaire (Figure 3) was designed to yield both quantitative and qualitative data to evaluate the relevance, applicability and acceptability of this training to established paramedics and advanced paramedics.

Design of simulation
To increase the learning value of the exercise, the overall scenario fidelity was examined beforehand. The scenarios were designed using a typology of simulation adapted from Rehmann et al (1995), which incorporates three elements of fidelity in simulation, namely; environmental, equipment, and psychological fidelity (Figure 4).

The environment chosen was a disused hospital block, which was transformed into several areas. The first area was used as the emergency department, where medical equipment and props were used to increase the fidelity of the environment. The second area was a large cubic that was transformed into a flexible residential area which was used as a bedroom, sitting room, kitchen, and office using domestic props depending on the scenario. The third area was used as the remote viewing and debriefing room. A large outside area was used for external scenarios which included a road traffic collision and crush injury under a fallen tree.

The simulation equipment used was Laerdal SimMan 3G and METI iSTAN pre-hospital mobile units. Their high functionality and wireless capability allowed for increased fidelity and easy transfer from the casualty site to the receiving simulated emergency department. Using two simulators sped up the change over time between the scenarios allowing a smoother flow to the day. It also facilitated a road traffic collision scenario that had two casualties. A wireless speaker and transmitter were fitted, so that controller could speak through the mannequin to give candidates the other cues which cannot be simulated with technology. Simulated patients who are individuals trained to act as real patients in order to simulate a set of symptoms or problems, were used for the more communication focused scenarios to increase the fidelity of the situation, such as confused and mentally ill patients.

An operational ambulance and a rapid response vehicle were taken out of service and loaned to us for the duration of the training. This increased the realism of the scenarios as the ambulance was used to transfer the simulated patients and mobile simulators. The participants’ were already
Research

Realistic learning objectives were set, as this is essential to ensure high quality learning from the simulation learning experience (Issenberg et al, 2005). These objectives dealt with both technical and non-technical skills. The technical learning objectives were carefully mapped from the PHECC Clinical Practical Guidelines, which set the standards for paramedical patient management protocols, algorithms, and guidelines in Ireland (PHECC, 2012). Enhanced technical skills alone are not sufficient to improve patient safety. Simulation is a useful means to train healthcare professionals’ human factors concepts, now seen with significant importance in patient safety (NPSA, 2010). The non-technical learning objectives focused on CRM and human factors incorporating communication, teamwork, leadership, delegation, situational awareness, use of all resources, and planning ahead. The rational for including human factors is that communication and teamwork are essential for safe outcomes of patients (Stanton, 2001; Flin and Maran, 2004; Leonard et al, 2004). Communication and teamwork failure has been cited in more than 70% of adverse incidents (Reason, 2008). With close consultation with paramedical trainers and emergency medicine experts the scenarios were designed to be challenging but not unrealistically difficult, stressful, or unbelievable. Stress can sometimes have a positive effect on learning and memory. A study by Bong and colleagues (Bong et al, 2010) demonstrated that all participants undergo significant stress in the simulated environment. Getting the balance right is essential to ensure that familiar with the operation and equipment on board the vehicles as they were the standard operational ambulance service vehicles. With increased environmental fidelity, the candidates are more likely to transfer knowledge and skills from the simulated environment into the work place (Beaubien and Baker, 2004; Rudolph et al, 2007).

Mobile audio-visual equipment was used in all areas internally and externally, including the slaving of the ambulance camera and patient physiology feeds, to ensure seamless and uninterrupted footage of the entire mission. The video was sent live to the viewing room where other participants could observe the scenario in real time and later, the entire video was replayed to aid the debriefing session. Live video was streamed over the internet using pan-tilt-zoom (PTZ) cameras and portable microphones. The audio and video was synced using a sound mixing board fire-wired to a laptop and streamed live over the internet using wireless mobile internet dongles and virtual network computing (VNC) to a receiving laptop and displayed on a large overhead projector. This action was taken as to avoid having the other participants and faculty members directly viewing the scenarios taking place which could cause distraction and jeopardise the fidelity of the situation (Alinier, 2009). A remote control room was temporarily setup in a separate part of the building for this reason.

Close consultation with the user group and emergency medicine experts allowed for careful planning and design of the 12 scenarios, to ensure that they were true to life (Figure 5). The use of actors as simulated patients, relatives, and bystanders was incorporated to increase the psychological fidelity of the situation.

Table 1. Paramedic/advanced Paramedic Simulation Evaluation Questionnaire

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The course met my learning needs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I found the course relevant to my stage of training</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am overall satisfied with the course</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I would recommend this course to a colleague</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>This training will impact on my clinical practice to the benefit of patient care</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>This training will have an impact on my future practice</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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- What did you like most about the course?
- What did you like least about the course?
- What could we do to improve the course?
Table 2. Participants comments to free text questions

<table>
<thead>
<tr>
<th>What the participants liked most about the training:</th>
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<tr>
<td>• Positive feedback from facilitators during debrief session</td>
</tr>
<tr>
<td>• Enjoyed the opportunity to observe their own patient care delivery</td>
</tr>
<tr>
<td>• Realism and fidelity of environment, simulators and equipment</td>
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<tr>
<td>• Found the training a good learning experience or opportunity rather than an assessment</td>
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<tr>
<td>• Sharing the learning experience with peers</td>
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<tr>
<td>• The safe environment</td>
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<tr>
<td>• The hands on and practical aspect</td>
</tr>
<tr>
<td>• The unexpected nature</td>
</tr>
<tr>
<td>• The course was useful for practicing decision making.</td>
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</table>

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<tr>
<th>What the participants liked least about the training:</th>
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<tbody>
<tr>
<td>• Viewing one’s own performance</td>
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<tr>
<td>• Not knowing what to expect.</td>
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<tr>
<th>Suggestions to improve the course:</th>
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<tbody>
<tr>
<td>• More exposure to simulation training</td>
</tr>
<tr>
<td>• Time management.</td>
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</table>

the scenarios are designed to be only appropriately stressful (Bong et al, 2010). One study indicated that participating in a simulated emergency may be more stressful than dealing with a similar situation in real life (Quilici et al, 2005). Matching challenges appropriately to the participant’s abilities is essential for the learner to have a positive meaningful simulation experience (Dieckmann et al, 2010).

Considerable time was spent with the candidates to ensure that they were familiar with the functionality of the simulation mannequins and medical equipment used, to increase participant ‘buy-in’ during the scenarios. The participants were briefed prior to the scenario, that the simulation environment is a safe place to make errors without adverse consequences to themselves or to real patients. There is huge learning potential from error in simulation where the free lessons learnt can be transferred to the workplace (Issenberg et al, 2005; Reason, 2008). As traditional paramedic training has heavily focused on the acquisition, testing and assessment of skills, there was reinforcement that this simulation exercise was for learning and not assessment (Jones et al, 2011).

The debriefing was assisted with video to highlight optimal practice, discuss technical and non-technical issues, and illustrate learning points (Fanning and Gaba, 2007). Each scenario lasted about 30–45 minutes followed by a 45 minute debriefing session that was conducted by experienced facilitators each a co-author from the simulation centre, ambulance service, and emergency medicine respectively. The participants’ previous clinical and simulation experience was ascertained during the pre-brief discussion to guide the facilitation style in the post-scenario debrief (Rudolph et al, 2007). The debriefing was performed involving a group of participant peers, as this has the benefit of shared meaning and learning for the entire group (Fanning and Gaba, 2007). Facilitation is a useful approach for adults as they are more self-directed in their learning. Facilitator assisted debriefing on performance is considered by some, to be the most important factor in the goal of effective learning in the simulated environment (Issenberg et al, 2005; Van Heukeloum et al, 2010). The NPSA (2010) emphasises that reflection and feedback are important tools to increase patient safety. Simply having an experience does not necessarily mean learning has occurred. Reflection is the key process in transforming an experience into learning (Boud et al, 1998). The facilitator plays a pivotal role in helping the learner reflect on the experience and is crucial to the process of learning (Fanning and Gaba, 2007).

Results

All 18 participants completed the anonymous evaluation forms immediately after the training, with 100% completion rate. The overall response to the training was overwhelmingly positive with 17 (94.4%) of the participants either strongly agreed (ten) or agreed (seven) that the course met their learning needs. Only one participant was undecided whether his/her learning needs were met. All 18 participants either strongly agreed (13) or agreed (5) that they found the course relevant to their stage of training. All 18 participants were overall satisfied with the course; of which, 12 strongly agreed and six agreed. All 18 participants would recommend this course to a colleague; of which, 13 strongly agreed and five agreed. All 18 participants either strongly agreed (14) or agreed (four) that the course will impact on their clinical practice to the benefit of patient care. All 18 participants either strongly agreed (13) or agreed (five) that the course will have an impact on their future practice (Table 1).

In the second section of the evaluation form the participants were not primed to answer any specific questions and the questions were deliberately left open to maximise the range of responses on what they liked most and least about the training and what suggestions they could offer to improve the training in the future. The common themes from the participants’ comments in order of frequency are listed in Table 2.
The overall participants’ evaluation of the pilot course was very positive; all were satisfied with the course and would recommend it to a colleague. This educational method seems to be acceptable and relevant to pre-hospital practitioners. It seems to meet their own learning needs and be relevant to their practice suggesting that the learning aims and objectives were set at appropriate level. There was high engagement with all the participants in each scenario and this was achieved through careful planning of the entire pilot with detail to all the elements of fidelity. Fidelity of scenarios was increased through the careful planning of the live AV solution used, which permitted the absence of any bystanders, faculty or peers directly viewing the scenario. This would have caused some degree of distraction and lowered the overall fidelity of the experience. These measures led to increased realism of the situation and increased engagement of the participants. Several participants commented positively in their course evaluations on the high-fidelity and realism of the scenarios, simulators, environment and equipment used. Many of the participants commented on this training as an opportunity to train and practise in a safe non-threatening environment and appreciated the positive feedback from the facilitators. Some welcomed the opportunity to review their practice and share their learning experience with their peers. However some participants stated they disliked the video replay in front of peers. This may be due to the historical use of simulation as an assessment tool in paramedical training. Several comments indicated that the participants found the course focussed on learning and not assessment. They enjoyed the hands-on nature of the course and found it useful to practise decision making. There were some comments suggesting that they liked and others disliked the fact that they did not know what scenario to expect. However, the authors consider the role of pre-hospital practitioner requires that they are often working in unexpected and varied circumstances. The overall most frequently cited comment was that they wanted more opportunity to engage in high-fidelity simulation, and that this should be part of their on-going professional training. Often adult professional learners are the best judges to evaluate whether an educational programme is meeting their own needs and is relevant to their every day work (Rogers, 2004; Fanning and Gaba 2007; Mohanna et al, 2008). All participants agreed that the training would lead to a change in their practice and more importantly felt that this would benefit patient care.

**Conclusion**

Based on participants’ judgement, this study has shown that high-fidelity simulation is both applicable and relevant to pre-hospital practitioners. The pilot programme was well received by all the participants and they felt that this type of training should be on-going throughout their careers. With careful mapping of learning aims and objectives and detail to overall fidelity can lead to high engagement from the participants, which in this
case met their own learning needs.

All participants agreed that the training would impact on their future clinical practice and that this would benefit patient care. This study has highlighted the need for further research within this area in order to provide robust evidence that the perceived benefits by participants translate into their practice. This pilot was costly in terms of finances, resources and time, both in the planning and delivery stages. A full report has been sent to PHECC who financed this pilot, as more research is needed to investigate whether the perceived benefits highlighted in this study outweigh the known costs and expenses associated with high-fidelity paramedical team simulation.

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McGaghie W (1999) Innovative simulations for assessing professional competence. Department of Medical Education, University of Illinois, Chicago
Pre-Hospital Emergency Care Council (2012) PHECC Clinical Practice Guidelines 2012 Edition. PHECC, Naas