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EDUCATION

On-shift simulation in aeromedical operations – making it work

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Abstract

Patient care in the prehospital and retrieval medicine (PHARM) environment presents many technical and non-technical challenges. Clinicians are frequently required to perform complex interventions in a time critical and resource limited setting. Intensive training is required prior to operational deployment, and ongoing training is vital to ensure optimal team performance in the delivery of high quality patient care. Regular simulation training with high situational fidelity is valuable in developing and maintaining excellence in PHARM. We describe the methods employed by two Australian aeromedical retrieval services to facilitate daily on shift simulation.

Keywords: *prehospital; aeromedical; transport medicine; simulation; training*

Introduction

Pre-Hospital and Retrieval Medicine (PHARM) clinicians treat patients in the complex and varied pre-hospital environment as well as in non-tertiary health facilities. They provide initial management and stabilisation and continue this care during transport to definitive care. This paper will describe the combined experience of two retrieval services in Australia in obtaining and maintaining optimal team performance in the aeromedical environment.

The patients treated by PHARM clinicians are often severely injured or critically ill, and may not have a definitive diagnosis. Complex higher risk retrievals include patients transported while undergoing treatment with intra-aortic balloon pump counter-pulsation (1) or extracorporeal membrane oxygenation (ECMO).(2) Each mission is unique from an environmental, transport, logistic, clinical and human factors point of view. These factors can present clinicians with a high cognitive and technical workload, with increased stressors that can impair performance.

Teams are frequently required to perform high-risk medical interventions such as rapid sequence intubation (RSI). Although many teams have shown that this can be done safely,(3-7) the training and governance methods used to achieve and maintain this level of performance have been less comprehensively described. Obtaining and maintaining excellence in the more rarely performed skills such as thoracotomy, resuscitative hysterotomy and escharotomy is also challenging.(3)

A minimum level of competency is required by all members of a PHARM team prior to operational deployment. All new crew members undergo a comprehensive outcome based induction programme, including training in the technical and non-technical skills required to function as part of a retrieval team. During the induction programme emphasis is placed on crew resource management, use of standardised clinical operating procedures and effective communication skills.

Following the intensive induction program, it is necessary to maintain a program of education and governance. This aims to further develop and maintain key areas of knowledge, skills and attitude for the individual, the team and the organisation. Ongoing deliberate practice may make the difference between performing an intervention to an acceptable standard compared to a very high standard.

Competence in the core clinical skills of RSI and surgical airway is periodically revalidated by mandatory formal skills testing. This robust system, allied with regular case review and comparison with key performance indicators provides clinical governance for complex, but frequently performed advanced airway management procedures.

Complementary to this specific competency revalidation is a system of daily on-shift simulation training. This is intended to both consolidate frequently performed skills and to develop competence in critical, but less frequently performed tasks.

Simulation training in prehospital and retrieval medicine

Scenario-based training is a widely used tool in prehospital education.(4) Good simulation involves the creation of training opportunities in real-life environments designed for optimal educational benefit.(5) Simulation improves clinical skills, teamwork, communication,(6) and decision-making, which may ultimately improve patient safety (7,8) as well as enhance emergency care skills.(9) Regular training opportunities may enable prehospital practitioners to perform better at trauma scenes.(10)

The importance of the non-technical skills (NoTECS) of leadership and communication in resuscitation is well recognised.(11,12) NoTECS learned in simulation can be directly transferred to clinical settings.(13) This may be particularly relevant to PHARM, where the team frequently manages critically unwell patients in a time-pressured context in conjunction with other practitioners that they have never previously met. The retrieval team itself may consist of individuals who have never or have rarely been rostered together in the past. In this context, simulation may improve the clinician's ability to identify and manage the complex human factors surrounding an otherwise technically simple clinical problem.

Simulation also allows the individual clinician to discover in advance, how they might themselves react to a rare but challenging emotional stress such as the severely injured child, the violently psychotic patient or to direct challenges to their decisions and leadership in time-dependent clinical scenarios.

Medical simulation can be defined by the style of patient, the location of the simulation and the style of the learning session. Patients presented to the teams can be simulated by actors, low technology manikins or computerised manikins with additional features. Scenarios can take place in the actual clinical environment, described as in-situ simulation, or in a dedicated simulation centre. Educational sessions may present information prior to the rehearsal of the skills, during the simulation in a pause and discuss format, or following the scenario in a traditional debriefing and feedback model. The aim of simulation based education is to develop knowledge, skills and attitude, and translate these into improved team performance.

On-Shift Simulation

In situ simulation is defined as simulation which occurs in the actual clinical environment, which for PHARM is in any location where patients require treatment. In-situ simulation with high situational realism may be optimal for effective aeromedical training. In-situ simulation has been shown to discover latent safety threats, identify knowledge gaps, and reinforce teamwork behaviour.(14) However, taking simulation to the roadside, cliff face or remote environment for training has increased risks and challenges for daily simulation based education.

Spurr et al have proposed a ten-point framework for effective in-situ simulation training in emergency and critical care.(15) This includes maximising the realism, and ensuring that the training is multi-professional. Strong leadership and training in how to run simulation is vital, both to make it happen and to ensure effective debrief. These principles of in-situ simulation can be applied to on-shift simulation for the PHARM team.

Situational, physical, psychological and physiological fidelity should be considered when planning simulation training. The session should be structured with preparation, a pre-brief, the scenario, debrief and then reflection. Learning outcomes will include clinical skills, logistics and human factors, all of which should be discussed with the team during the debrief.

Situational fidelity can be achieved by performing the scenarios in the actual aircraft or land ambulances, while wearing operational uniform, harness and other personal protective equipment. Base facilities can be used to simulate domestic settings, and with appropriate safety-conscious planning the environment around the base can be used to recreate other operational scenes. Remaining within base surroundings ensures that the team retains a rapid deployment capability in the event of a real mission tasking.

The use of a full set of training medical packs identical to operational kit maximises the familiarity of the teams with their equipment and checklists. Further realism can be added by the use of mobile real-time monitoring with real alarms such as the iSimulate system (*ALSi Patient Condition system; iSimulate, Sydney, Australia*) in conjunction with simulated patients or manikins. This provides realistic patient monitoring without the added complexity or cost associated with high-fidelity manikins, and allows the clinicians to remain immersed in the scenario. Other relevant media such as ECGs, ultrasound images, blood gas results should be readily available. The use of ultrasound can be incorporated into the scenario using inexpensive ultrasound simulators. (16)

Confederates may be used to play the part of other professionals or family members. The use of an actor as the patient allows for better simulation of communication skills, and provides a realistic patient weight for the packaging and loading elements of training.

Involvement of the entire team, including the flight crew develops crew resource management skills, and educates the flight crew on the complexities of emergency patient care. This fosters the development of a high performance team, not just individual competence. Human factors training can be incorporated in the learning outcomes by creating specific challenges or interactions for the team to work through during the session.

Commonly encountered patient presentations may be simulated to develop excellence in day-to-day clinical operations through deliberate practice. Simulation of familiar tasks is useful to gain experience of how simulation 'runs'. System improvements may also be identified in an environment free of clinical risk. Simulation of rare but complex procedures such as decompressive craniotomy, field amputation, escharotomy and resuscitative hysterotomy allows clinicians to retain the required psychomotor skills and maintain metacompetence – the ability to make correct clinical decisions about when to perform these interventions. (8)

The technical skills required for these procedures such as use of the Gigli saw and Hudson Brace can be practiced on either dead mammalian tissue or simulated tissue attached to

the simulated casualty. Inexpensive 'home made' task trainers such as the airway salad (17) or escharotomy man (18) can add complexity, and provide added clinical challenges to maximise the benefit obtained from regular simulation.

Challenges of making daily simulation happen

Simulation training must not affect the normal operations of the base, and should take place during the natural 'downtime' between missions. The daily routine should also be flexible enough to take advantage of time off-line for maintenance or due to weather. Availability of teams, trainers, equipment, cost and team enthusiasm have been recognised by our services as barriers to scenario based training.

Some PHARM bases have multiple crews on duty for each shift, while others have a single crew at any given time. Simulation at change of shift allows for the involvement of multiple teams, however operational requirements and crew fatigue management requirements present limitations. Multi-crewed bases can use one crew to direct a simulation for another crew. In ideal circumstances a supernumerary clinician may have responsibility for running simulation training on a given shift. Single crew bases require more creativity to sustain effective simulation training.

A collection of detailed pre-scripted scenarios (supplementary file) allows a single crew to maintain the scenario trajectory. Alternatively, the script may allow non-clinical personnel (e.g. flight crew or administration staff) to direct the scenario. Pre-programming the iSimulate with the vital signs and expected action may provide additional benefit. Other local EMS or rescue personnel may be invited to participate, and this has added benefits of improving communication and interoperability.

Availability of equipment can provide some teams with challenges. A readily available supply of out of date equipment could be the starting point for creating an education cache. Expensive and reusable gear (such as stretchers) may need to be used from the operational stock, being mindful to ensure they are returned to the vehicle in the event of a tasking or the end of the session.

Capital costs of manikins or monitors can be a perceived as a prohibitive expense for many teams. Using available human resources to provide in-scenario observations and vital signs, the use of low cost smart phone simulation monitor applications, low technology manikins (such as Crash Kelly) or even a child's doll as the patient are methods teams have used to keep costs to a minimum whilst maintaining a training program.

Time is a valuable resource and on-shift simulation can be perceived to utilise time where the team could be performing other duties on base or managing their fatigue. This may require a cultural shift prioritising education and training for improved teamwork and patient care in the PHARM environment.

Regardless of the number of medical staff or equipment available, simulation should be scheduled, and be part of the base daily routine. Until it becomes ingrained in the culture, strong leadership is required to make this happen.

Debrief

One of the most important elements of any simulation is the debrief.(19) This should be frank but non-confrontational, drawing on the experience of all members of the team. Many debrief tools (such as FFAST) are available to aid this part of the simulation process.(20) Key learning points identified during the simulation should be discussed in an open and structured manner. These should also be disseminated to the staff not present for the simulation and debrief. Simulation sessions may also be live streamed to remote bases, or video recorded for later viewing. Consideration may also be given to publishing the lessons learned for the benefit of the wider Free Open Access Medical Education (FOAMEd) community (e.g. by way of the GSA HEMS blog; www.sydneyhems.com).

Conclusion

Simulation training is an effective way to develop and maintain both technical and non-technical skills required for optimal performance in pre hospital and retrieval medicine. While this paper specifically describes simulation training in aeromedical operations the principles can be adapted to the different skill-mix present in any Emergency Medical Services setting. Training as a team may have benefit in a formulating a shared mental model, which helps to maintain the mission trajectory. Daily on-shift simulation presents challenges, but strategies exist to facilitate clinicians in achieving worthwhile educational value from daily training.

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