

# Unannounced in situ simulations: integrating training and clinical practice

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Received 14 March 2012

Revised 12 July 2012

Accepted 2 November 2012

## ABSTRACT

Simulation-based training for healthcare providers is well established as a viable, efficacious training tool, particularly for the training of non-technical team-working skills. These skills are known to be critical to effective teamwork, and important in the prevention of error and adverse events in hospitals. However, simulation suites are costly to develop and releasing staff to attend training is often difficult. These factors may restrict access to simulation training. We discuss our experiences of 'in situ' simulation for unannounced cardiac arrest training when the training is taken to the clinical environment. This has the benefit of decreasing required resources, increasing realism and affordability, and widening multidisciplinary team participation, thus enabling assessment and training of non-technical team-working skills in real clinical teams. While there are practical considerations of delivering training in the clinical environment, we feel there are many potential benefits compared with other forms of simulation training. We are able to tailor the training to the needs of the location, enabling staff to see a scenario that is relevant to their practice. This is particularly useful for staff who have less exposure to cardiac arrest events, such as radiology staff. We also describe the important benefit of risk assessment for a clinical environment. During our simulations we have identified a number of issues that, had they occurred during a real resuscitation attempt, may have led to patient harm or patient death. For these reasons we feel in situ simulation should be considered by every hospital as part of a patient safety initiative.

## INTRODUCTION

Simulation-based training for healthcare providers is well established as a viable, efficacious training tool,<sup>1</sup> particularly for training non-technical team-working skills. These skills include communication, decision making, leadership, task management and monitoring, and are known to be critical to effective teamwork,<sup>2,3</sup> and important in the prevention of error and adverse events in hospitals.<sup>4</sup> Simulation significantly enhances learning through formative feedback, repeated practice and variation of difficulty, all within a controlled, safe environment.<sup>3,5</sup> Improvement in quality of care and retention of skills has been demonstrated when simulation training is used in addition to standard training.<sup>6</sup>

Simulation can be delivered in many ways, from low-fidelity part-task simulation to integrated fully immersive environments (eg, fully simulated operating rooms), with higher fidelity considered a key advantage.<sup>7</sup> Simulation suites, however, are costly to develop, and releasing clinical staff to attend

training is often difficult.<sup>8</sup> Such factors may restrict access to simulation training as not all hospitals have the space and resources to offer a simulation suite.

Here we discuss an application of 'in situ' simulation when training is taken to the clinical environment, thus decreasing required resources while increasing realism and affordability, widening multidisciplinary team participation, and enabling assessment and training of non-technical team-working skills to real clinical teams.

## The concept of in situ simulation

In situ simulation is simulation that takes place in the clinical setting.<sup>9</sup> This form of simulation may therefore be preplanned (announced) for training of a particular group in their own environment (eg, ward), or may be unannounced. If it is unannounced, staff may be, for example, suddenly called, without prior warning, to a simulated cardiac arrest, rather than being rostered to attend a training session in a dedicated simulation centre. Technological advances over recent years mean that it is entirely feasible to deliver training in resuscitation, and other forms of simulation, in the clinical environment.

Patterson *et al*<sup>9</sup> described in situ simulation as 'Simulations that occur in the actual clinical environment and whose participants are on-duty clinical providers during their actual workday'. Simulation in a dedicated centre can be very effective in revealing the strengths and weaknesses of an individual's skills, but in situ simulation has the added benefit of providing training with all the contextual cues, practical difficulties, interruptions and distractions of the real clinical environment.<sup>10,11</sup> While these can all be simulated within a training centre, the familiarity of the clinical environment heightens the realism of the simulation and reduces the feeling that participants are 'performing', enabling them to behave as they would normally.<sup>12</sup>

Given that clinical errors affecting patient safety are often blamed on failures embedded within the structure and functioning of the overall healthcare system,<sup>13</sup> the creative use of the clinical environment during training will potentially enhance trainees' resilience and adaptability in the face of system problems. In a recent study of a series of unannounced cardiac arrests, Lighthall *et al*<sup>14</sup> identified several hazardous events occurring during the arrest simulations, which could have compromised patient care if they had occurred during a real resuscitation. In situ simulation does appear to have the potential to identify previously unreported risks and hazards and to bring these fully into the training scenario.<sup>13</sup>

**To cite:** Walker ST, Sevdalis N, McKay A, *et al*. *BMJ Qual Saf* Published Online First: 3 December 2012 doi:10.1136/bmjqs-2012-000986

**AIM**

As an example of in situ simulation we describe our training programme for Cardiac Arrest Scenarios at Imperial Healthcare NHS Trust. Patients receiving emergency resuscitation care are exposed to a higher rate of adverse events than the general hospital population.<sup>15 16</sup> Many factors contribute to this, including the need for rapid decision-making, often with limited patient information, and also the fact that ad hoc teams are assembled instantly by the emergency call, but may have never worked together or even met each other before. All these factors support the need for non-technical skills training specifically for emergency care teams.

Our aim was to explore the feasibility, practical and ethical issues around unannounced, in situ cardiac arrest simulations and to assess the participants' views of the value of in situ simulation compared with standard simulation training.

**METHODS**

After identifying a location for the simulation, an assessment was made of clinical activities within the hospital to ensure it is appropriate to patient care. All simulations were performed using a Laerdal SimMan 3G Patient Simulator (Laerdal Medical, Stavanger, Norway) offering the highest fidelity patient simulation currently available.

Hospital staff responded to the cardiac arrest call as they would normally do. Upon arrival at the site of the simulation (eg, hospital ward, communal area) they were instructed to proceed as they would normally manage a cardiac arrest. Upon completion of the scenario participants were debriefed (AMcK, SG) and the aim of the exercise was explained to them.

Simulations were recorded using a SMOTS mobile recording system (Scotia UK, Edinburgh, UK) for the purposes of constructive feedback to participants and to enable retrospective detailed analysis of the simulations. The simulation then proceeded as detailed in box 1.

**Box 1** How to run an in situ simulation

## Set-up

- Identify a suitable location to run the simulation, and select a pertinent scenario for that location. Ward managers at the identified location should be involved at this stage to ensure that running the simulation will not present any risk, and coordinate an appropriate time
- Identify key aim and objectives of the simulation
- Check the various clinical commitments around the hospital to determine whether it is safe to run the simulation
- Assemble the simulation faculty (at least two, but preferably three people) and the simulation equipment at the desired location
- Set up the equipment in the chosen location, preferably in a way so as to minimize disruption to patients, relatives and staff. A side room on a ward, for example, is preferable as staff will be less aware that something is planned
- Ensure any audiovisual equipment is used in such a way that only the simulation team and not real patients are being recorded
- Warn any patients or relatives in the vicinity of what will be happening so as not to cause any distress when they see the cardiac arrest team arrive. Also warn important members of staff as required (eg, intensive care unit consultant/attending on-call)

## Simulation

- Recruit one member of nursing staff from the clinical location. Explain to them what is happening, including a brief introduction to the mannequin in terms of the degree of fidelity. They may be used to mannequins that do not breathe, do not talk, and do not have a pulse. Therefore this will all need to be explained to them to enable the simulation to run smoothly with a high degree of 'buyin' at later stages

- Describe the clinical scenario to the first participant, and ask them to proceed 'as if it were a normal patient'
- During the initial stages, participants may need some encouragement and prompting. For example, if they say 'now I'd like to call for help', they should be told to go and do that as if it were real
- The simulation should then proceed with minimal interference from the simulation faculty.
- The faculty needs to ensure the mannequin responds appropriately to treatment instigated by the arrest team
- After the simulation has run (approximately 10–15 min), a similar length of time should be spent debriefing the team on technical and non-technical skills, with adequate time for questions and teaching at the end of the session—the technique of advocacy with inquiry is used to elicit responses from team members

## Post-simulation

- Debrief should occur with faculty members to identify any technical, fidelity or scenario issues
- Equipment should be suitably cleaned and stored for the next session
- A robust reporting system should be in place to document and act on any risk assessment issues (latent problems or failures) identified during the simulation. These should be followed up in a timely manner to ensure the appropriate action has been taken to rectify the issue
- A record of the simulation is kept, noting the area, scenario, personnel and key learning points

**RESULTS**

Feedback from 55 of the cardiac arrest team members who have taken part in our in situ simulations to date has been very positive. Overall, participants strongly agree that the simulations are a realistic representation of an arrest event and that the clinical environment improves realism (table 1). They also strongly agree that the in situ simulations are useful for training and assessment of technical and non-technical skills, that they are more useful than simulations performed in a laboratory environment, and that the unannounced nature of them better represents actual behaviour. All participants had prior experience of emergency care training in a simulation centre environment, such as an advanced life support (ALS) course, with which to compare this experience. Informally, many team members have asked us to return for further unannounced simulations at a later date and have little objection to the time away from clinical duties.

**DISCUSSION**

While we acknowledge that there are clearly occasions when lab-based simulation training or attendance of training delivered in simulation centres is more appropriate, such as for large throughput courses (eg, ALS), or repetitive skills practice (eg, central venous cannulation), in our opinion there are occasions when in situ simulation is superior; such as for training real multidisciplinary teams in emergency situations. However, we should emphasise that, to our knowledge, no direct comparison has been performed. Our experience of in situ simulation has confirmed the benefits previously described by others who have used this approach to training. We would further emphasise three particular aspects.

**Understanding the impact of the real environment on technical skills**

The obvious benefits, as demonstrated in our results and those of Lighthall *et al*,<sup>14</sup> are the benefits of delivering training directly to the entire multidisciplinary team in a low-risk, believable environment that is relevant to them,<sup>17</sup> and preventing the need to provide 'relief' for a preplanned training session. The

**Table 1** Participants' attitudes towards unannounced adult in situ simulation training in cardiac arrest

| Statement  | N  | Median (IQR) |
|--|----|--------------|
| <i>Realism of the simulations</i>  |    |              |
| The simulated environment is a realistic representation of an actual cardiac arrest                                      | 54 | 4 (4–5)      |
| The simulated environment is a realistic representation of a peri-arrest event   | 55 | 4 (4–4)      |
| The clinical environment increases the realism of the simulation   | 54 | 5 (4–5)      |
| The model used is a realistic representation of a real unwell patient  | 54 | 4 (3–4)      |
| The simulation scenario is realistic overall   | 55 | 4 (4–4)      |
| <i>Training and assessment</i>   |    |              |
| This simulation offers a good opportunity for training technical skills  | 53 | 5 (4–5)      |
| This simulation offers a good opportunity for training non-technical skills  | 55 | 5 (4–5)      |
| This simulation offers a good opportunity for assessment of technical skills   | 53 | 4 (3–5)      |
| This simulation offers a good opportunity for assessment of non technical skills   | 52 | 4.5 (4–5)    |
| <i>Attitudes towards unannounced simulation</i>  |    |              |
| My behaviour in this simulation mirrors my behaviour in a real emergency   | 52 | 4 (3–4)      |
| I would benefit by repeating this simulation in the future   | 53 | 5 (4–5)      |
| I felt that an unannounced scenario is a better test of how I would perform in a true emergency                          | 55 | 5 (4–5)      |
| This simulation is more useful than a simulation which you were warned of in advance                                     | 53 | 4 (3–5)      |
| This simulation was more useful than a similar scenario taking place in the skills laboratory or during a formal course. | 51 | 4 (4–5)      |

Scale: 1=strongly disagree, 3=neither agree nor disagree, 5=strongly agree.

time spent giving structured feedback is as valuable as the simulation itself because it is rare for team members participating in a 'real' cardiac arrest to spend time debriefing due to the pressures of clinical work, a finding that was similarly reported by Miller *et al.*<sup>18</sup> During the feedback sessions we have been able to clarify details of the resuscitation protocol, taught team members practical issues such as how to assemble an arrest drug 'minijet', and reinforced correct use of the defibrillator.

### Assessing the skills of actual clinical teams

The nature of the unannounced in situ simulations means that 'real' cardiac arrest teams are brought together and we are therefore able to assess genuine team interactions. We have been using a non-technical skills assessment tool (Observational Skill-based Clinical

Assessment tool for Resuscitation—OSCAR),<sup>19 20</sup> designed and validated specifically to assess these skills in resuscitation teams. This has highlighted a large variation in the standards of non-technical skills within the teams. The fact that these teams may have never worked together reinforces the importance of training in these skills so that team members have shared knowledge, skills and attitudes. Teaching of team-working skills has recently been introduced as a concept in current ALS courses, but they are not taught in detail. We therefore create an awareness of non-technical skills, emphasise excellent behaviours and mention those requiring some improvement in our feedback. Benefits of team training are hard to measure and demonstrate but we know from other clinical team training programmes<sup>21</sup> that training may lead to a reduction in mortality, and improve team-working and task completion.

**Table 2** Examples of safety issues (latent problems) identified during our in situ simulations and corrective actions taken

| Event location         | Safety issues identified   | Corrective action taken   |
|------------------------|--|---|
| Endoscopy suite        | <ol style="list-style-type: none"> <li>Crash team access swipe-card did not enable access to endoscopy suite</li> <li>Incorrect defibrillator pads stocked which were incompatible with machine in use</li> </ol>  | <ol style="list-style-type: none"> <li>Security informed, and crash access codes updated</li> <li>Resuscitation department and nurse in charge informed. Correct pads supplied and equipment ordering details changed</li> </ol>  |
| Labour ward room       | <ol style="list-style-type: none"> <li>Medical team unaware of location of labour ward, therefore delaying arrival time</li> <li>'Cardiac arrest' call not activated on labour ward anaesthetist's bleep, therefore delaying arrival of anaesthetist</li> </ol>  | <ol style="list-style-type: none"> <li>Further education at staff induction to hospital emphasising importance of learning locations in hospital</li> <li>Switchboard informed to put crash call out on labour ward bleep in future</li> </ol>  |
| Clinical decision unit | <ol style="list-style-type: none"> <li>Poorly stocked resuscitation trolley. No intubation bougie available, leading to failed intubation of mannequin</li> <li>Nursing staff uncertain of terminology or use of advanced airway equipment, and therefore unable to help struggling anaesthetist</li> <li>Delay in arrest team arrival due to recent building work that led to frequent moves and renaming of wards, causing confusion over location of event</li> </ol> | <ol style="list-style-type: none"> <li>Trolley used on ward was not appropriate for use as resuscitation trolley. Therefore, new larger trolley supplied by resuscitation department with space for all equipment required. Nursing staff made aware of importance of regular trolley checks</li> <li>Nursing staff educated in advanced airway equipment. Nurse in charge informed of need for ongoing staff training in this area</li> <li>Trust board made aware of issues, and need for increased signage and communication with staff during hospital refurbishment and structure changes</li> </ol> |
| Trauma unit            | <ol style="list-style-type: none"> <li>Delay in starting basic peri-arrest care due to a lack of basic equipment in critical care bedspace</li> </ol>  | <ol style="list-style-type: none"> <li>Simulation was performed in a new ward area. This highlighted an issue of lack of basic stock. The ward manager was informed and stock policy amended</li> </ol>   |

### Training across all clinical environments

The ability to set the simulation equipment up in any location has enabled us to perform scenarios in locations where cardiac arrest events are rare. Training staff who have less exposure to cardiac arrest events is becoming more critical in our own and other hospitals as the overall reduction in the number of cardiac arrests due to earlier identification of the 'unwell patient', and the reduction in the working hours of training doctors in the UK means that, surprisingly, in our study 25% of nurses and 11% of doctors had never attended a real cardiac arrest.

We have also been able to assess some of the practical difficulties encountered when running an arrest in these environments. For example, during a simulation in the endoscopy unit it was brought to our attention that the emergency team did not have access to the unit using their security cards. This has subsequently been amended. Since all the equipment used is from the clinical area we are able to assess other aspects, such as equipment availability. In the endoscopy suite, for example, we identified defibrillator pads that were not compatible with the defibrillator machine they use. With increased awareness throughout the hospital of our simulation training programme, managers from a variety of areas have asked us to perform simulations as part of a clinical risk assessment, and not just in the context of a clinical training session. It is vitally important that a robust reporting system is in place to ensure this risk assessment information is documented and reported back to relevant individuals to ensure a change can occur. Table 2 gives further examples of safety issues we have identified, with the corrective changes made briefly described.

It is a very positive aspect of these simulations that, although intended as a training intervention, they resulted in the identification of what are effectively 'latent factors' that can contribute to problems in care delivery during an arrest in our hospital. This aspect of in situ simulation has been described in the literature<sup>14 22</sup> and is often the ultimate endpoint of such simulations. For example, Herzer *et al*<sup>13</sup> advocated the use of in situ simulation to 'identify hazards and defects associated with latent failure modes that are embedded in the system' in their recommendations to prospectively identify and mitigate clinical hazards. They argued that a high-fidelity simulator should be used to add realism to such scenarios, as a participant's belief in the scenario is essential if they are to take the simulation seriously and therefore perform as they would in real life. This is required to enable observation of real team interactions and to uncover real life latent systemic failures. This is what we obtained in our simulations.

### Practical and ethical issues

#### Equipment and faculty

Set-up time for faculty members in the initial stages was up to 2 h, which requires significant commitment from the simulation team. We managed to reduce this time with experience to 30–60 min. However, this still has the potential to strain an overstretched faculty and highlights the importance of having dedicated simulation staff with appropriate clinical expertise and simulation experience.

#### Availability of clinical staff

Despite attempts to ensure all areas of the hospital that will be affected by the simulation are not busy at the time, including assessing the workload of the medical on-call team, we have had issues that we did not anticipate. An example includes putting a call out during a medical meeting that we were not aware of,

leading to some frustration from the general medical department on that particular day. We also realised that while we attempt to make the simulation unannounced, it is important for certain key personnel, such as the intensive care unit (ICU) consultant/attending on-call for the day, to be aware that it is a simulation so as to excuse their team from the training, in exceptional circumstances, if it is unsafe for them to leave the ICU. While this is the approach we have taken in our hospital, one could argue that this never really 'tests the system' from a risk assessment/latent factors perspective. The decision of which approach to take rests with the simulation team and it is of course a trade off between resources and acceptable (or safe) levels of 'stress' to the hospital system. In the light of our experience, and those of others, we take the view that integrated clinical education within the workplace should always be a priority, and therefore emergency training sessions ought to be attended by relevant personnel. Our in situ simulation programme has the full backing of the clinical governance committee and post-graduate department as a resuscitation training priority.

One potential concern of the unannounced nature of our simulations is whether the participants/learners can change rapidly from doing their clinical duties to being part of a simulation for which there is no briefing to the situation or the patient simulator. In our experience, this has not been a problem. Participants often pause very briefly when they first arrive at the simulation, but then rapidly become absorbed in the situation. Also, while being in their clinical environment is an advantage in terms of familiarity, there is the risk of participants being distracted by pending clinical duties or other patients in the ward environment, thus reducing the learning potential during the simulation. This is part of the trade off between doing a simulation in situ and attending a training session during protected educational time in a simulation lab.

#### Potential impact on patient care

One of our concerns when setting up the programme was the potential for delay in actual patient care during the conduct of a simulation. There has so far been no evidence of any detrimental effect on patient care, although obviously training of any kind reduces direct contact time with patients. It is critical to anticipate potential problems and time the simulation accordingly. Prior to starting the simulation, every effort is made to ensure that the clinical environments throughout the hospital are not busy. Positive reactions to in situ simulation have also emerged from the patient population. A study at Cincinnati Children's Hospital Medical Center addressed relatives' perception of in situ simulation.<sup>9</sup> While training sessions clearly had the potential to delay healthcare provision, this study found that families 'were glad the health care teams were practicing for high-risk situations and that the additional time spent waiting because of a simulation was not significant in the context of an Emergency Department visit'.

### CONCLUSION

Based on the available evidence and also our experience, in situ simulation is a useful training tool, conveying a greater sense of realism and team interaction at a fraction of the cost of laboratory-based simulation. While courses remain valuable for teaching technical skills, in situ simulation can play an important complementary role in reinforcing these skills and providing a bridge to the clinical environment and the use of these skills in patient care. In situ simulation is particularly valuable for the training and assessment of non-technical skills critical for

successful teamwork, and is something that could be implemented in every hospital even when finances are stretched and space for simulation suites is not available. The additional benefit of having an opportunity to assess risk in the clinical environment to identify system failures and latent problems cannot be emphasised enough and is a good reason to perform the simulation even if a specific training session has not been planned. Overall, in situ simulation has the potential to significantly improve the safety of patients in hospitals.

**Contributors** The research was not commissioned but was the idea of SW, SL and AMcK, all of whom have experience in resuscitation and simulation. SG was instrumental in facilitating the in situ simulation programme. SW wrote the majority of the paper with input from SL. AMcK and SG reviewed the paper from a clinical perspective. RA reviewed the paper with regards to expertise in simulation. NS and CV reviewed the paper from their many years of expertise in the area of patient safety, human factors and non-technical skills.

**Funding** This research was funded by a grant from the Wellcome Trust (grant 085877/Z/08/Z), UK. The funding source of the study had no role in the study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit for publication.

**Competing interests** SW, RA, CV and NS are affiliated with the Centre for Patient Safety and Service Quality at Imperial College Healthcare NHS Trust, which is funded by the UK's National Institute of Health Research.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** Data available on request from the corresponding author.

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*BMJ Qual Saf* published online December 4, 2012  
doi: 10.1136/bmjqs-2012-000986

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