Intensive care and simulation — a guide

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Patient simulation lends itself very well to training and education for acute clinical situations. It is an excellent learning environment to explore interactions and behaviours such as team working, decision making, handover and other elements of communication which are so important in the acute clinical setting. This review provides some practical and educational 'directions' to help you get involved in this kind of teaching.

Keywords: Simulation; intensive care; learning objectives; curriculum; debriefing

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INTRODUCTION

Specialties within medicine which are characterised by their involvement with acute care situations and where complex skills are needed from both individuals and health care teams align themselves particularly well to high fidelity simulation. It is therefore no surprise that initial developments with human patient simulators came from within the anaesthetic community[1]. Over the subsequent forty years the use of simulators within anaesthesia training has become well established, and other groups have come to realise that there is significant potential for high quality learning, particularly of emergency skills, within the simulated patient environment. Among these are emergency medicine[2], obstetrics[3], surgery[4] and nursing[5], and it is somewhat surprising that intensive care medicine has not made greater use of high fidelity simulation until recently[6].

Clinical practice within these specialties of medicine share many attributes. They are "hands on" and labour intensive; complex knowledge and practical abilities are required; and they involve equipment of variable complexity. The timescale of acute clinical events is often short, and decisions with important consequences are commonly made under pressure of time, with limited information, and sometimes in the presence of limited resources[7]. Decision making is dominated by heuristics[8]. Very often teams of people from different backgrounds are thrown together suddenly in a situation of urgency and high stakes, making clear and accurate communication essential if a good clinical outcome is to be achieved[9]. Both practical patient management and clinical decision making are either disrupted or supported by interruptions[10]

In the light of all of this it can be appreciated that recreating these types of events in a simulated clinical environment, made as realistic as possible, could be educationally useful. By enriching the process with incomplete information, messy clinical presentations, the need for real-time management, monitoring, or communication, the application of interruptions from pagers, telephones, relatives or alarms, an aporetic teaching space can be created. Today it is more and more recognised that good clinical care is not only dependent on adequate knowledge and skill but that other factors like communication, leadership and followership can influence clinical outcome.[11] Other factors have a major influence. These so-called non-technical skills are recognised as fundamental in the fields of patient safety, clinical error and critical incident prevention[12]. These skills (or the absence of them) can be observed very well in the simulated clinical environment, and with skilled debriefing the learner can appreciate changes in behaviour that have the potential to improve clinical outcomes. Improvements in simulator technology have allowed more complex simulated conditions to be constructed and have facilitated the introduction of high fidelity simulation into intensive care medicine training.

Learning "by trial and error" in the intensive care environment is now seen as unacceptable – and to a great extent inefficient – as a learning tool, as it implies acceptance that individual patients will come to harm for the "greater good of the many"[13]. Real time simulation allows the learner to make mistakes without patients being harmed, and immediate post event debriefing facilitates the development of alternative strategies, both in cognitive and non-cognitive domains. In this way it can create a safe environment for both the patient and the learner.

In short, simulation has become an integral component in the entire spectrum of clinical training from the undergraduate[14] to the post-graduate, and across many clinical disciplines[15, 16]. There is a plethora of technologies, formats and techniques currently in use. Comprehensive reviews detailing their history and development are readily accessible[17,18,19]. In the following article we have tried to give an over-view of the use of advanced clinical simulation in the context of intensive care training and education.

WHAT DO WE MEAN BY ADVANCED PATIENT SIMULATION ?

There are three components to this:

1. The set up: we recreate a clinical environment and patient story which is believable and brings the case to life for the learners. This involves the clinical area, equipment, disposables and the simulator.
2. During the simulation scenario the patient's clinical course must be realistic: so the learners must take a history, examine and assess the patient, start treatment (oxygen, fluids, antibiotics, analgesia and so on), establish monitoring, interpret this and the results of investigations They then need to respond to the abnormalities appropriately. These events need to happen in 'real-time' and are recorded for discussion.
3. The crucial bit: the scenario is debriefed utilising the recording

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of both clinical action and the physiology generated by the simulator. More later.

This review is concerned with whole patient simulation using commercially available mid- and high-fidelity systems which may be 'instructor driven' or model driven. The difference here is that a model driven simulator will respond appropriately to clinical input (if oxygen is applied to the 'patient', the SpO_2 will rise), whereas in an instructor driven simulator, physiological parameters can be changed by the instructor to mimic what he thinks is an appropriate response (he notices that oxygen has been applied to the patient, and increases the SpO_2). Commonly these two approaches are merged when a physiologically driven simulator is 'piloted' by an instructor, fine tuning the scenario in real time in order to increase the fidelity (believability). This is how we do it.

It is pivotal that the scenario appears 'real' and that the learners can suspend disbelief allowing themselves to be immersed in the experience, otherwise the platform upon which the debriefing is built will be insecure. The mannequin, and the simulator software are only part of the preparation that is required. The environment should be as close to the appropriate clinical environment as possible, and should contain equipment that is suitable to the scenario that is to be undertaken. Clinical materials should be similar to (or the same as) those currently in use within the hospital.

In the kind of educational encounters that we are highlighting here simulation scenarios are run in real time with a group of clinical learners. They are expected to recognise, assess and manage the patient while simultaneously initiating both supportive and definitive treatment, applying appropriate monitoring, making diagnoses and assessing illness severity. This clinical approach is clearly described in a web-based 'initial assessment and treatment' tutorial[20] .

So, to summarise, by advanced patient simulation we mean:

- Use of a mid to high fidelity simulator
- Recreation of the clinical environment as closely as possible
- Scenarios are audio and video recorded
- Debriefing is grounded in this recording and the focus is on both technical and non-technical skills

BEFORE YOU EVEN START...

Don't go out and get the money to buy 'a simulator' until you've thought about the following things. If you already have 'a simulator' in a corner, in a box or in a cupboard these suggestions may help to get things moving.

- Define ***why*** you are going to teach: simulation is a very powerful tool for learning. Most of the time participants come to learn from simulation, not to be assessed. A safe and constructive educational environment should be created.
- Define ***who*** you are going to teach: who are the learners? Remember that learners are from different backgrounds and have varying levels of experience and therefore different learning needs.
- Know ***what*** you want to teach: this should be allied to what the learners need to know – you should have pre-defined learning objectives. Is simulation the best way of achieving those objectives?
- Think about ***how*** you are going to fund your ongoing activities. Many models exist – top-down funding from your institution or national body, industry sponsorship, or individual or group rates for a "course". You may need to think about a combination of these
- Consider ***where*** you are going to use your simulator. This will allow you to decide what you will need in the way of space, and supporting equipment such as audio-visual recorders, projectors and computers. Does this equipment need to be portable?
- Decide ***when*** you are going to do it: a scenario may last a hour, but will take ten times that to prepare (organising the 'programme', learning to deliver it, developing and collecting materials). In order to sustain ongoing training this will need dedicated, recurring time, preferably built into trainers' job plans.
- Get involved with your local, regional or national simulation centre. This should allow you to gain experience and expertise in all aspects of simulation. It will also allow you to develop simulation teaching networks to share ideas and materials, and will support you and your colleagues in educational professional development
- Start small and build up.
- Don't re-invent the wheel! Other centres and organisations may have already developed the type of programme that you are looking for.

RUNNING A SIMULATION SESSION

Simulation training sessions which are structured with specific learning objectives in mind afford learners the opportunity to go through the stages of the experiential cycle in a structured manner. The active participatory components of the simulation exercise itself are combined with a subsequent analysis of, and reflection on, the experience with the aim of facilitating changes in clinical behaviour in practice[21]. It is essential that the facilitator creates an environment of trust early on, typically in the introductory session of induction and orientation. This briefing period is the time when the facilitator highlights the purpose of simulation, the learning objectives are agreed and the running of scenarios and the debriefing process are explained. The learners' previous clinical and educational experiences will have an impact on their engagement with the whole process, and on the effectiveness of the training. It is helpful if issues can be identified and taken into consideration[21].

Based on these premises we organise our training sessions as follows:

1. Introduction

After introducing ourselves, we ask the learners to introduce themselves. This is particularly important if they are from different institutions and background, or work in different areas within the hospital. Everyone wears a stick-on name badge all day. We explain that this is a training opportunity, emphasising that it is *not* assessment, and we state that 'what happens in the simulator stays in the simulator'. Candidates and visitors sign a confidentiality agreement. We ask the learners to define what they want to achieve over the course of the day – in effect they set their own learning objectives, and we align these with the predetermined learning objective which we have established. We note all of these, and refer to them again at the end of the day.

2. Orientation

We take the learners through to the simulation room, and show them what the mannequin does and doesn't do. We show them where the equipment is: monitors, ventilators, defibrillator, difficult airway equipment, anaesthetic machine and infusion devices. They see what is in the drug cupboard and are given relevant telephone numbers to call should they need help, investigations and so on. We then allow them time to familiarise themselves with the simulated environment – listen to heart sounds and breath sounds, and practise 'normal' laryngoscopy, for example.

3. Scenarios

Each scenario takes approximately 60-90 minutes: about 30 minutes of scenario followed by approximately 30-60 minutes of debriefing. In a large group the learners are divided into 'observers' and simulation 'participants'. The 'observers' can see what is happening in the scenario via a video link from the simulation room to the seminar room, and they can also see real-time physiological data generated by the simulator. They are briefed to watch actively, in order to contribute to the subsequent

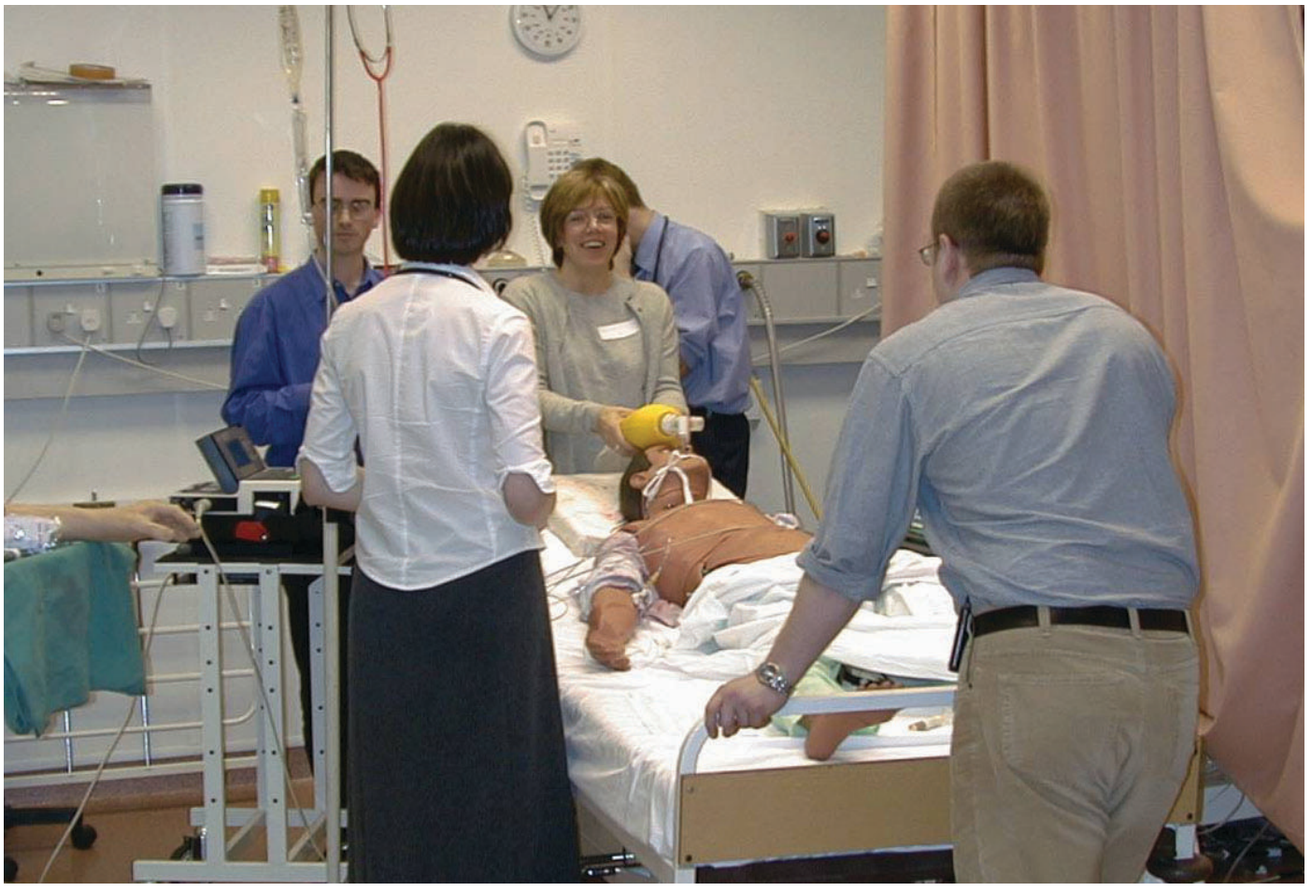

FIGURE 1. Team working.

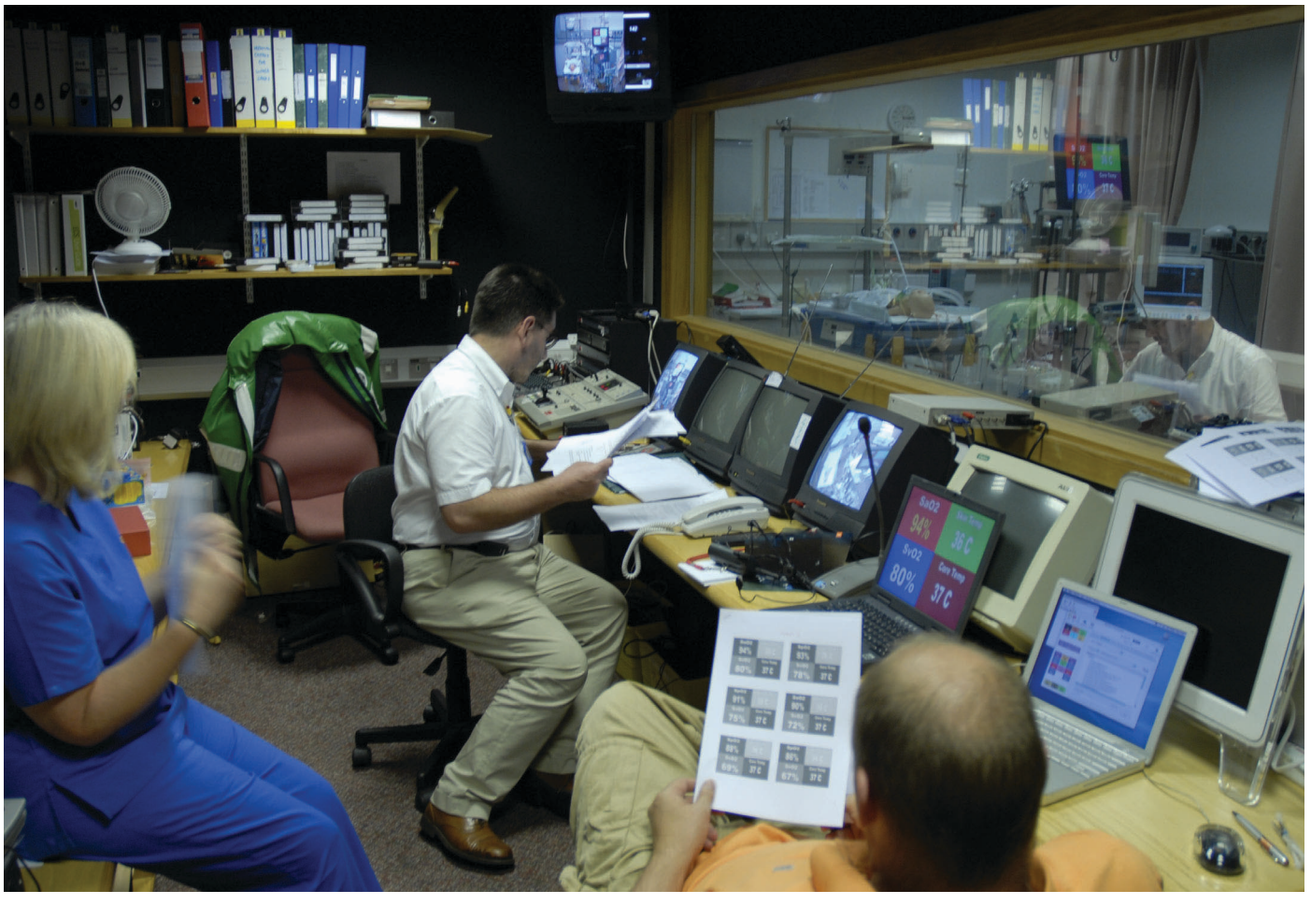

FIGURE 2. The control room in action.

debriefing. The 'participants' are briefed outside the simulator room, and then go on to treat the simulated patient. At least one member of the teaching faculty is present in the simulator room during the scenario, to assist with equipment and to provide clinical information that is not readily available from the mannequin (skin colour and temperature, neurological signs, for example). The action is video and audio recorded, and the recording is used in the subsequent debriefing. It is very helpful to have a superimposed contemporaneous recording of the physiology on the recording of the scenario.

4. Debriefing

A systematic review of the literature of high fidelity simulation identified feedback (including debriefing) as the most important feature of simulation based medical education[18]. It is also the most challenging, difficult, complex and rewarding aspect of advanced patient simulation and we would recommend that when you attend your local, regional or national simulation centre, you should focus on the debriefing. Simulation should be run and debriefed by clinicians who are not only subject matter experts in their domain but who are also skilful in observing professionals and in providing feedback (including support and encouragement) at individual and team level. This requires very active watching and listening by the facilitators. The credibility of the facilitator/debriefer is enhanced by their subject matter expertise and their ongoing clinical involvement and also improves the reliability of clinical information delivered. Debriefing is the main emphasis of the SAInT (Simulation Applied to Intensive Care Training) Train the Trainers course which has been designed for those involved in simulation applied to intensive care training[22]

The purpose of debriefing is to analyse the clinical situation, identify suitable learning opportunities within the recorded scenario, to analyse the factors contributing to the eventual outcome, and to both reinforce effective activity (eg good team working) and to propose alternative strategies that might have improved the outcome, or made it easier for the participants. Based on experience and feedback from participants, we believe that it is vital to record the scenario and to use the recording to inform the debriefing. A number of complimentary components contribute to the educational efficacy of the debriefing: group discussion and debate, analysis of events in the recording, facilitation to achieve learning objectives (below) and the priceless opportunity for learners to witness what they really did and said, not what they thought they had. The pre-determined learning objectives can be explored during the debriefing. In addition, owing to the dynamic nature of the simulation process, the learners may propose new ideas or identify areas of specific learning need, so that there is a degree of opportunistic learning occurring. The goal is to give all the participants what they need educationally!

EDUCATIONAL CAPITAL (OR GETTING THE MOST OUT OF SIMULATION AND YOUR TIME DOING IT)

It is generally accepted by experienced simulation teachers that advanced patient simulation works best for acute clinical situations. There is also increasing awareness that this type of training is particularly suited to teaching on, and learning about, behavioural aspects of acute patient management. Indeed there has been significant work done on Non-Technical Skills (NTS), such as team working and decision making, in anaesthesia[11] and surgery[4], and there is an emerging literature on NTS in the domain of intensive care medicine [5,23]. A course has been developed for training in neonatal and paediatric extra-corporeal membrane oxygenation with the ECMO team from Yorkhill Hospital in Glasgow and the Scottish Clinical Simulation Centre. In the initial development meetings the ECMO staff repeatedly emphasised that "this is a highly technical procedure" and they anticipated that technical aspects would be prevalent in their simulation courses. In fact around 90% of the discussion in the debriefings is around NTS issues[24].

In order for debriefing to be most effective, it is ideal that learners bring with them a certain level of knowledge and skills, allowing debriefing to be focussed more on non-technical aspects of performance. This knowledge can be provided out-with the simulation environment by other educational activities – an approach which has its roots in established teaching practice[25]

This brings us to the issue of how can we utilise simulation training. We believe that if it is integrated into a curriculum or training programme, it is more likely to succeed[26]. There are a number of models which could be envisaged. This is not an exhaustive list and the different combinations are not necessarily mutually exclusive. We have highlighted the *simulation centre* first as we have extensive experience of this area. The suggestions for local simulation are based on discussions with colleagues and some personal experience.

IN THE CURRICULUM

Ideally the simulation learning would be embedded in teaching programmes based on national or regional curricula. An example is that of Emergency Medicine in Scotland where specialist trainees attend a series of simulation courses annually throughout their training covering many domains from the curriculum sequentially[26] Indeed part of this programme has been adopted by the College of Emergency Medicine as a national standard across the UK[27].

In the UK the Inter Collegiate Board for Training in Intensive Care Medicine (IBTICM) has responsibility for the medical aspects of intensive care medicine training and is in the process of evolving into the Inter-collegiate Faculty of Intensive Care Medicine. Simulation training has been discussed and debated under the auspices of IBTICM but we are a way from formal discussions about the place of simulation in intensive care medicine training in the UK.

In Europe however, SAInT, working under the aegis of the Education and Training Group of the European Society of Intensive Care Medicine (ESICM), has developed simulation learning modules aligned to a comprehensive on-line teaching programme – PACT (Patient-centred Acute Care Training)[28]. The concept is that learners work through PACT modules in preparation for the simulation training, and therefore approach the simulation with the knowledge required to interact with the educational material presented during the scenarios. In Scotland, for example, courses are run in the national simulation centre with faculty from around the country. This means that medical and nursing learners from different hospitals can attend sequentially. They study pre-simulation, attend the course and then have the opportunity of taking their learning back into the work place[29].

Another approach is to include this type of experience in curricula specifically aimed at teaching about patient safety. The Society for Academic Emergency Medicine has produced just such a curriculum [30] and it has been recommended that this be reproduced for Intensive Care Medicine[31]. The richness of advanced patient simulation in the area of non-technical skills training strongly supports this alignment.

IN THE TEACHING PROGRAMME

A potential mechanism to incorporate simulation training into *local* education is to have short sessions aligned with existing programmes. In some centres one or two scenarios have been run on the designated 'educational afternoon' once monthly. There are issues about set up and recording facilities. In other areas innovative strategies have included the use of empty bed-spaces of the ICU as the simulation area allowing team training on site with unit standardised equipment. There are pros and cons to this – the simulation takes place in a real clinical environment which can contribute to the "suspension of disbelief" described above, but it

has the potential disadvantage of distracting clinicians from their normal duties, and learners may be re-directed to clinical work if the workload on the ward increases. One of the major advantages to the individual learner of attending a designated course is the necessity to ring-fence their time to allow it to go ahead.

SUMMARY

We have discussed the mechanics and the philosophy of advanced patient simulation, and the inclusion of simulation training in traditional curricula and teaching programmes. This article has been written to raise interest in, and awareness of, advanced patient simulation with the goals of increasing the involvement of clinical teachers in local, regional and national initiatives, and of informing potential learners where they can search for these learning opportunities. There is an enormous and increasing need for training and education across the gamut of professions and specialities involved in the provision of clinical intensive care. Simulation training can fulfil some of those needs, but must be performed to a high standard, with good organisation, to be effective and enduring. We anticipate that the provision of simulator training will increasingly be at a local level, and we anticipate that there is a need for local, hospital based simulator training to be allied with training in regional or national simulation centres if it is to succeed.

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