Neonatal simulation – training a workforce for the future

This article describes the different types of neonatal simulation training available and explores the evidence for the use of high fidelity simulation. The future of simulation training is discussed and the national support for increasing simulation training in healthcare highlighted. A successful 'point of care' neonatal high fidelity simulation programme including debriefing methodology is outlined.

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Key points

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1. Simulation training allows repetitive practice and errors can be made without clinical consequence.
2. Learning occurs during the debriefing; facilitators must develop debriefing skills and enough time must be allocated for a skilled debriefing to occur.
3. Low and high fidelity simulation tools exist, use the one most appropriate to the type of training you are conducting.
4. 'Point of care' simulation allows teams that work together to train together in their own working environment. It is more cost effective and easier to arrange than off site simulation.

Simulation training was pioneered by the aviation industry in the early twentieth century and is used extensively by military organisations to try to reduce error and improve team performance. The first mainstream medical simulator (Resusci Annie) was developed in the early 1960s by Laerdal and using manikins became a mainstay of resuscitation training. The equipment used for simulation training has improved considerably with the development of increasingly complex and expensive simulators.

It is important to remember that simulators themselves are merely an educational tool and that, along side technical advances, we should focus on the educational aspects of simulation sessions and the importance of an effective debrief.

National recommendations for simulation training in the UK

The Chief Medical Officer was impressed by the the aviation industry's use of simulators and their safety record.

> 'When a person steps on a plane, their risk of dying in an air crash is one in 10 million. When a person is admitted to hospital, their risk of dying or being seriously harmed by medical error is one in 300.'
>
> *Chief Medical Officer, Sir Liam Donaldson, Annual report 2008*[1]

He stated that "*Simulation training in all its forms will be a vital part in building a safer healthcare system*", and could be used to train and assess teams and rehearse emergency situations.

The Department of Health has strongly endorsed increasing simulation training in healthcare and commissioned an independent report on the availability of simulation training within the NHS[2]. This report highlighted a range of simulation providers and a number of differing local practices.

The European Working Time Directive (EWTD) and Modernising Medical Careers, (MMC) has limited the amount of time in which trainees can gain experience and receive training[3]. A government commissioned report into the effect of EWTD on training[4] concluded that "*simulation training increases the acquisition of skills*" and "*enables a review of performance and the ability to make errors without clinical consequences*".

Types of simulation training

Task trainers

Task trainers are very useful for teaching procedural skills such as intravenous, intraosseous and arterial cannulation, percutaneous long line insertion, lumbar puncture and newborn hip examination. Similarly, animal carcasses (piglet or rabbit) can be used for demonstrating chest drain insertion. More complex task trainers can be used to teach technically difficult procedures, eg teaching surgical trainees laparoscopic techniques.

Low fidelity

The term 'low fidelity' is often applied to manikins that do not provide feedback to the trainee. These manikins are relatively inexpensive and are extensively used by resuscitation courses (eg the Newborn Life Support Course, run by the Resuscitation Council UK). Feedback during a scenario needs to be provided by a facilitator. Low

fidelity manikins can be cheaply adapted to improve their degree of realism.

High fidelity

The term 'high fidelity' is used to describe manikins that provide direct feedback to the trainee. There are a number of different manikins available with different features. Many can 'breathe', they have palpable pulses, they can move and demonstrate seizures, they can demonstrate cyanosis. They can be intubated and often have facilities for the insertion of lines. High fidelity manikins can be fully 'monitored' which significantly adds to their realism during simulation sessions. They are useful for teaching leadership, communication, team dynamics, and the clinical management of more complex situations. Crisis resource management – the optimal use of people and equipment to manage a clinical emergency can be explored.

The best type of simulation is one that is most suited to the training undertaken. In all cases it needs to be properly set up, run and debriefed. It is important not to underestimate the time and planning needed to do this.

Simulation can be delivered at the 'point of care' (sometimes referred to as '*in situ* simulation') or at a simulation centre. 'Point of care' training allows staff to train with people they work with on their own unit. It has less impact on service provision and is more cost effective. Simulation centres provide excellent facilities but are expensive to establish and run. External courses at these centres are not always regularly available to the whole multidisciplinary team.

Does simulation training work – what is the evidence?

People learn skills by repetitive deliberate practice. Dreyfus[5] describes a model of skill acquisition where students progress from a novice to an expert (**FIGURE 1**).

When staff begin working on a neonatal unit, it is important for them to progress to the stage of 'competent' as quickly as possible in order to maximise patient safety. Simulation training has the advantage that it allows trainees to 'accelerate their learning curve' by deliberate practice.

David Kolb has published extensively about the theory of 'experiential learning'[6]. The concept of 'learning by doing' will be very familiar to clinical staff. Kolb describes four distinct phases of adult learning which we have adapted to show how simulation training can fit within a clinical environment (**FIGURE 2**).

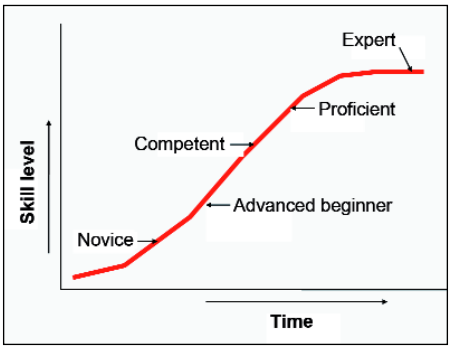

FIGURE 1 Progression along the learning curve from novice to expert[5].

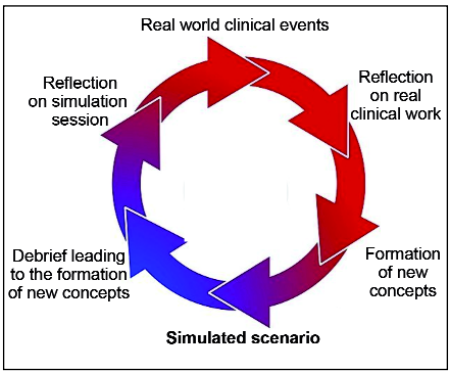

FIGURE 2 Simulation training incorporated into Kolb's learning cycle[6].

There are strong educational arguments about the benefit of simulation training, but is there proof that it changes outcome?

David Gaba from Stanford wrote:

> "No industry in which human lives depend on skilled performance has waited for unequivocal proof of the benefits of simulation before embracing it."[7]

There is an increasing body of evidence of the benefits of simulation.

Many of these are qualitative papers published in educational journals that focus on simulation, and there will inevitably be publication bias.

Simulator training has been shown to improve surgical skill both in cleft lip repair[8] and laparoscopic surgery. Comparing groups of surgeons trained in a traditional apprenticeship model with those trained on a simulator showed that each hour training in a simulator reduced the time to competence on real patients by 2.3 hours[9]. Simulation training has been used in many ECMO centres with the aim to decrease critical events[10].

Training using high fidelity simulators has been demonstrated to improve retention of life support algorithms[11] and there are now studies that are starting to demonstrate improved performance in real emergencies[12].

There are a number of studies demonstrating 'high user satisfaction' with high fidelity simulation sessions; including specific neonatal simulation sessions[13,14] and students rate their experiences of simulation second only to real clinical experience[15].

A study looking at anaesthetic trainees showed that it was possible to correctly rank the experience level of trainees by watching their performance in a simulator, suggesting that performance in a real clinical environment is mirrored by performance in a simulated environment.

A 'Best Evidence in Medical Education' Review[16] looked extensively at which features most enhance simulation training sessions. The importance of an effective debrief with skilled facilitators was highlighted as an essential feature of simulation training. Expensive manikins with increasing levels of reality remain only tools. The educational content of sessions and the way that this is delivered remains

FIGURE 3 Real ICU environment used for high fidelity neonatal simulation showing position of mannikin, monitor, notes and intensive care charts.

the key to effective simulation training.

Are there studies showing unequivocal improvement in clinical care following simulation training? Not yet, but increasing international research collaboration may answer this question. The importance of excellent staff training, especially in intensive care environments cannot be underestimated – can we afford not to embrace simulation as a safe educational tool?

The Leicester Model

Simulation delivery

The Leicester neonatal simulation training programme was set up in 2007 and runs fortnightly point of care, total immersion, high fidelity simulation scenarios on the neonatal unit at Leicester Royal Infirmary (**FIGURE 3**, previous page). Two doctors (ST1-3 and ST4+) and two nurses (one junior, one senior) attend each session and everyone adopts their usual roles (**FIGURE 4**). Sessions last approximately one hour resulting in minimal disruption to clinical service.

A 15-minute introductory lecture outlines the session, gives some background to simulation and discusses the features of the manikin. We highlight that the session is not an assessment, it can not be failed and there is no marking system. We feel that this session is very important as it creates a confidential training environment that allows trainees to discuss the team performance and problem areas in an open and honest way.

Simulated scenarios run for 15-20 minutes and our most popular ones are shown in **TABLE 1**. Simulation is a versatile tool that can be delivered on delivery suite, the neonatal unit, postnatal ward or during a neonatal transport (**FIGURE 5**). Training sessions are derived from common clinical scenarios and are designed to reflect feedback from previous participants, national patient safety alerts, and our own internal clinical governance information. Following delivery of the scenario the team return to a non-clinical area and a 30 minute debrief commences immediately while the team are still in an emotionally high state from the simulation.

Debriefing

Debriefing commences with the facilitator clarifying the clinical situation to avoid time being spent discussing what was wrong with the baby. Our debriefing strategy is based on a narrative approach[17] combined with a debriefing technique called advocacy enquiry[18]. Our simulation team have had specific training in debriefing methodology to improve consistency[19]. Problem areas are explored in an open and honest way. Concerns are shared and explored and the facilitator guides the team in finding out 'why' the scenario went the way that it did, focussing on candidate's ideas and frame of mind. Rudolph et al[18] explore the concept of 'debriefing with good judgement' and this is an excellent starting point for readers who wish to explore debriefing styles further.

At the end of the debriefing all participants are asked to write down the three most important things they have learnt and these are presented back to the group; a number of learning points recur. (**TABLE 2**).

FIGURE 4 'Point of care' neonatal simulation in action at Leicester Royal Infirmary.

- Continuous positive airway pressure – needs intubation
- Term meconium/persistent pulmonary hypertension of the newborn
- Term pneumothorax
- Term antepartum haemorrhage/fits
- 34 week gestation respiratory distress syndrome
- Undiagnosed transposition of the great arteries
- Transport – term, sepsis, low endotracheal tube
- Chronic lung disease – respiratory deterioration
- Term right sided congenital diaphragmatic hernia
- Term sepsis

TABLE 1 Top ten most popular scenarios.

- Clear targeted, specific communication – use names, make eye contact, 'communication receipt', listen
- Clear leadership
- Role clarity
- Avoiding getting fixated on one thing
- Assert concerns – say what you are thinking

TABLE 2 Recurrently obtained participant-derived learning points.

Multi-disciplinary approach

Our core faculty includes medical and nursing staff and this has helped us design and deliver more realistic scenarios and has facilitated appropriate handovers to nursing staff at the start of simulated scenarios. Involving a nurse practice educator has enabled the simulation programme to be targeted towards relevant nurse training needs. A band 5 nurse entering a band 6 transport post might benefit from a transport scenario or stabilising a baby in unfamiliar surroundings. Training can also be adapted to meet medical staff needs, eg leadership skills in trainees starting in a middle grade role, or more complex ethical scenarios for a trainee approaching the end of their training.

FIGURE 5 Technical and team working skills being employed during a neonatal point of care simulation.

The future of neonatal simulation training

Many neonatal units are beginning to incorporate simulation training into their educational programmes. Within the East Midlands we have begun to expand neonatal high fidelity simulation training across all of our network hospitals. There is a need for more trained facilitators and simulation leaders are working towards benchmarking the educational quality of simulation sessions[20]. Although a number of simulation training courses exist, many are generic and few are neonatally focused.

Currently neonatal simulation is used for training rather than assessment; with the changes brought about by revalidation of UK senior medical staff, this may change. We feel that it is important that appropriately validated scoring systems are created and evaluated prior to the widespread use of simulation to assess teams.

The British Association for Perinatal Medicine has recognised the value of simulation training and requested that a national framework for neonatal simulation training is created. A neonatal simulation interest group, NeoSim, has been formed and can be accessed at www.neosim.co.uk.

Greater collaboration between units using simulation and improved links with paediatric and paediatric anaesthetic groups are needed. Various national (eg NeoSim, ASPiH – Association for Simulated Practice in Healthcare www.aspih.org.uk) and international (IPSSW – International Paediatric Simulation Symposium and Workshops www.ipssw.com) groups exist. These should share resources, disseminate good practice and set up research collaborations and the direction of future developments.

With Department of Health and Chief Medical Officer support, evolving evidence of efficacy, enthusiastic advocates around the country and high user satisfaction, simulation training in all its forms is here to stay. Crucially it allows us to make our mistakes safely and get it right first time when it really counts on live infants.

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