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*"I would have everie man write what he knowes and no more."–Montaigne*

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# Editorial

## Simulator-based training in paediatric anaesthesia and emergency medicine – Thrills, skills and attitudes

Paediatric anaesthesia and emergency medicine are clinically demanding fields, presenting the practitioner with unique challenges, particularly when caring for neonates, infants, and small toddlers. They have been described as clinical environments with high-risk and low-error tolerance.[1] In many countries, tertiary paediatric services are becoming increasingly centralized, while medical working hours have been reduced, leading to a situation where the non-specialist's exposure to difficult cases and emergencies is fading. Nevertheless, a significant proportion of paediatric surgical procedures will continue to be performed outside tertiary centres, and paediatric emergencies still have to be managed locally.[2] Several studies demonstrate a close inverse correlation between the level of specialization, perioperative morbidity, and mortality associated with paediatric anaesthesia.[3–6] However, clinical circumstances and the relatively small number of paediatric cases admitted to most hospitals impede the establishment of an optimal training environment.

The question then arises as to how best to address this discrepancy between the high degree of required clinical proficiency and the low level of exposure to paediatric patients. Recent research demonstrates that the effective application of 'technical' (medical) skills closely depends on the presence of robust 'non-technical' skills.[7] A term coined by human factor research, performed in aviation since the 1970s, and more recently in medical environments,[8 9] 'non-technical skills' include items such as situation awareness, team building and leadership, communication, task management, and decision making.[10] Difficulties arise in how such skills can be taught. Traditionally, medical education has relied on five main teaching techniques: lectures, workshops, skill and scenario training, and role play.[11] Over the last decade, these established techniques have increasingly been supplemented by the use of integrated human patient simulators. These can create a highly realistic, safe, and reproducible learning environment[12] and are associated with the potential to more effectively balance familiarization with the medical (technical) and non-technical aspects of patient care in paediatric anaesthesia.

The major advantage of simulator-aided training compared with that of skill manikins is in the presence of a highly realistic clinical feedback by the simulator and its vital signs monitors, which allows the instructor to stay back or even outside the room. Combined with an appropriate clinical environment, this creates a high authenticity of training. Consequently, it has been shown that simulator-based training can enhance the transfer of technical and non-technical skills into clinical practice, and effectively supports the changes of attitude and behaviour.[13] This applies to trainees of all levels of experience, for single candidates and also for teams. As part of a multimodular concept, simulator-based training may facilitate an improvement of quality of care and patient safety.[14]

Adult human patient simulators have enjoyed widespread acceptance as powerful training and assessment tools. Anaesthetic training, which is characterized by innovation and a multidisciplinary approach, has played an important role in developing these new educational tools. In 1999, the first high-fidelity paediatric simulator was introduced: the METI PediaSIM™ (Medical Education Technologies Inc., Sarasota, FL, USA) represents a child between 5 and 7 yr of age. Nevertheless, it was not before mid-2005 that two integrated infant simulators became available, the Laerdal SimBaby™ (Laerdal Medical, Stavanger, Norway) and the METI BabySIM™. With an appearance similar to advanced life support (ALS) manikins, these exhibit the standard vital signs and variable airway features (e.g. tongue swelling, laryngospasm), breathing patterns and sounds (e.g. see-saw, retractions, breath sounds, pneumothorax), cardiovascular features (e.g. heart sounds, peripheral pulses), and others (e.g. abdominal sounds and distension, fontanelle bulging).

Both infant simulators produce a vast range of monitor signals and allow extensive treatment interventions (e.g. intubation, laryngeal mask and nasogastric tube insertion, intravenous and intraosseous canulation, thoracocentesis). Embedded in real work place environments, their realistic feedback features provide a high clinical authenticity to facilitate the candidates' suspension of disbelief. The control of the clinical features for the METI BabySim™ is based on a physiological model that can be overridden manually, and the Laerdal SimBaby™ is controlled manually, with scenarios and trends user-programmable.

There now exists a sizeable body of international experience with paediatric simulator courses, most of which have used the PediaSIM™ child simulator.[15] However, specific course experience with the new integrated infant simulators is still limited.

In our institutions, we use a Laerdal SimBaby™, predominantly for training in the management of critical incidents and medical emergencies for trainees and specialists in anaesthesia and paediatric critical care medicine. In contrast to adult courses, many candidates place an emphasis on medical knowledge and clinical skills (i.e. technical skills), which has been attributed to their perceived limited experience with paediatric and, specifically, infant cases.[16] Hence, the active involvement of simulator facilitators with special acute paediatric expertise is essential. However, the more senior the candidates are, the greater becomes their interest in non-technical aspects of the scenarios.[17] We have found a close correlation between the difficulty of the scenarios and the candidates' own perception of their learning effect.[16] Scenarios that the candidates have rarely, or never, encountered in their own clinical practice were felt to be threatening, but particularly beneficial in terms of their training demands (e.g. an infant in circulatory shock because of extensive thermal injury). On the other hand, simulator training of a structured clinical approach to frequent incidents (e.g. laryngospasm) was also highly appreciated and perceived as a good opportunity for self-assessment.[13 14] In order to facilitate swift adaptation to paediatric simulator courses, it proved helpful if the candidates were already familiar with other scenario-orientated courses, with assessment and treatment algorithms, such as the European Paediatric Life Support (EPLS) and Advanced Paediatric Life Support (APLS) courses. Consequently, such paediatric knowledge and skill courses could be part of a modular educational approach, with paediatric simulator courses primarily aimed at advanced trainees and clinical teams.

The demand for paediatric simulator courses is high, presumably fuelled by the perceived imbalance between the potential difficulties of incidents and emergencies and the everyday clinical routine, particularly in the areas of infant anaesthesia and paediatric emergency medicine. Simulator-based courses can effectively supplement bedside teaching in paediatric anaesthesia for trainees, non-tertiary centre anaesthetists, and paediatric anaesthetists alike. Simulator training of clinical teams, both single and multi-disciplinary, becomes increasingly important, as clinical failures most frequently result from poor team interaction.[8 9] Patient simulators are considered the 'gold standard' for authentic training in crisis resource management (non-technical) skills. The new infant simulators can generate a wide range of paediatric scenarios and, in addition, have the advantage of being mobile to a large extent. This creates even greater authenticity by being able to run scenarios in real clinical environments, such as operating theatres, paediatric intensive care units, emergency departments, or ambulances.[18]

While patient simulators are well accepted as a core component of authentic training facilities, their acceptance as assessment tools for clinical performance remains much debated.[19] In particular, some senior professionals are reluctant to be assessed in a simulator environment (e.g. in the process of their recertification).[20] However, some validated scoring systems for simulator-based performance assessments have been developed, such as the Gaba or ANTS ('Anaesthetists' Non-Technical Skills') systems.[10 21] Together with an increasing familiarization with the new training tools, simulators may change the image of individual assessments in general as they provide a more realistic feedback system and a higher objectivity than most other testing techniques.[22 23] Hence, the Association of Paediatric Anaesthetists of Great Britain and Ireland (APA) has recently decided to implement standardized simulator-based scenarios as a compulsory part of training and assessment in paediatric anaesthesia of specialist registrars.[24] Subsequently, a collaborative project with nine simulation centres throughout the UK has been initiated.[25]

Simulator-based training is relatively costly, which is why rigorous research into its educational superiority and validity is required. It is comparatively easy to demonstrate a particular learning effect of simulator courses in terms of knowledge and skill acquisition. Immediate post-course changes in attitude and behaviour have also been shown.[13] However, it remains difficult to objectively measure long-term behavioural effects, and it appears to be almost impossible to extract any simulator impact on patient outcomes. Notably, the latter has not been demonstrated for *any* training technique yet.

Other potential areas of utilization for infant simulators include the development and evaluation of paediatric technical equipment and clinical workplaces and also research into the effects of stress on the anaesthesiologist's performance in a specific high-risk domain.

In conclusion, the new high-fidelity infant simulators permit realistic training and exposure to a large spectrum of authentic scenarios in paediatric anaesthesia and emergency medicine. However, we are in the early stages of paediatric simulator-based training, and current courses and workshops are still exploring their full potential. In the future, paediatric simulator courses will have to be tailored to specific target groups to meet their educational

demands and optimally support integrated training of technical and non-technical skills. Medical training is multimodular, and simulator-based techniques may prove pivotal in improving the management of clinical emergencies in infants and small children, which are seen infrequently by an individual clinician or team. This could greatly enhance the quality of care provided and improve patient safety.

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