Safe anaesthetic care: further improvements require a focus on resilience

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Anaesthesia has been described as a ‘model for patient safety’.1 In recent years, the significant risks that accompany administration of anaesthesia have been mitigated by developments in practices and technologies, commonly seen as a benchmark for other areas of health. Studies of anaesthesia-related mortality show that the mortality rate related to anaesthesia is approximately one in 58,000, and even lower in healthy patients.2 It has become increasingly difficult to investigate specific hazards of anaesthesia because of the rarity of these events, requiring large nationwide research efforts. One such audit was the Fourth National Audit Project (NAP4) of the Royal College of Anaesthetists and the Difficult Airway Society. The NAP4 project found that patient harm from airway management during anaesthesia occurs rarely, with 46 reported events of major airway management complications during anaesthesia per million general anaesthetics, and a mortality rate of 5.6 per million general anaesthetics (1:180,000).3 Even if the numbers of instances were underreported by a factor of four as suggested, the numbers of adverse events are still very low. Despite the safety of anaesthesia, however, the NAP4 report claims there is still ‘room for improvement’.

Anaesthesia shares two key characteristics of other high-reliability organizations; a preoccupation with safety and a goal of ‘zero harm’. The challenge for anaesthetists in this current era of safety is to find the next step that will reduce harm even further at a time when the number of adverse events to learn from is shrinking. Rather than concentrating on the reduction of harm (i.e. focusing on things that ‘went wrong’), another way of approaching safety is to determine why things went well. This approach of strengthening safe practices is termed ‘resilience’. Resilience describes the property of being flexible, robust, and elastic.4 In high-reliability organizations, this translates to an ability to ‘respond to sudden, unanticipated demands for performance and then return to normal operating condition quickly and with a minimum decrement in performance’.5 We believe that human factors research focusing on resilient behaviours of practitioners is required to improve the high-standard quality of anaesthetic care further.

The interdisciplinary domain of human factors refers to the study of interrelations between humans, technology, and their environment, and has been successfully applied to improve standards of health care.6 Within traditional human factors research, safety is associated with the absence or reduction of errors that may induce patient harm. Reason’s Swiss cheese model7 is one that is well established within this view of safety and frequently used in order to describe risk prevention. The model explains accidents by lined up holes (i.e. ‘safety gaps’) in the multiple defensive layers of a system. These occur from the combination of latent conditions (‘resident pathogens’ within the system) and active failures (‘unsafe acts’ by practitioners). Within this model, investigative tools such as ‘root cause analyses’ aim to identify these holes and thereby support the development of safety measures that fill them or mitigate their effects. Some causal factors of failures by clinicians at the ‘sharp end’ are frequently identified that are assumed to have caused patient harm.8

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harm; personal performance-modifying factors, such as time pressure and tiredness, or cognitive factors, such as inadequate situational awareness and flawed decision making, are commonly cited.\(^8\)\(^9\) The solution to these cognitive and personal performance problems is often limited to further education to prevent similar situations occurring in the future.\(^15\) The effectiveness of education to improve non-technical skills has been tested using behavioural rating scales, such as the Anaesthetists’ Non-Technical Skills scoring system (ANTS).\(^11\)\(^12\) There is still much to learn about error prevention, and traditional human factors research has greatly contributed to the high safety standards that have been reached within the anaesthetic domain. The limitation of this approach, however, is that quality and safety improvement has mainly become a retrospective activity, focusing on what went wrong. This approach is known to be susceptible to hindsight and outcome biases and insensitive to the potential side-effects caused by preventing the initial error.\(^15\)

A more recent alternative is to view safety as a ‘dynamic non-event’; dynamic because it is ‘preserved by timely adjustments of the anaesthetic practitioner’, and non-event because successful outcomes rarely call attention to themselves.\(^7\) Hence, the anaesthetist is the central source of keeping safety within acceptable boundaries. Few human factors studies in anaesthesia have used such a ‘resilience-based’ approach. Cuvelier and Falzon\(^14\) investigated how anaesthetists anticipate situations that may disturb routine working conditions. They found that anaesthetists consider potential scenarios before selecting suitable techniques for each of these scenarios. Preferences in techniques varied widely among anaesthetists; for instance, in a simulated paediatric situation involving syndactyly in a 2-yr-old infant, six anaesthetic practitioners would strictly exclude intubation by laryngoscopy as an option, whereas 12 would include it. Here, anaesthetists base their decisions on reflection of their own and team resources and adaption of these collaborative resources to the specific situation. This shows that ‘safe’ performance cannot be achieved solely by regulation and standardization but is based on resilience-building self-assessments on an individual level. Anaesthetic teams also show resilient behaviours when coping with unforeseen events.\(^15\) Anaesthetic teams differed in strategies to ‘recover’ and ‘control’ a situation involving a moved tracheal tube that disrupted oxygen supply. Some teams initially communicated in order to gain a shared understanding and identify the problem, and consequently, oxygenated and re-intubated. Other teams were more ‘cautious’,\(^15\) and firstly recovered the situation by manual oxygenation before communicating on how to proceed. Opposed to the former, these teams also called other staff for help. Cuvelier and Falzon’s study demonstrates that: (i) the anaesthetic practitioners’ resilience is fundamental in maintaining the patient’s safety; and (ii) anaesthetic teams differ in the strategies they use to create resilience. Both teams succeeded in keeping the safety of the patient within acceptable boundaries, although their approaches to safety differed. In contrast, the traditional human factors approach would rather focus on whether behavioural and cognitive deficiencies had contributed to potential patient harm, such as failing to call for help or to communicate effectively before taking action.\(^14\) With the traditional view, safety is a binary construct depending on identifying performance that is ‘inadequate’ and ‘erroneous’ compared with rules and established guidelines, whereas the assessment of safety from a resilience view depends on the conditions of the situation and the involved trade-offs in decision making.\(^15\)

Examining how anaesthetic practitioners create safety therefore offers a valuable contributory pathway for future research to complement the traditional ‘error counting’ approach. In terms of the Swiss cheese model, the resilient anaesthetic practitioners at the ‘sharp end’ of operations keep a large number of holes undetected. Only a few holes reach attention eventually, by means of incidents that are reported. By focusing on how anaesthetic practitioners bridge the majority of gaps, more feasible information can be obtained about what makes their daily performance successful. As suggested by Moloney,\(^16\) the day-to-day responsibilities of anaesthetic practitioners in patient care may be better represented by a ‘Parmesan Cheese Model’; during their daily work, anaesthetists frequently encounter adverse events that may take ‘shavings’ from the quantum of safety. These shavings are important regardless of how thin they may be, because they erode the safety margins that we work within. In Moloney’s model, the anaesthetist is fundamental in keeping emerging disruptions (i.e. ‘shavings’) within an acceptable safety boundary. Resilient strategies help to identify where and when they occur and attempt to mitigate their effects. A focus on resilience ensures that safety is not overestimated, which is a risk when the emphasis is primarily placed on occasional, noticeable incidents.

The predominant view of safety as a ‘dynamic non-event’ actively maintained by the anaesthetic practitioner naturally presumes that safety requires resilience. Resilient behaviours are ubiquitous in the anaesthetic domain, although resilience-based research is not yet widespread. The human factors domain offers suitable research methods for uncovering practitioners’ resilient work by observing how anaesthetic practitioners do their daily work and how they successfully manage potentially harmful situations.\(^4\) Future safety research in anaesthesia should identify behaviours that safe, resilient practitioners use so that they can be distributed and embedded into clinical practice guidelines. By systematically building in resilience, we can ensure that new safe practices become widespread.

**Declaration of interest**

None declared.

**References**


**A new view of safety: Safety 2**

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*Primus non nocere* (first do no harm) is a priority for our practice, and nowadays safety is under constant scrutiny by patients, politicians, and the press. This is increasingly recognized by our profession, and articles with a focus on risk and safety are starting to appear in UK anaesthetic journals.¹ ²

Safety is a concept that we intuitively believe we understand but is difficult to define. A suitable definition might be ‘the control of recognized hazards to achieve an acceptable level of risk’. A system is evidently not safe when an episode of harm has occurred (e.g. wrong-site surgery), but a system cannot be deemed to be safe simply because an adverse event has not occurred recently. The longer a team, department, organization, or service goes without anything going wrong, the more likely it is that the people managing it and working within it believe it to be safe, but this is not necessarily true. While safe systems will usually go for long periods without adverse events, this can also occur by chance in unsafe systems, and superficially, it is not possible to distinguish between the two. Health care is continually being pushed to improve, not only in terms of safety, but also with increased efficiency and economy. This invokes the *law of stretched systems*, where ‘every system is stretched to operate at its capacity and as soon as there is some improvement, for example in the form of new technology, it will be exploited to achieve a new intensity and tempo of activity’.³ Increased efficiency eats silently and progressively into safety margins without us noticing, and after a while operating within this increasingly risky environment we are caught out by an adverse event occurring within the system that we thought we understood. Health-care organizations then immediately increase their focus on safety, investigations follow, and we offer assurances that lessons will be learned.

Established models of accident investigation are generally based on cascade or domino models of the serial, sequential worsening of an incident into an accident. Heinrich⁴ first presented this notion in his book *‘Industrial Accident Prevention’* in 1931, with five falling dominos, one being ‘human error’. James Reason’s popular and influential ‘Swiss cheese model’ of accident evolution invokes a similar idea, with the concept of breaches in various defences (cultural, organizational, and personal) allowing propagation of an incident into an accident.⁵ ⁶ These are essentially linear narratives, based on what Hollnagel calls a ‘causality credo’.⁷ ⁸ The main assumption in these analyses is that the event under review occurred in a system that is capable of deconstruction to its composite parts, and that it is describable and understandable as a culmination of a number of identifiable factors, which form a stepwise narrative. These models are superficially simple and satisfying, appealing to our desire to discover causation and perhaps culpability in the aftermath of a distressing event. A key feature in this form of enquiry is that ‘work as done’ deviated from ‘work as imagined’.⁹ ¹⁰ Work as done refers to the practical and pragmatic way that tasks are achieved ‘at the sharp end’, where approximations and adjustments are continually made in order to achieve desired outcomes and there is necessary variation in activity between groups or individuals performing similar tasks in varying conditions. In this model, errors are continually prevented, detected, and managed using a mixture of proactive and reactive strategies. Work as imagined has a different perspective, a key feature of which is that minimal variation in process is expected and that there is one correct way to achieve an outcome. This is often perceived to be the presiding view of those ‘at the blunt end’ and is reflected in the vast arrays of protocols and policies that populate health-care internet sites.