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EDITORIAL II

Crisis resource management and teamwork training in anaesthesia

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Over 20 yr ago, my research group was the first of what would become many who would recognize that there were sufficient parallels in the cognitive profile of the work of anaesthetists to that of airline pilots to justify examining, adapting, and adopting the paradigm of Crew (originally 'Cockpit') Resource Management (CRM), then fairly recently begun in aviation training.[1] The CRM paradigm can be summarized as the articulation of principles of individual and crew behaviour in ordinary and crisis situations that focuses on skills of dynamic decision-making, interpersonal behaviour, and team management.[2] Just as these were found to be of equal or greater importance to ensuring safety of flight of airliners, so too were they found to be relevant for patient safety in anaesthesia.[3 4]

Over the years, the theoretical focus and implementation methods for CRM training in aviation evolved as various theories and techniques came in and out of vogue.[5] Nonetheless, the overall focus on what are widely known as 'non-technical skills' of individuals and teams has remained at the core.

That the adaptations of CRM to healthcare started in anaesthesiology is no coincidence. As I have articulated elsewhere, anaesthesiologists have a special need to emphasize patient safety.[6] We share with pilots a cognitive profile of 'hours of boredom and moments of terror', and an analogous work process that combines technical skill and decision-making in a complex and diverse interpersonal environment (indeed, that of healthcare is probably more challenging than

that of aviation). The general applicability of CRM to healthcare has now spread far beyond anaesthetics, first to analogous specialities such as critical care, emergency medicine, neonatology, multidisciplinary operating theatre care, and more recently to a number of less acute settings of care (e.g. medical wards). Thus, as for much of the patient safety movement, anaesthesiology has been the pioneer, providing a gift of experience in CRM to the rest of medical practice.[6]

As is so often the case, however, the advances of the unsung heroes in anaesthesia are ignored or forgotten by others who plough the same ground as if they were the first.

Indeed, even at this time, there still remains a fascination with the doings of pilots, including those without any experience in healthcare whatsoever. Many medical domains have acted as though the CRM approach must come straight from the mouth of a pilot, despite the 20 yr of development within healthcare. I would contend that this is no longer necessary. While we owe a great debt to aviation for establishing a key template, and clinicians should always continue to look for useful data and parallels from other industries, there is now sufficient experience and expertise with CRM in healthcare to make this experience our primary wellspring without having to continuously be led by those within aviation (there are 141 papers in Medline about 'Crew Resource Management' or 'Crisis Resource Management', mostly concerning healthcare, not to mention the many books and book chapters on the topic).

For anaesthesia, and healthcare in general, many different articulations of 'CRM' or 'teamwork training' have been promulgated. Some of these curricula have been academic developments—our own *Anesthesia Crisis Resource Management* course was the earliest (the first ACRM course was held in September 1990). ACRM has been widely followed, adapted, and altered by groups of instructors around the world. Formal instructor training courses for ACRM have been operating continuously since 1995. Indeed, the term *Crisis Resource Management* has now essentially become 'generic' at simulation conventions much like terms, such as 'aspirin' or 'zipper', that were once registered trademarks. Similar courses are offered at many sites in the UK.

Several standardized teamwork training curricula have been promulgated in the USA, especially over the last 10 yr. These include (but are not limited to) MedTeams® (adapted from US Army rotorcraft safety experience);[7 8] TeamStepps® (developed by the Department of Defense's Patient Safety Program in collaboration with the Agency for Healthcare Research and Quality);[9] and the US Department of Veterans Affairs Medical Team Training program.[10] All of these teamwork training systems started out as 'seminar-based' methods, combining didactic training on teamwork principles with exercises such as role-playing or the discussion of 'trigger videos' of team performance. More recently, simulation has been added to many of these curricula, either with full combined teams or with single-discipline groups for which confederates play the role of the other disciplines in simulations.

There are similarities and differences between these approaches and between specific curricula. In general, 'teamwork training' paradigms have focused on principles of 'teamwork' and tend to highlight specific techniques of improving team communication (e.g. the 'SBAR' technique of structuring communications by 'situation, background, assessment, and recommendation' or the 'I PASS the BATON' mnemonic for handing off care to another provider). ACRM-like approaches also address generic teamwork skills (especially team management) while also focusing on other elements of domain-relevant dynamic decision-making by individual leaders and practitioners. Most of these approaches have been less prescriptive of specific techniques than is, say, the TeamStepps® curriculum.

Nonetheless, although each curriculum has distinct advantages and disadvantages, there is much overlap between them. In general, there is no evidence, or even reason to believe, that any one is categorically better than the others. They can largely be viewed as different paths to the same destination, and some are likely to be truly complementary to others. Some curricula are available for adaptation and adoption by the medical public, either through the free availability of materials (such as TeamStepps®), by substantial academic publication (like ACRM and its spinoffs), and the offering of detailed instructor training courses (e.g. ACRM, TeamStepps®). Some curricula are totally proprietary, offered commercially, sometimes by groups that have expanded their offerings from providing CRM training solely in aviation to also include healthcare clients. Healthcare sites should choose whichever route to providing CRM or teamwork training to clinicians that best meet their needs, resource availability, and preferences. One can outsource such training or develop in-house expertise. Again, there is no firm reason to believe that any one approach is systematically better than the other.

In an era of evidence-based medicine, the most frequent question now asked about CRM and teamwork training in healthcare, and especially for that using simulation, is 'where is the evidence?' The last 25 yr has seen the steady accumulation of a variety of studies about the development, application, and validation of these techniques. Yet, at most, we can say that these studies have chipped away around the edges of the 'real' question, which is: 'Do these techniques improve patient care and patient outcome?' I would submit that we do not yet know the answer to this question and further that it may not be possible to obtain an unequivocal answer to them. If we are to follow the examples set by aviation and other high-hazard industries that have achieved very strong (but not yet perfect) safety goals using simulation-based CRM as a key component, we see that the real question has to be interpreted as follows: 'What is the impact of these techniques when they are applied in a program that is:[11 12]

- a comprehensive and integrated strategy;
- of intensive, continuous, and repetitive simulation-based training;

- carried out for all personnel across an organization (as individuals, teams, and work units);
- over the entirety of their careers;
- linked to programs of performance assessment and competence testing and remediation;
- evaluated over a long time horizon;
- for outcomes of improved individual and team knowledge, skills, and attitudes and ultimately also for outcomes of patient care processes and patient outcome.'

No study done to-date, or even contemplated for the future, has come close to tackling this question.[13] To do studies like this would require dozens of institutions to adopt the training techniques on a wholesale basis with thousands of clinicians and many thousands or even millions of patients, engaging in stringent evaluations over a long period of time (probably a decade or more).[14] Is any funder likely to offer support for such long and complex trials with no prospect of a patentable product generating billions of pounds in profits?[14]

It is interesting to note that aviation itself lacks such data even though their CRM training programmes meet many of the above criteria, and where simulations are mandatory on at least a yearly basis. Aviation does not have 'Level 1A evidence' (multiple, well-controlled, randomized trials) that simulation saves lives or aircraft. Such studies and such evidence may never be acquired in aviation because pilots—being the proverbial 'first ones at the scene of the accident'—are unlikely to be willing participants in a randomized trial in which they do not receive simulation training.

I am not suggesting that we should not acquire evidence of efficacy and effectiveness where we can, and perhaps someday even do the very long and hard trials. The existing system of training and sustaining the healthcare workforce has worked well, but not well enough. The *status quo* for education and training has never been tested for efficacy or effectiveness, and the rate of medical errors and near misses is testament to the fact that we can do better. Every other industry that deals with intrinsically hazardous work has adopted the simulation strategy articulated above, and without level 1A evidence.

Multiple challenges remain for optimally implementing CRM or teamwork training. Pedagogically, we do not yet know what mix of the many different modalities of teaching (verbal simulation, role-playing, standardized patient actors, manikin-based simulation, online virtual worlds, virtual reality) that should be applied, to what target populations and with what frequency. Professor Matthew Weinger recently articulated a pharmaceutical model for simulation applications, pointing out that we do not yet know the right mix of educational modalities (analogous to the correct 'drug' and 'route'), or the right 'dose' and 'dosing schedule' for these educational interventions.[15] The same is true of CRM and teamwork training with or without simulation. Clearly, 'one shot' is not enough. Continuous, intensive, realistic training over an entire career is necessary to achieve a sustained cumulative effect—this has surely not been achieved anywhere, and even the initials steps have not yet made it to the bulk of practicing anaesthetists.

Improving patient safety requires a multifaceted approach. Training alone cannot do the job; it must be accompanied by improvements to clinical systems and processes, better design of equipment and user interfaces, and the creation and maintenance of a true culture of safety in the workplace that reinforces the lessons taught in CRM training. If these other things are not achieved, no amount of training can overcome the barriers to optimal safety. CRM or teamwork training, especially with simulation, can be a 'lever for culture change' because it is intrinsically clinically engaging, providing an entry point for the discussion of systems and culture issues that do not mean much to most clinicians when presented only as abstractions.

Aviation safety was not achieved overnight, and even as safe as flying is in the USA and Western Europe, it is still not perfect. Achieving the current level of safety has been a long hard process over many decades with investments of billions of pounds, Euros, and dollars for safety management that could otherwise have been used to increase 'production' or improve shareholder returns. CRM training has been a crucial part of this investment, but only one of many. These expenditures are mandated because the public demanded, through their political representatives, a nearly perfect record of flying safety. Any lapses in this system are immediately known and widely publicized (and lambasted). Public demand for safety in healthcare has been growing steadily but has not yet translated into an equivalent demand for patient safety or an equivalent level of investment. It is a truism that patients are not airplanes, and we will probably never be able to achieve the same level of outcomes in anaesthesia and surgery as for aviation. Nonetheless, our pendulum is currently quite far from that ideal; we do not have to make ourselves exactly the same as industries like aviation to make considerable progress.[16] We can certainly do better than we are today. Anaesthesia and other fields are largely 'voting with their feet' adopting safety practices, like CRM and teamwork training, that are perceived to be very valuable components of safety in other industries. We have come far, but we have much farther yet to go.

Conflict of interest

D.M.G. receives royalties on the sale of the book *Crisis Management in Anesthesiology*. He receives an annual honorarium from the Society for Simulation in Healthcare in his position as Editor-in-Chief of the journal *Simulation in Healthcare*. The organizations that he directs receive tuition fees for conducting instructor training and clinician training on crisis resource management.

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EDITORIAL III

Risk management, NASA, and the National Health Service: lessons we should learn

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This year sees the 40th anniversary of the Apollo 13 mission; during which the United States' National Aeronautics and Space Administration (NASA) successfully rescued three astronauts whose vehicle had become disabled after it suffered a mid-flight explosion in an oxygen tank during the outbound leg of its lunar mission.

Travelling away from the Earth at 25 000 miles h^{-1}, in a capsule with failing environmental control and life support systems, loss of their source of power, and damage to their propulsion system, it appeared at the outset that this scenario would be irretrievable. However, NASA's crisis management system, which engaged the crew, their ground-based mission control, and myriad back room support teams, was able to solve a sequence of complex problems in parallel and in real time and return the crew safely to Earth.[1 2]

The story of the Apollo 13 accident has come to epitomize NASA's superlative abilities in crisis managment. In the post-Apollo period, some of these skills were translated for application in the aviation industry. In 1979, NASA convened a workshop at Moffet Field in California with the goal of improving aviation safety.[3] This meeting, which brought NASA together with aircraft accident investigators and representatives from the airline industry, gave rise to the system of Crew Resource Management (CRM). In the decades since, CRM has proved itself a powerful framework for the management of risk in the aviation industry. In seeking safer ways to manage risk in healthcare systems, the medical profession has attempted to emulate this success.[4 5]

CRM comprises three principle components that address the avoidance, trapping, and mitigation of risk.[5] The bedrock of this system of management lies in the avoidance