

Human Behavior in Medical Emergencies: Learning from Past Mistakes

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TEAMWORK MATTERS

Teamwork is increasingly cited by health care organizations in terms of improving patient care and safety. This interest follows decades of investigations into the nature of effective teamwork in aviation, business, military and sport settings^{1,2}. More recently, the importance of effective team working for the maintenance of workplace safety has become a special focus for research in health care^{3,4}.

This chapter highlights key areas from a vast literature; a literature which fails to reach clear conclusions about the extent to which teamwork training is effective, if at all. It presents an overview of teamwork research under three main headings: concepts of teamwork; teamwork training; and, finally, the impact of teamwork training interventions with a particular focus on obstetrics and gynecology. It examines shortcomings in the use of practical models of teamwork training such as crisis resource management to predict patient outcomes in a cause–effect linear way, arguing that this may be reductive. Building effective teamwork requires a broader context of system changes and investment in continuing professional education which should be seen along a learning continuum and within a culture of reiterative training and feedback.

CONCEPTS OF TEAMWORK

Teamwork is commonly defined as ‘a distinguishable set of two people who interact, dynamically, inter-dependently, and adaptively toward a common and valued goal’⁵. Other authors suggest that ‘complementary skills’ and ‘mutual accountability’ should also be added⁶. Various conceptual models have evolved to analyse the characteristics of teams which can influence their performance. The basic model from psychological research of what constitutes a high performing team shows that team outputs (e.g. team effectiveness as identified by successful outcomes) is a result of group processes (e.g. leadership, communication, coordination, shared goals, mutual monitoring of performance). These group processes are in turn influenced by a variety of ‘inputs’ (e.g. work climate, individual task proficiency, attitudes, organizational culture)^{5,7,8}. To successfully achieve team goals, Flin *et*

*al.*⁸ argue that the ‘processes’ that teams use to interact with each other are an essential complement to individual team members’ abilities and the availability of wider resources. In other words, processes are a mix of systems and methods which combine with a special focus on what the team does to develop the skills and motivation to perform together more effectively. A further level of sophistication has been introduced by research into the causes of error in high-risk organizations^{9,10}. According to these latter findings, the basic model of input, throughput and output should not be interpreted as a linear chain but rather in terms of ‘causal networks’. Reason⁹, for example, describes an accident sequence as a complex interplay of organizational culture, workplace climate, the specific task and the event itself. In other words, rather than isolate the specific components in an error, complexity theorists suggest that the essential way to understand how errors have occurred is embedded not in the single components (e.g. technology failure, individual mistake, team communication) but in their interconnectedness^{9,11}.

Many of these theoretical insights and much of the impetus for team training and safety in high-risk organizations have arisen from pioneering research in aviation. For instance, aviation accidents have been analysed in terms of ‘interconnected’ breakdowns in teamwork at various levels^{8,9,12,13}. Importantly, also emerging from this research is that safety culture and team processes can be enhanced through specific training interventions^{5,14}.

TEAMWORK TRAINING: LESSONS FROM AVIATION

The extent to which safety in health care has been influenced by aviation is illustrated by considering how the aviation industry learned to analyse fatal incidents. Half a century ago, root cause analysis of accidents became an established practice in aircraft investigations. The three successive fatal crashes of the first commercial jet liner, a BOAC de Havilland Comet in 1954^{9,15}, caught the public eye in a similar manner to the Concorde flight 4590 in Paris in 2000¹⁶, the difference being that in 1954 the task of finding out what happened was more difficult. In

1954, the aviation industry did not have black boxes, cockpit voice recorders or flight data recorders. The British Comet investigation thus represented a landmark inquiry into accident investigation⁹. Interestingly, both accidents were either partly or wholly attributable to structural weaknesses in the fuselage of these particular aircraft. In both instances, the remaining aircraft of this specific design were withdrawn from service. In the decades following the Comet tragedies, however, improved aircraft manufacturing, and data collection combined with huge media coverage of air accidents shifted the emphasis to human factors^{9,17}. One emblematic case commonly cited by human factor researchers is the Tenerife collision in March 1977 between two jumbo jets. This high profile case brought human factor analysis to a world audience. Along with other high profile disasters, it has also subsequently influenced health care. A total of 583 individuals either died or were mortally wounded in what is still today the worst accident in aviation history. However, using human factor analysis principles, these deaths were entirely avoidable. Briefly, the KLM and Pan AM jets were diverted to the small airport at Tenerife from their scheduled stop in Las Palmas for refueling. This was because of a terrorist bomb scare at Las Palmas. However, the fatal combination of a crowded and unfamiliar landing field, inexperienced control tower operators, crackling audio technology, language problems, fog and poor visibility, flight deck violations, submissive crew members and a dominating senior commander proved to be lethal. Vivid reconstructions based on the official investigation which highlighted the teamwork and human factor contributions to the catastrophe populate the world wide web^{18,19}.

Flin *et al.*⁸ describe many more incidents with strikingly similar dynamics, including the Three Mile Island nuclear accident, and the USS Vincennes and Eastern Airlines flight 401 crash, to name but a few. What emerged from a spate of enquiries into these accidents was a surprisingly short list of critical teamwork problems. These included *poor role clarity; lack of explicit coordination; poor communication between team members; submission to hierarchy; poor situation awareness; poor decision making; failure to assert authority; and workload management*. These were all 'non technical skills'^{8,13,20}.

In 1979 a reaction to these events led to the development of crew resource management training. Also known as 'human factor training', crew resource management was initially designed to reduce operational errors and improve emergency responses in aircrews. The rationale was that errors are inevitable²¹, but that to perform effectively and reduce the risk of making catastrophic mistakes individuals in teams must be proficient in non-technical skills (NTS). The emphasis in aviation, where this training originated, was to shift attitudes among trainees from one of individual autonomy to team centered interdependence. In this new perspective, safety became the binding principle of crew management. Of overriding importance, this

attention to safety has permeated organizational culture in the aviation industry and is no longer confined to crews; rather it is a system philosophy²². Crew resource management has now been adapted to other high reliability team settings into other fields such as nuclear power generation, maritime and rail industries, fire services^{20,23}, the offshore oil industry²⁴, aviation maintenance²⁵ and health care²⁶⁻²⁸.

In an influential report released in 1999 by the Institute of Medicine *To Err is Human: Building a Better Health Care System*²⁹ aviation-based crew resource management became crisis resource management and was identified as a key strategy for reducing error in the complex treatment teams that are such a feature in modern health care. Following this report, health care authorities around the world have recommended the implementation of team training to improve teamwork^{29,30}. In particular, the need for interprofessional and multidisciplinary team training approaches across the full spectrum of health care education has been included in competency descriptions by European, North American and Australasian medical associations. Communication, partnership and teamwork are identified as core domain competencies by the European General Medical Council (GMC)³¹, the Accreditation Council for Graduate Medical Education (ACGME), the Australian Medical Council (AMA), the Medical Council of Canada (MCC) and many others³²⁻³⁵. How this evolution of team training in health care has affected obstetric teams is the focus of the next section.

TEAMWORK TRAINING INTERVENTIONS IN OBSTETRICS AND GYNECOLOGY

Effective teams have supported the management of obstetric emergencies for many years; at the same time, when they fail, the results have appeared in many national reports³⁶. The ability of functioning obstetric teams to perform in high-stake situations is crucial and forms the basis for widely regarded literature. To be effective, teams require a high degree of technical and non-technical skills, plus the ability to be able to come together in an instant to co-ordinate their diverse members into a rapid response. Teams in obstetrics are multiprofessional and can be extremely fluid. While the static component to any obstetric unit is the midwifery (in the US and many other countries it is nursing) staff, many other members including the trainee obstetricians and anesthetists are mostly temporary. This circumstance makes the ability to implement effective training programs or even to research the effect of interventions on teams challenging, as team members never work together enough to rehearse any new skills learned during training.

Describing those elements which constitute an ideal team has been the basis of research for many years. It starts with identifying what can be replicated from high-risk industries where teams are under scrutiny and trying to apply this information to our own specialty. Several groups have worked with obstetric care givers to define and validate what they feel contributes

to successful clinical outcomes within their own practice^{37,59}. This has formed a platform from which to measure effectiveness, by setting a standard of teamwork that may have previously been undefined. Of course, good teamwork may mean something different to one profession as compared with another. In their uniprofessional domains, each group experiences a different set of professional boundaries, hierarchies and expectations of themselves and others within an emergency setting. It is the bringing together of these teams that attempts to develop understanding and a common language between them to create superior performance. This is the essence of what Salas describes as 'dynamic interdependence'⁵.

Many different approaches can be used to train obstetric teams; these vary from classroom based lectures focusing entirely on obstetric emergencies and/or crisis resource management³⁸ to simulated emergency scenarios combined either with³⁹ or without⁴⁰ specific teamwork theory to provide a platform from which to discuss team interactions. Each method seeks to develop and incorporate many of the aviation industry principles of crisis resource management which provides the basis for 'portable skills' that can be directly translated into clinical scenarios⁴¹. Where the training actually takes place can have significant implications for the transfer of these lessons to clinical care. In fact, the location of training is a powerful predictor of transfer⁴¹ and is effective without the time or costs involved in using simulation labs. Local training can improve accessibility, clinical relevance and address system issues unique to a specific obstetric unit³⁹.

Evaluating the effectiveness of obstetric team-training programs has been challenging due to the heterogeneity of interventions, course design and assessment tools⁴². Many interventions, however, can be described in one dimension or another on the Kirkpatrick scale⁴³. Kirkpatrick created a framework on which to judge the effectiveness of any educational intervention, extending beyond satisfaction scores used commonly to evaluate training to looking at organizational change and improved patient outcomes that come about.

Level 1: learner reaction

Evaluation limited to participant satisfaction tells us a certain amount about the impact on teams, since team training is not only enjoyed by team participants, but also has the potential to improve knowledge of teamwork and shared decision-making⁴¹. Even if the impact of clinical outcome is harder to evaluate, participants commonly report improvement in communication and team functioning as a result of training⁴⁴.

Level 2a: modification of learner attitudes and perceptions

Attitudes of teams to entering into obstetric emergencies is positively affected by simulation training⁴⁵, as is the perception of the importance of communication

and the concepts of patient safety particularly in relation to postpartum hemorrhage⁴⁶.

Level 2b: learner acquisition of knowledge and skills

Skills and knowledge improve within simulated obstetric emergencies particularly when using high-fidelity models⁴⁷. In addition, using simulation creates the advantageous situation of retained improved knowledge scores for longer times⁴⁵. The benefit of additional specific team training has been questioned by some and is variable⁴⁷. This may in part be due to the way in which these studies sought to evaluate team improvements within simulated emergencies. Others have had more success when team training or crisis resource management principles have been the focus of the training and have not involved simulation³⁸. However, Gaba *et al.* support the use of simulation to create a setting for applying the principles⁴⁸. Therefore, there is compelling evidence that even simulation-based training in obstetrics is an appropriate approach to reduce errors and risk in obstetrics.

Level 3: change in learner behavior

In 2007, Birch *et al.*⁴⁹ demonstrated that teams trained with simulation sustained their improvement in clinical management, interdisciplinary communication and self-confidence when tested 3 months later compared with their colleagues trained with just lectures or a combined approach. Teams taught with simulation also improved their interdisciplinary communication skills compared with those taught exclusively by lecture.

Level 4: benefits to the organization/patient resulting from learner performance

Of course, the greatest challenge comes to the ability of any form of training, classroom, simulation or otherwise, to transfer its perceived benefits into the clinical environment and ultimately onto patient care. It ultimately comes down to clinical outcomes, and the only real study that has been able to demonstrate a significant impact has done so in perinatal outcomes⁵⁰. Impacts on maternal outcomes have yet to be realized, and this may be, in part, due to the manner in which organizations have approached obstetric team training programs. A recent study suggests that team training without drills with patient simulators have not been shown to lead to improvement in outcome⁵¹. It is worth questioning, however, whether attempts to apply randomized controlled trial methodologies to multifactorial and complex interactions between team members represents the magic bullet⁵² – in other words, whether they can reliably take account of confounding factors or isolate 'interventional' benefits in a convincing way.

Which teams benefit more?

The experience of team members will undoubtedly affect the ability of studies to show improvement in skills or knowledge but also may have positive effects on their behaviors. Most studies on the impact of simulation team training have evaluated midwifery/obstetric teams excluding anesthetists in the structure of the whole team. Anesthetists have historically been familiar with concepts of crisis resource management and simulation based training⁵³ and thus may be invaluable in disseminating the language of concepts such as situational awareness and 'shared mental models' that are often so unfamiliar in maternity units; basically these terms refer to 'collective wariness' where each member of the team is vigilant and contributing actively to the team's understanding of the clinical situation. Studies which eschew any members of the team run the risk of undermining a key trait of crisis resource management in maintaining safety.

Is it cost-effective?

The cost-effectiveness of such rigorous attention to team work will always be a question for every organization which seeks to invest in it. Litigation within obstetrics sites and poor communication between professions remains a top root cause of error. With bills for organizations in millions of pounds, the relatively small cost of programs targeting team behaviors cannot be ignored as an eminently achievable investment⁵⁴.

The location of training has also been evaluated, given the huge potential for unnecessary expense incurred by using simulation centers. No additional benefits to knowledge acquisition are found by training in simulation centers over locally conducted training⁴⁰. Salas finds the same beneficial effect on teams when trained within their clinical environment³⁹. This has hugely encouraging implications on the accessibility of simulation-based training in developing countries and has underpinned the success of programs such as PRactical Obstetric MultiProfessional Training (PROMPT)⁵⁰.

Although there is evidence suggesting the efficacy, reliability and validity of simulator-based training, its superiority over conventional training with regard to cost-effectiveness has yet to be proven. Because there is a limited amount of high-quality evidence on the effect of simulation-based training, it is important for researchers to reflect carefully on the specific characteristics of the educational environment that may require different approaches to study design and analysis. Studies need to be performed using standardized simulation scenarios to evaluate the fundamental aspects of human performance in health care. In this regard, it is important to keep in mind that it is not randomization *per se* that is critical to the quality of educational experiments, nor is it that the methods of clinical experimental research can and should be adopted wholesale into the educational setting⁵².

CONCLUSIONS

Teamwork research is designed to improve workplace training interventions. Few would disagree with the idea that improving teamwork through better communication, clarifying goals, sharing expectations about the task and mutual monitoring of performance are all good things. Equally, it is difficult to deny that programs that encourage these behaviors should have at least some positive benefit on team performance in health care. Despite this, few of the psychological concepts explaining successful teamwork in various high-risk industries such as team situation awareness, shared mental models and adaptive coordination have been investigated systematically in health care. This is borne out in team-based research in obstetrics and gynecology. These conceptual descriptions of good teamwork undoubtedly provide helpful insights and useful analytical traction. However, the findings from these studies are uneven and lack synthesis; for example, they do not make explicit exactly what aspects of teamwork need to be improved. While, on the one hand, it is claimed that many adverse events could have been prevented by improved teamwork, few empirical studies have systematically investigated the role of teamwork in preventing minor problems from escalating into more serious incidents^{8,55}. The extent to which this research can influence practice is, as a result, unclear. So why does this training seem less successful than we would like? Is our analytical lens too thick?

Many lessons are available from aviation and research in high risk organizations. Some researchers, however, question whether some of these have been lost in translation into health care²². For instance, 'behavioral markers' underlying crisis resource management training refer to explicit, observable behaviors employed by ideal practitioners. The idea has been embraced that if you teach everyone to adopt these and practice them, results will follow that can be measured. As a result, crisis resource management training has directed a growing body of research to identify linear effects of team training on patient outcomes. Interestingly, this is despite the fact that in aviation itself research evidence for the benefits of crisis resource management has been elusive^{22,56}. On the other hand, what has been learned from complexity theorists is that factors contributing to patient safety and error are multiple and interdependent; they do not lend themselves exclusively to individual or team analyses⁵⁷. Beneath the behaviors in any specific team are a collection of attitudes and beliefs embedded in the social and work environment and the organizational culture of a workplace⁶. These have been described as the context of teamwork, or what Musson refers to as the 'unobservable ingredients enriching our cognitive processes, and behavior'²².

What is the implication of all this work? Perhaps there are two. On the one hand, the immense variety of potentially hazardous situations requires that training for safer behavior is delivered at the level of the

team. On the other, it is that if team training is not undertaken as part of a wider program to address dysfunctional factors at the organizational level, the work environment level and the individual level, it is difficult to see how behavioral marker-based crisis resource management-oriented team training will be able to fulfil its potential in improving the quality of care in our current systems²². Patient safety outcomes as seen through this lens represent an emerging phenomenon arising out of a complex dynamic network which is not amenable to simple causal relations. Nor is it directly attributable to one isolated feature in the system⁵⁸. Most measures of teamwork still focus on individual behaviors. Future evaluation and research of team training will need to be founded on more conceptual clarity as well as wider analytical frames for what constitutes effective teamwork.

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