TEAMWORK AND COMMUNICATION IN HEALTHCARE

A LITERATURE REVIEW

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Safe care... accepting no less

Teamwork and Communication in Healthcare a Literature Review

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Suggested Citation:
Teamwork and Communication Working Group. Improving patient safety with effective teamwork and communication: Literature review needs assessment, evaluation of training tools and expert consultations. Edmonton (AB): Canadian Patient Safety Institute; 2011.

This publication is available as a free download from: **www.patientsafetyinstitute.ca**

The Canadian Patient Safety Institute would like to acknowledge funding support from Health Canada. The views expressed here do not necessarily represent the views of Health Canada.

ISBN: XXX-X-XXXXXX-XX-X (online)

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EXECUTIVE SUMMARY

Teamwork and communication failures are a leading cause of patient safety incidents in healthcare. Though many healthcare providers must work in teams, not only are they are not well trained in teamwork and communication skills, but they also come from different backgrounds, making it difficult to establish a shared mental model in a team setting. Moreover, healthcare workers may not be supported by the organisational culture in which they work.

Considering healthcare in terms of high reliability theory and learning from other high reliability organisations, team training and organisational change were explored as interventions to enhance communication and teamwork in healthcare by grounding these processes in theory. These were also explored with a mind to apply them in the Canadian context.

The first finding is that most of the team training programs implemented are based on Crew Resource Management from aviation. Some are proprietary. These are found to be effective in terms of trainee reactions, with clinical outcomes more often reported in proprietary training programs. Challenges to their implementation include hierarchical culture, costs and logistics. The second is that specific tools to improve team processes are mainly structured communication techniques, with briefings and SBAR found to be effective. The third is that patient safety culture would require changing patient safety climate.

Seeing as teamwork and safety culture are both advocated in healthcare in Canada, the findings in this broad-based review may enable staff in healthcare at all levels to have a better understanding teamwork, communication and safety culture, so that they can make informed decisions about and/or participate in improvement strategies.

1. INTRODUCTION

Attribution of errors in healthcare

In healthcare, a significant percentage of errors can be attributed to communication breakdowns and lack of effective teamwork [1]. Communication failures have been identified by the Joint Commission as the primary root cause in more than 70% of sentinel events from 1995 to 2003 [2]. Communication breakdowns and teamwork failures have been identified as key contributing factors in the occurrence of patient safety incidents [3, 4] [5]. While healthcare workers typically work in teams to coordinate and manage patient care, they are generally not well-trained in the generic or non-technical skills – such as communication, situational awareness, decision making and teamwork – that underpin technical skills [6]. Poor non-technical skills, including teamwork and communication, may lead to patient safety incidents and medical errors [2, 10-12]. A corollary to this is that effective communication and teamwork have been cited as essential for achieving high reliability and creating a "culture of safety" to support the safe delivery of patient care [1]. Team cohesiveness can be challenged by a number of factors including discipline specific educational backgrounds [7], the ad hoc forming of teams with changing membership (eg: OR teams, Code teams) [8] , a "siloed" approach to health care [9] and hierarchies in professional cultures that impact safe patient care [8]. With the incidence rate of patient safety incidents in Canada as high as 7.5% [131], it is important to understand and harness tools that improve communication and teamwork to contribute to a culture of patient safety

The purpose of this review is to explore team training as a tool to enhance communication and teamwork in Canadian healthcare.

Communication

Two approaches define communication: the information engineering approach and the social construction approach. The information engineering approach defines communication as the linear transmission of messages through a conduit [13]. Effective communication is therefore the accurate and unbroken transmission of information that results in understanding [14, 15], such that receivers decode sent messages. Physical noise and psychological noise in the system comprise the main barriers to effective communication. This model treats communication as a defined process that occurs within an already established social context. It does however limit the ability to appreciate powerful social dynamics.

The social construction approach emphasises how team communication can create the dynamic context in which people work. This view maintains that communication, rather than just a neutral conduit, is the primary social process through which a meaningful common world is constructed [16]. From this perspective, efforts to improve information transmission are limited as they do not address how patterns of communication create and sustain a team's definition of itself. Thus, team communication is both about transmission and social construction of reality, encompassing the explicit and implicit frameworks the team develops regarding appropriate goals, roles and behaviour. Within a team, effective communication can create a "centripetal force" [17] to draw team members

together by building shared situational awareness of the context [18] and deepening each member's capacity for acting with each other's perspective in mind [19].

Team

The key features of a team are as follows: 1) consists of two or more individuals, 2) each individual has a specific role or task to perform and interacts and/or coordinates with other members to achieve a common goal or outcome, 3) makes decisions, 4) embodies specialised knowledge and skills, often functioning with a high workload, 5) exhibits interdependencies with regards to workflow, collective action and goals, 6) is a part of a larger organisational system [20-27]. Teams are usually "organized hierarchically and sometimes dispersed geographically; they must integrate, synthesize, and they need to coordinate and cooperate as task demands shift throughout a performance episode to accomplish their mission" [28]. Examples of healthcare teams that fit this description are medical emergency teams, intensive care unit teams, labour and delivery teams and operating teams.

This definition of a team is interdisciplinary in nature. While the term "interdisciplinary" is sometimes used interchangeably with the term "multidisciplinary," there are key differences. An interdisciplinary team integrates the approaches of different disciplines and relies on communication processes that are collaborative rather than a shared communication model [30, 31]. A multidisciplinary team utilises the skills and experience from different disciplines without integrating the approaches [29]. A "gatekeeper" member determines how other disciplines will participate in an independent, discipline-specific team that conducts separate assessment, planning and provision of services with little coordination between the team members [30]. Each discipline works within parameters specific to the discipline to achieve goals unique to its profession, which can be directly or indirectly communicated to the rest of the team [31].A transdisciplinary team approach values and shares the knowledge and skills of team members and crosses traditional disciplinary boundaries in assessment and service planning [30]. There is a necessary devaluing of turf issues to allow for boundary blurring between disciplines, with elements of cross-training and flexibility in accomplishing tasks [31].

The nature of the team processes (multidisciplinary, interdisciplinary and transdisciplinary) are an important consideration in the implementation and effectiveness of team training programs. Generally, teams in healthcare are characterised as an "interprofessional collaborative" [32], with the first term alluding to an integration of two or more professional cultures operating transdisciplinarily [33] and the second encompassing concepts of sharing, partnership, interdependency, power and process.

Teamwork

Members of a team must engage in both task work and teamwork processes to achieve their common goal. Task work is the component of the individual member's performance independent of interaction with other members [28]. Teamwork is the interdependent component of performance necessary to effectively coordinate the performance of multiple team members [28]. Team performance is a multilevel process that develops as members engage in task work and teamwork [52]. Teamwork can be conceptually nested within team performance as a "set of interrelated cognitions, attitudes, and behaviours contributing to the dynamic processes of performance" [28]. Finally, team effectiveness

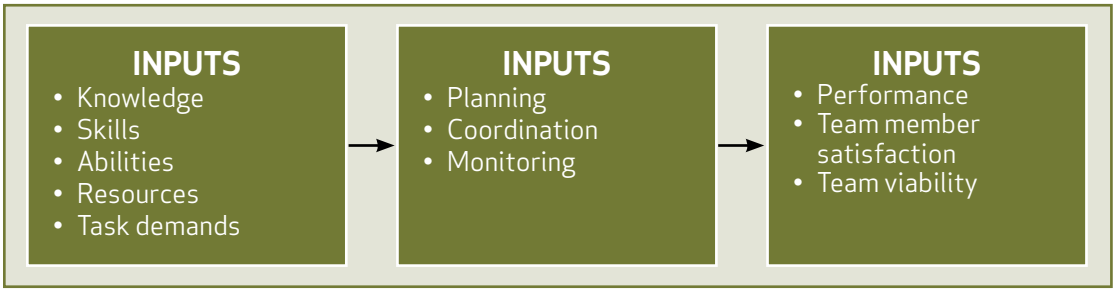
represents an evaluation of team performance outcomes relative to some criteria set [26]. Thus, the definitions of performance and effectiveness on the team level encompass the activities engaged in while completing a task and an appraisal of the outcomes of that activity [53].

Teamwork has been well-studied across different disciplines. Effective teamwork has been described in 138 conceptual frameworks over the past 20 years [34], representing a myriad of models ranging from parsimonious to more contextualised. The frameworks described below have been applied liberally to healthcare.

The I-P-O model

The 3 stage IPO model [35] defines characteristics of effective teams and presents a framework for organising the factors that may facilitate or inhibit team effectiveness (Figure 1). This framework uses inputs (resources), maintains internal processes and generates outputs, as a result of the input and throughput. Input encompasses characteristics of team members including abilities, past experiences and available organisational resources. Processes comprise the interdependent acts and behaviours that convert inputs to outputs, including team performance, task outcomes and team member satisfaction [26].

Figure 1 The I-P-O model [35]



Viewed from a different lens, the organisational structure, individual contributions and team processes (Table 1) [25, 36-38] can be likened to the IPO Model. Organizational structure and individual contributions are akin to inputs while team processes identify the outputs or tenets of an effective team. Analysing the inputs (organizational structure and individual contributions) can help identify issues that require improvement while outputs (team processes) can be used for evaluating team effectiveness [37].

Table 1 Characteristics of an effective team [37]

Organisational structure	Individual contribution	Team processes
Clear purpose	Self knowledge	Coordination
Appropriate culture	Trust	Communication
Specified task	Commitment	Cohesion
Distinct roles	Flexibility	Decision making
Suitable leadership		Conflict management

Relevant members		Social relationships
Adequate resources		Performance feedback

1.3.3.3 The Salas model

The Salas conceptual framework identifies five core components for effective teamwork [39]: team leadership, collective orientation, mutual performance, backup behaviour and adaptability. The interplay among the five components suggest that, 1) leadership directly affects collective orientation, performance monitoring and backup behaviour; 2) collective orientation and back up behaviour influence performance monitoring; 3) performance monitoring and backup behaviour generate adaptability [39]. These relationships are promoted through three coordinating mechanisms, shared mental models, closed loop communication and mutual trust. The core components in conjunction with the three coordinating mechanisms comprise the specific knowledge, skills and abilities (KSAs) team members should possess to promote effective teamwork as identified in Table 2 [6, 7, 24, 40]. The components of this framework could be applied as a foundation for the development and enhancement of effective team processes.

Table 2 Team KSA Competencies, adapted from [7]

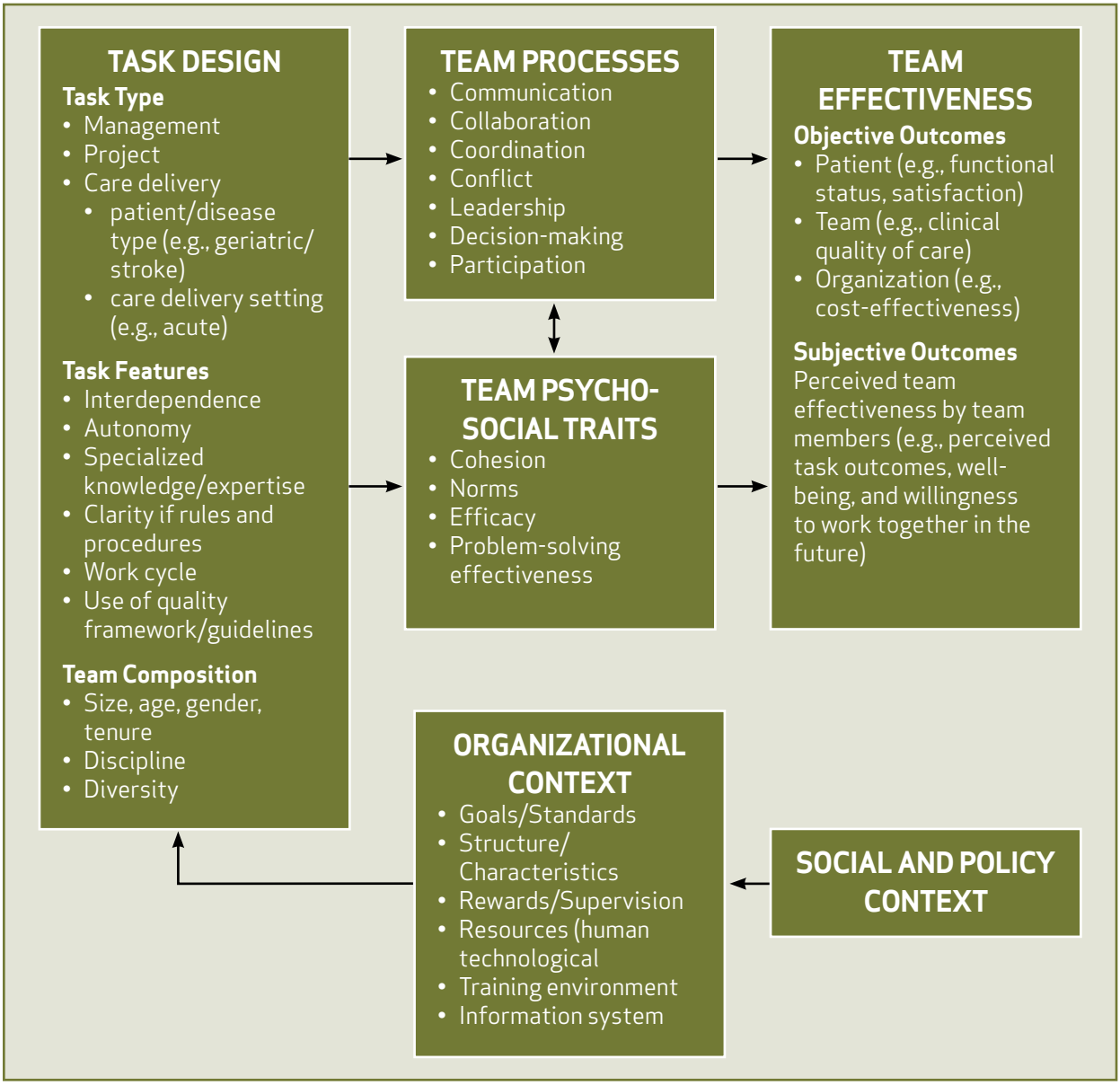
Teamwork	Definition
Team leadership [24, 40, 41]	Ability to direct and coordinate activities of other team members, assess team performance, assign tasks, develop KSAs, motivate team members, plan and organize, and establish positive atmosphere
Mutual performance (or situation) monitoring [42]	Ability to develop common understandings of the team environment and apply appropriate task strategies to accurately monitor teammate performance
Backup behaviour (or mutual support) [42, 43]	Ability to anticipate other team member's needs through accurate knowledge about their responsibilities; ability to shift workload among members to achieve balance during periods of increased workload or pressure
Adaptability [24, 44]	Ability to adjust strategies based on information gathered from environment through using compensatory behaviour and reallocation of intra-team resources; Altering course of action or team repertoire in response to changing conditions
Shared mental models [45, 46]	Knowledge structure of the relationships between task team is engaged in and how team members will interact
Closed loop communication [42]	Sender initiates communication; receiver confirms that the communication has been heard and repeats the content; sender verifies the accuracy of that content
Collective orientation [47-49]	Propensity to take other's behaviour into account during group interaction; belief in importance of team goal's over individual member's goals

Teamwork	Definition
Mutual trust [50, 51]	Shared belief that team members will perform their roles and protect interests of their teammates

The Integrated (Health Care) Team Effectiveness

The heuristic Integrated (Health Care) Team Effectiveness Model (ITEM) (Figure 2), amalgamates the work of health care researchers Fried et al. [54] and Schweikhart and Smith-Daniels [55] with that of organisational studies researchers Cohen and Bailey [56]. Organisational studies literature offers clear and consistent definitions of the team construct; thus, Cohen and Bailey's [56] research was used to underpin the ITEM model.

Figure 2 The ITEM model [57]



Team types were modified to encompass the teams most commonly found in health care: 1) project (e.g., quality improvement teams); 2) management, and; 3) care delivery, with the latter divided into patient population or disease type and care delivery setting.

Team effectiveness involves complex interactions between task design, team processes, team psychosocial traits and team effectiveness. Task design factors are influenced by external environments, can be manipulated by managers to improve team effectiveness and can directly influence team outcomes or can influence outcomes via impact on team processes and traits. Team processes are distinguished from embedded team psychosocial traits. These (team processes and

traits) interact with one another and are influenced by task design to affect team outcomes.

While not a definitive model of health care team effectiveness the ITEM model does allow for a broad understanding of the dimensions of teams and the processes and outcomes that might be relevant in health care settings. Multiple models of team effectiveness may be necessary, depending on team type, task type, work processes, and the types of outcomes health care organizations pursue [58, 59].

The ITEM model also allows for examination of the possible effects of diversity in teams on team effectiveness. For example, racially diverse nursing teams were found to have different perspectives and alternative realities when evaluating team communication effectiveness [60]. Social isolation, selective perception and stereotypes were three themes found to deepen conflict and dissatisfaction with team communication while leadership served as a powerful mitigating factor [60].

Instruments to measure effectiveness of teamwork in healthcare (attitudes and behaviours)

A number of tools have been developed to assess aspects of team culture as well as structural influences of norms, roles and status, which are directed at measuring team member or whole team behaviours. These include, for example, the Operating Room Management Attitudes Questionnaire (ORMAQ) [61, 62], the Interdisciplinary Collaboration questionnaire [63] and the Team Climate Assessment Measurement (TCAM) questionnaire [64]. The Team Self Review (TSR) [65] may be used in conjunction with the TCAM, as it offers a set of techniques that can be used to review and develop team performance. The TeamSTEPPS Teamwork Assessment Questionnaire (T-TAQ) [66] assesses attitudes towards core components of teamwork (e.g. team structure, mutual support).

Tools developed primarily for observation of team member behaviours in the operating room may be applied to other settings. These tools may assess individuals working in a team setting or rate a team as a whole. The Anaesthetists' Non-Technical Skills (ANTS) [67] measures individual anaesthetist's non-technical skills, including teamwork, task management, situation awareness and decision-making during the course of an operative procedure. The Non-Technical Skills for Surgeons (NOTSS) system [68] measures a surgeon's non-technical skills during surgery through assessment of communication and teamwork, situation awareness, task management and decision-making. The Observational Teamwork Assessment for Surgery [69] uses a checklist and five behavioural constructs – communication, leadership, coordination, monitoring and cooperation – to rate teamwork.

The NOn-TECHnical Skills (NOTECHS) tool was designed to assess airline pilots' non-technical skills [70]. Adaptations to this tool include the Oxford NOTECHS [71] or Revised NOTECHS [72] applied as a measure of non-technical skills of a surgical team or sub team using categories similar to those described above. Flin and Mitchell [73] provide many more examples of instruments to analyse behaviour of the surgical team in the operating room which may used to evaluate the impact of an interventions to improve non-technical skills.

Heinemann and Zeiss [74] provide an overview of health care specific instruments that measure aspects including team climate, collaboration, meeting effectiveness, attitude towards teams, team

integration and development of teams.

The nature of high reliability organisations and healthcare

High reliability organisations (HROs) are environments that are relatively error-free because they have established systems to help consistently avoid potentially catastrophic errors while achieving their goals [75]. The hallmark of HROs is a preoccupation with failure that ensures errors are averted. Healthcare systems are similar to HROs as they can be confronted with a variety of unexpected events under critical conditions [76]. These events typically affect the individual rather than the sweeping, multi-person catastrophes seen in other industries [77].

High reliability theory treats safety and reliability equally and assumes that if each component in the system operates reliably, accidents would not occur [78]. High reliability practice encompasses organisational behaviours that reflect a not only a preoccupation with failure, but also a reluctance to accept simplifications, sensitivity to operations, resilience to error and deference to experience [19]. These five behaviours help to create the state of mindfulness that is required to for reliability to occur [79]. Reliability, in turn, must be established in order for safety to exist [79].

However, reliability is not synonymous with safety, even though the two are treated as equivalents in HRO theory. Reliability is the probability that "a component satisfies its specified behavioural requirements over time and under given conditions" [78]. Safety is freedom from unacceptable losses or accidents [78]. Thus it is essential to understand and overcome the barriers to establishing reliability in healthcare in order to achieve safety.

Exemplars of healthcare systems that follow HRO principles

A number of healthcare organizations embrace the tenets or HRO principles. These organizations display a strong commitment to patient safety through their willingness to change as a part of their organisational culture and through fearless efforts to drive change for improving quality of care. The Mayo Clinic exemplifies this commitment with its four-part approach that focuses on the fundamentals of 1) optimising the culture for safety, outcomes and services; 2) enhancing a supportive infrastructure; 3) making effective use of systems and human factors engineering; and, 4) delivering disciplined effective execution with the help and leadership of the quality committees [80]. Patient Safety Leaders at Partners HealthCare and the Dana Farber Cancer Institute have also developed strong statements, endorsed by their Boards of Trustees [82] to articulate their commitments to patient safety [81].

The Back Bay Children's Hospital applied the five HRO principles to achieve improved patient outcomes in the paediatric intensive care unit (PICU), in which care was derived from problem solving methodology rather than protocol [83]. As the PICU engaged in HRO training, healthcare workers monitored one another's performance, giving assistance through mutual teaching and learning. During the years the PICU operated as an HRO, period admissions and ventilator use went up and mortality and consequential events went down. Following a leadership change, the unit's functioning returned to the hierarchical medical model and outcome variables such as infant mortality, patient return to the PICU after discharge and days on the PICU degraded, reflecting the importance of leadership in sustaining changes in organisational culture.

Evolution of causation of errors – from individual to system failure

Non healthcare HROs include commercial aviation, the military and nuclear power plants. These industries emerged as HROs after continually identifying possible danger indicators and countering them so that system functioning could be maintained and disaster avoided.

In mining, oil and nuclear industries, efforts to detect the causes of system failures underwent several stages of development, building on one another over time [84, 85]. During the "technical period," which began in the 1900s, accidents were attributed to mechanical malfunctions, such as equipment design, construction and reliability [86]. The 1920s saw human errors as the source of system breakdown, thus assigning blame and responsibility to the person in the unsafe act [87, 88]. By the late 1940s, the "sociotechnical period," the conception of human errors began to be seen as an interaction of human and technical factors. The fourth stage of development has come to recognise "organisational culture" [84, 89] as a cause of system failure. Commencing in the 1980s, researchers acknowledged that operators engage with technology not in isolation, but as a coordinated team of an organisation that is entrenched within a particular culture.

These causes of system failures were countered primarily through team training and organisational culture modification [90] that draw on a human factors approach. This approach posits that inherent constraints of human fallibility guarantee mistakes, even for those who are skilled and experienced. Human factors encompasses all the environmental, organisation and job factors as well as individual characteristics that influence behaviour at work and, thereby, organisational outcomes. Both team training and organisational culture modification operate by improving non-technical skills, such as communication, situational awareness, decision making and teamwork—the first by training and practice and the second by fostering a culture supportive of such skills. Non-technical skills are viewed as distinct and separate competencies from technical skills, or the specialised knowledge essential to performing a task [91].

Although team training programs have been commended as an "essential component of the airline industry's efforts to achieve high reliability," [7] the impact of such training on reducing airplane accidents has not yet been established [92]. Since catastrophes resulting from human error tend to be rare in commercial aviation and non-active military forces, it is difficult to link team performance to error reduction. Nonetheless, the literature provides an argument for the interrelationship between effective team performance and proxy indicators (i.e. adaptability, resourcefulness and mutual trust) [93, 94].

Organisational culture

Organisational culture defined from an organizational psychology perspective involves a "pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems" [95]. This definition focuses on the functional significance of culture and the means through which productivity can be improved [96-98]. Organisational culture conveys a sense of identity for members and enhances social system stability which influences behaviour to help to build organisational

commitment, establish a management philosophy and motivate personnel [98]. This perspective assumes that organisational culture can be broken down into smaller components (safety culture, service culture, creativity culture and motivation culture) to be empirically manipulated [98].

Safety culture

The concept of safety culture is most relevant to this review. Numerous definitions of safety culture originated from the nuclear power, mining and manufacturing industries [99]. A global definition of safety culture, considering the commonalities among these definitions regardless of industry, is "the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behaviour based on lessons learned from mistakes, and be rewarded in a manner consistent with these values" [100]. This neutral definition allows for organisational culture to exist on a continuum with either a good safety culture or one which can be improved upon [101]. The myriad models of safety cultures may be found in Cooper's thorough review [102].

A positive safety culture is characterised by "communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures" [103]. Reason suggests that four aspects promote a positive safety culture; 1) an informed culture, in which those who manage and operate the system have current knowledge about the factors that determine the safety of the system, 2) a reporting culture, in which people are prepared to report their errors, 3) a just culture, in which people are encouraged and/or rewarded for providing safety-related information, and 4) a learning culture, in which people are willing and knowledgeable about drawing the correct conclusions from the safety-information to implement reforms [104].

An effective safety culture eventually leads to the goal of zero accidents, with the attainment process varying from one organisation to another [105]. There are at least five global themes related to safety culture that are measurable: organizational commitment, management involvement, employee empowerment, reward systems, and reporting systems [106]. These are assessed qualitatively via employee observations, focus groups and case studies, as well as quantitatively, via standardised structured interviews, surveys and questionnaires [107].

Team training and organisational culture change

The most widely applied strategy to improve team performance is through team training; the application of validated instructional strategies such as simulators, lectures and videos [108, 109]. According to Baker et al.[7], effective team training follows the general principles of learning theory, teaches requisite team behaviours, and provides the opportunity for participants to practice learned skills and receive remedial feedback. What team training specifically offers is the development of individual team member competencies [1, 24, 110], during simulation or role-playing, in a "consequence-free" environment that supports learning [111].

The most effective strategies and techniques for training specific knowledge, skills and attitudes

(KSAs) are the subject of ongoing research. Guidelines for assertiveness training [112], cross-training [113], stress management training [114] and team self-correction [115] as effective strategies for training specific team KSAs have been developed. Cross-training, team coordination and adaption training, and guided team self-correction address different aspects of teamwork. In cross-training [116] team members rotate positions during training to develop an understanding of the knowledge and skills necessary to successfully perform the tasks of other members and to garner an understanding of the importance of each individual's role. Team coordination and adaptation training together aim to help team members learn about specific teamwork skills and how to optimally use periods of low task demands by anticipating and discussing potential problems. With guided team self-correction training [115] team members learn to diagnose the team's problems and to develop effective solutions. This intervention fosters common expectations such as shared mental models among team members contributing to more effective team performance.

Examining and re-engineering environmental conditions such as modifying tasks, workflow, or structure [117] can enhance teamwork and create a culture of safety. A culture of safety can be created through improvement to the indicators of safety culture including organizational commitment, management involvement, employee empowerment, reward systems, and reporting systems [106].

Effectiveness measures of teamwork training programs

Effective team training comprises organised learning strategies for non-technical skills that help a team to reach its optimal performance. Effectiveness of these strategies can be considered a measure of team performance outcome relative to some set of criteria. Since the goal of team training is to advance high-quality team performance through instructional strategies, effective team training can be measured, at the very least, by the KSAs deemed critical to high-quality performance [44]. These competencies enable task work to achieve the shared goals of the team leading to better decision making and medical intervention, which may directly or indirectly impact organisational practice and, most importantly, patient outcomes [118].

Under the assumption that team performance is affected by the non-technical skills taught and practiced, some indicators or measurements of team performance (outcomes) or teamwork (process) may be found in Kirkpatrick's evaluation framework (team reaction, learning, behaviour and results of the team performance) [119]. Kirkpatrick's framework has been adapted by Hammick et al. [120] for measuring interprofessional education outcomes (see Table 3).

Table 3 Classification of Interprofessional Education Outcomes, reproduced [120]

Level 1: Reaction	Learners' views on the learning experience and its interprofessional nature
Level 2a: Modification of perceptions & attitudes	Changes in reciprocal attitudes or perceptions between participant groups. Changes in perception or attitude towards the value and/or use of team approaches to caring for a specific client group
Level 2b: Acquisition of knowledge & skills	Including knowledge and skills linked to interprofessional collaboration
Level 3: Behavioural change	Identifies individuals' transfer of interprofessional learning to their practice setting and their changed professional practice
Level 4a: Change in organisational practice	Wider changes in the organisation and delivery of care

Mickan's Outcome measures of effective teamwork [121] (Figure 3) has some similarities to the modified Hammrick classification.

Figure 3 Outcome measures of effective teamwork [121]

Outcome measures of effective teamwork			
		Individual benefits	
Organizational benefits	**Team benefits**	**Patients**	**Team members**
Reduced hospitalisation time and costs Reduced unanticipated admissions Better accessibility for patients	Improved coordination of care Efficient use of health care services Enhanced communication Professional diversity	Enhanced satisfaction Acceptance of treatment Improved health outcomes	Enhanced job satisfaction Greater role clarity Enhanced well-being

Objective outcomes of the ITEM model of team effectiveness include measurable improvements in patient outcomes (e.g., functional status, satisfaction), organisational outcomes (e.g., efficiency, costs), staff behaviour (e.g., absenteeism, prescribing patterns) and patient behaviour (e.g., adherence to medical advice). Subjective outcomes are attitudinal aspects of team effectiveness (e.g., team members' perceptions of their teams' effectiveness).

There are a variety of measures due to certain caveats of hard outcome measures. It is quite possible that teams may behave in different ways but end up with the same outcome, a result called "equifinality" or "equal finality" [122]. On the other hand, it has been highlighted that similar situations can generate different outcomes [123]. Thus, it may be sometimes inappropriate to designate hard outcome measures of performance [124]. Behavioural observations related to outcome may be more applicable in certain situations where procedures are clearly defined and can be measured relatively easily. For instance, it would be inappropriate to measure survival rates in relation to

team or leader performance alone as survival is dependent on many factors including a patient's physiologic condition [125].

The caveats suggest that non-technical skills should be judged in relation to the context and use of teamwork assessment tools [126]. However, observational techniques have their disadvantages as well. Observational techniques are limited by the accuracy of information recording. Thus video recording of trauma and cardiac resuscitations are mainly utilised [127, 128]. These methods are deemed useful in identifying the coordination and cooperation of a team. The main disadvantage of direct observation techniques is the Hawthorne effect—a change in behaviour due to direct observation [129]. A corollary to this is that people may be accustomed to having their daily work observed. For example, emergency teams may be less likely to be distracted by an observer and more to be highly focused on the task at hand [130].

2. TEAM TRAINING IN HEALTHCARE

Brief history of team training programs in healthcare

Most team training programs in healthcare are rooted in human factors principles which have been used extensively to enhance the design of equipment, work environments and human performance in aviation and the military. Since realising the number of accidents attributable to pilot error was, in fact, due to inadequate communication, coordination and decision making skills, the aviation industry developed Crew Resource Management (CRM), the premier team training program in non-technical skills. The structure of the program generally follows three phases: 1) awareness, 2) skills practice and feedback and 3) recurrent training. Through raising awareness of cognitive and social skills for effective teamwork, CRM trains flight crews to acknowledge their human fallibility and to use all available resources at their disposal including personal and team capabilities [132]. Specifically, CRM uses techniques of simulation, team training, group briefing and the performance improvement processes to develop skills in briefing, inquiry, assertion, workload distribution and vigilance [133, 134].

CRM team training has also been implemented in military aviation as Team Dimensional Training (TDT). TDT supports teams to analyse and correct their operational errors, a process guided by teaching team leaders [115].

Environmental scan of team training programs in healthcare

CRM training program

The CRM curriculum has been adapted for use in healthcare [135]. The curriculum was first applied to an operating room setting in Switzerland and has subsequently been tailored for training in emergency departments, anaesthesia departments, intensive care units and labour and delivery areas [101]. As in aviation, the curriculum enhances healthcare participants' interpersonal and communication skills [5, 108, 136] and trains them to make optimal use of all resources, equipment and people available to promote safety and enhance efficiency [137]. CRM has sparked the development of Anaesthesia Crisis Resource Management, MedTeam and Geriatric Interdisciplinary Team Training [101].

CRM -based team training programs

Team training programs in healthcare were traditionally categorised as either simulation or classroom-based learning [138] and targeted frontline healthcare providers and administrative staff. Table 3 highlights some of the CRM-based team training programs found in the literature. The programs in Table 3 have been selected as they train in non-technical skills, are featured prominently in published literature, showcase a variety of characteristics that are different from one another and/or are shown to have effective outcomes. Additional details on these programs are contained in Appendix C. In this section, five characteristics of each program will be identified: 1) the target healthcare specialty, 2) the place of development, 3) the target trainees, 4) the tools, if any, used and

5) the delivery of the program. Strengths and weaknesses of each program are briefly highlighted in Table 4.

Table 3 Team training programs in healthcare

Simulator-based programs
Anesthesia Crisis Resource Management (ACRM)
Team Oriented Medical Simulation (TOMS)
Multidisciplinary Obstetric Simulated Emergency Scenarios (MOSES)
Classroom-based programs
Medical Team Management (MTM)
Geriatric Interdisciplinary Team Training (GITT)
Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS)
Triad for Optimal Patient Safety (TOPS)
Managing Obstetric Risk Efficiently OB (MOREOB)
MedTeams
Lifewings
TeamPerformancePlus

Simulator-based programs include Anesthesia Crisis Resource Management, Team Oriented Medical Simulation and Multidisciplinary Obstetric Emergency Scenarios.

Anesthesia Crisis Resource Management (ACRM), developed by Gaba and colleagues at Stanford University, emphasises leadership, teamwork, communication and resource management [139-145]. Following didactic sessions on CRM principles, training takes place in a simulator to engage participants in critical incidents that have the potential to occur within high-risk environments (i.e. an operating room, an emergency room, or an intensive care unit). Participants are mainly anaesthesiologists, who are trained in a multidisciplinary team setting, rotating through various roles during simulator scenarios. Recently, physicians from other specialties, such as emergency, obstetrics, surgery, radiology and internal medicine, have participated separately in this course [146, 147]. During the simulation exercise, participants are filmed and the video is subsequently used to debrief the team and participants [148]. Following successful completion of the program, some malpractice insurers, such as the Harvard Risk Management Foundation, lowered premiums for ACRM-trained anaesthesiologists [149].

Team Oriented Medical Simulation (TOMS) was developed by the Kantonsspital, University of Basel, Switzerland. TOMS trains operating room personnel, including surgeons, nurses, anaesthesiologist and orderlies simultaneously [150]. The simulated OR contains typical anaesthetic equipment linked to a computer. The mannequin (patient) has an abdominal segment containing pig organs to allow the surgeon to perform laparoscopic surgery. The first hour of this three-hour course covers key teamwork concepts, such as communication, resource management and leadership followed by surgical and anaesthetic simulation. The last hour of the course is spent on instructor debriefing using videotapes of team performance, with feedback for improvement [151].

Multidisciplinary Obstetric Emergency Scenarios (MOSES) was developed by the St. Bartholomew Hospital and the London Simulator in 2002 [152] to teach multidisciplinary teamwork with an emphasis on crisis management. Participants in the mid- to high-fidelity simulations of obstetrical emergency scenarios, obstetricians, midwives and anaesthetists may attend in teams or come together as individuals from different locations to form a team for the day [153]. Like ACRM, participants are videotaped during simulation sessions and debriefed at the end of the session by experts.

Classroom-based programs include Medical Team Management, Geriatric Interdisciplinary Team Training, Team Strategies and Tools to Enhance Performance and Patient Safety, Triad for Optimal Patient Safety Program, Managing Obstetric Risk Efficiency OB, MedTeams, Lifewings and TeamPerformancePlus. The last four programs are proprietary.

The goal of **Medical Team Management (MTM)**, is to reduce medical errors by focusing on human factors associated with teamwork [150]. The three-day program was developed by the United States Air Force to address errors occurring within Air Force health care facilities [151]. Participants include physicians, nurses, medical technicians, lab technicians, pharmacists, ward clerks, and admissions clerks, from inpatient and outpatient settings. MTM uses seven modules to teach CRM principles and communication issues [151]. Training is premised on a train-the-trainer methodology where trained experts disseminate information locally. MTM offers retention modules and devices, including periodic team leader meetings and formal teamwork recognition.

Geriatric Interdisciplinary Team Training (GITT), an initiative funded by the John A. Hartford Foundation, includes a day course in skills development and self-evaluations, making use of Teams Signature technology to help each team understand its own level of cohesion, leadership, diversity, and other relevant characteristics [151]. This interdisciplinary program is directed at physicians, nurses, nurse practitioners, social workers, pharmacists, therapists and administrators [154]. The curriculum varies depending on which of the eight academic institutions it is housed at, but includes didactic and clinical sessions. The didactic curriculum includes interdisciplinary courses and workshops, geriatric case studies, bibliographies, self-study modules, videotapes, and learning exercises on CD-ROM and the World Wide Web. The sessions highlight the complexity of geriatric care and teaches trainees about the knowledge and skills of other disciplines. Clinical components of GITT are offered in health care settings including in-patient rehabilitation services, primary care clinics, day care facilities, home health care sites, and hospice centers. This component offers trainees the opportunity to engage with patients, advise on problems and needs and participate in interdisciplinary team meetings. Unlike other programs, GITT is not heavily based on CRM principles.

Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS), is a publicly released evidence-based team training toolkit developed jointly by the United States Department of Defense (DoD) and the Agency for Healthcare Research and Quality (AHRQ) through an iterative process. TeamSTEPPS facilitates provider communication and teamwork by optimising information exchange, situational monitoring, leadership, team structure and mutual support [155, 156]. It integrates didactic lecture with practice scenarios and tools and provides

a comprehensive strategy for organisational change management that includes planning and assessment tools [157]. The program is geared to healthcare professionals working in high-stress areas (surgical suites, emergency and intensive care units) and ambulatory care settings, with flexibility on whether teams trained are interdisciplinarily / multidisciplinarily or not. TeamSTEPPS principles are being popularised by means of its ease of access and varied learning interfaces (eg: role playing; video gaming). Of note is the 3DiTeams, a first-person video game, which was developed by Duke University and Virtual Heroes, used for team training and medical education [158, 159].

Triad for Optimal Patient Safety (TOPS) Training, a multidisciplinary team training program to address communication and teamwork, was developed at the University of California [160] for an inpatient medical unit. The curriculum consists of four hours of didactic presentation, facilitated discussion using a safety trigger video and small group scenario exercise to practice the skills learned. The program targets nurses, pharmacists, physical therapists, speech therapists, case managers, social workers, patient care assistants, unit clerks and custodial staff to strengthen the teamwork message.

Managing Obstetric Risk Efficiently (MOREOB) was developed by the Society of Obstetricians and Gynaecologists of Canada. The program targets midwives, nurses and obstetricians involved in the care of the mother and newborn. The program contains three core modules to be completed over three years, with an optional fourth module building on successes [161]. The fourth module is a "performance driven and solution focused program packaged with core components" [162] from previous modules in addition to performance enhancing tools, which are tailored to the specific hospital's needs to attain its patient safety goal. In each of the three modules, teams engage in measuring progress, guiding improvements and identifying successes. Specific techniques used by this program include emergency drills, simulations to develop clinical skills and specific tools to target teamwork skills.

MedTeams was originally developed by Dynamic Research Corporation [163] as a program for emergency room medical team management including physicians, nurses and technicians [164, 165]. Subsequent modifications extend applicability of the program to the operating room and labour and delivery suites teams. MedTeams is delivered in three distinct phases using a train-the-trainer delivery model: site assessment, implementation and sustainment. Site assessment entails an on-site consultation to determine whether the hospital is ready for a teamwork training plan. In the implementation phase, instructors are trained to deliver and assess teamwork training. The sustainment component of the program allows for process improvements, analysis and refresher training. Since it is designed solely to reduce errors through interdisciplinary teamwork, the training strategy focuses on generic teamwork skills and behaviours rather than context-specific competencies. The curriculum encompasses seven dimensions important for effective teamwork with approximately 48 associated behaviours which can be assessed by using the Behaviorally Anchored Rating Scales [6].

LifeWings (formerly, Dynamic Outcomes Management), offered by Crew Training International, aims to enhance patient safety and reduce medical errors, improve trainee skills in team-building and counter the effects of stress. The course is designed for Operating Room surgeons, nurses

and anaesthesiologists. Classroom discussions, role-playing, conflict resolution and dealing with stress sessions are led by former aviation pilots. Training involves three sessions each occurring approximately two months after the previous session. To reinforce training, a challenge-and-respond checklist is available for use in the operating room for debriefing [151] and includes questions such as: "What went well?", "What should we do differently to improve for next time?" and "Did we have everything we needed to do our job?".

TeamPerformancePlus, from the Harvard Risk Management Strategies Foundation, offers interdisciplinary team training in the context of obstetrical care [166] for obstetricians, midwives, nurses and anaesthesiologists, The curriculum has three phases in the implementation of team training. The first involves training physicians and nurses on the curriculum's four modules using a train-the-trainer technique: communication, situation monitoring and mutual support using specific tools such as SBAR and advocacy. The instructors then teach the curriculum to the entire obstetrical staff at their hospital. Finally, the instructors become coaches to help each unit behave like a team. The approach taken to develop the programs was adapted from MedTeams [167]. There is a lack of information regarding the delivery of curriculum. Reduced malpractice premiums are available for physicians who complete the training.

Table 4 Strengths and weaknesses of CRM-based team training programs

Team training programs	Strengths	Weaknesses
ACRM	- Provides three days of hands-on skills practice in a simulated operating room (OR) - Each scripted training event followed by a detailed instructor-led debriefing - Allows trainees to experience situations impossible to replicate in actual OR - Cross-training via role rotations allows for learning from different perspectives [149]	- Not multidisciplinary—instructors, not fellow trainees, play the roles of nurses and physicians; thus, trainee teams do not practice teamwork in simulations - Focus on full-fidelity simulation to the neglect of other forms of learning - Simulation taking place too early on in training, before participants have complete grasp of the necessary factual background information. - High costs of commercial simulator (exceeding $200,000) [168] and operations for limited application of exclusive anaesthesiologist training in OR - Focus on only "skills practice and feedback" phase of CRM

Team training programs	Strengths	Weaknesses
TOMS	- Multidisciplinary team training - Each scripted training event followed by debriefing - Allows trainees to practice technical skills in actual OR	- High costs of simulator set-up against one hour of actual use - Training itself not adequately documented or reported
MOSES	- Multidisciplinary team training, - Cross-training/interprofessional training - Each scripted training event followed by a instructor-led debriefing - Allows trainees to practice technical skills in actual OR - Allows individuals from different locations to form team for training, thus leaving sufficient staff in clinical area	- High costs of simulator set-up against one hour of actual use - Training itself not adequately documented or reported
MTM	- Multidisciplinary team training - Uses series of active learning techniques including formal lectures, behavioural modelling and experiential learning knowledge of teamwork, skills, and attitudes - Builds upon well-established learning theories, requiring the trainees to master factual material in advance of the hands-on skills practice - Offers retention modules and devices	- Too much time devoted to transfer of factual information and less to actual skills practice - Scenarios via low-fidelity techniques (e.g. behavioural modelling via videotaped vignettes) - Aids for retention not tools (i.e., checklists, quick reference cards, flow diagrams), but rather briefings on practices or cross-check procedures)
GITT	- Interdisciplinary (perhaps even transdisciplinary) team training - Allows trainees to practice non-technical and technical skills in clinical setting	- Learning gap of trainees from different disciplines and levels of training

Team training programs	Strengths	Weaknesses
TeamSTEPPS	- Transferability to any health care setting, with materials to best meet an organisation's specific teamwork needs and resource availability - Flexibility in implementation—over 130 scenarios available for customisation to specialty area - Consideration of organisational culture in TeamSTEPPS initiative, as three steps need be taken: assessment; planning, training, implementation; sustainment - Free access to specific tools including SBA	- Operates mainly by creating awareness - Limited opportunities for practice
TOPS	- Multidisciplinary team training - Incorporation of non-front-line staff	- Lack of retention tools or devices
MOREOB	- Multidisciplinary team training - Cross-training/interprofessional training - Teaches technical skills in a team setting	- Proprietary-related costs - Amount of time involved (three years)
MedTeams	- Multidisciplinary team training - Transferable to different healthcare settings (labour/ delivery, OR, ICU) - Requires members to participate in development projects or practicum to address specific department teamwork issues - Provides with physical tools (e.g. checklists, quick reference cards,) for review/ use within workplace - Post-classroom component (annual refresher training) of training for skills retention	- Proprietary-related costs - Focus on declarative knowledge - Does not employ cultural assessment/evaluation component prior to implementation; thus training would only be effective in hospitals with prior commitment to teamwork and upper-level management support and just culture
Lifewings	- Multidisciplinary team training - Sessions dispersed over the six months, allowing for some semblance of refresher	- Proprietary-related costs - Replication of training itself not adequately documented or reported

Team training programs	Strengths	Weaknesses
TeamPerformancePlus	- Multidisciplinary team training - Refresher materials available	- Proprietary-related costs - Training itself not adequately documented or reported

This review identified more programs premised on classroom-based than simulation-based training. The programs generally target healthcare providers involved in high risk areas of practice including labour and delivery (n=4) and the operating room (n=3). GITT and TOPS are targeted at geriatrics and inpatient medical units, with TeamSTEPPS purporting to be suited to any health care setting. Four of the programs are proprietary and involve costs. The primary target trainees for all programs are mainly clinicians. However, TOMS, GITT and TOPS training are directed at anyone who may come in contact with a patient. The majority of these training programs have been developed for practicing professionals, post licensure. Most of these programs are multidisciplinary, in which members from different disciplines are trained together. MOSES involves an element of cross-training as professionals watch how others perform in their tasks in order to better understand others' roles and appreciate their skills. GITT is truly interdisciplinary. The four proprietary programs are the ones with the least information as to the delivery of program compared to the non-proprietary programs, with the exception of MedTeams.

Effectiveness

The effectiveness of the reported team training programs from section can be found in Table 5, categorised according to Hammick's measures of effectiveness: reaction (to training), learning (KSAs), behaviour (change before and after training), results (of team performance on organisation) and patient outcomes [120].

Table 5 Effectiveness of medical training programs

Program	Measures taken	Methods used	Effectiveness
ACRM	*Learning* Attitudes toward teamwork Teamwork behaviour *Outcomes* Staff burnout Rate of medical errors Patient satisfaction	Surveys; observations; quasi-experimental design to assess the relations among various process factors and enabling factors	Generally, positive learning measures Some positive effect of training on outcome criteria such as medical errors, patient satisfaction

Program	Measures taken	Methods used	Effectiveness
TOMS	*Reaction* Impressions of training	Survey	Responses generally favourable
MOSES	*Reaction* Impressions of training *Learning* Clinical practice	Before and after data collection using telephone or email interviews; video-recorded debriefings were analysed	Positive reactions Observation of peers in simulations highlighted alternative strategies
MTM	*Reaction* Impressions of training *Learning* Knowledge	Survey	Training should be continued Increased knowledge
GITT	*Learning* Communication abilities Attitudes towards health care teams Self-described skills *Behaviour* Team cohesions	Pre-post survey	Post-training statistical means higher than pre-training levels on all measured variables

Program	Measures taken	Methods used	Effectiveness
TeamSTEPPS	*Learning* Team skills and attitudes Team knowledge *Results* Patient safety culture	 Observation for freq of tools used Observation for freq of tools used Incident reporting rates and seclusion rates	 6.8% increase in total KSA score Improvement in frequency of event reporting & organisational learning with reduced rates of seclusion
TOPS	*Reaction* Impressions of training	Survey	High rating of training
MOREOB	*Results* Liability carrier incurred costs	Cost review	Reduction trend in liability carrier (hospital) incurred costs after implementation of program

Program	Measures taken	Methods used	Effectiveness
MedTeams	*Learning* Attitudes on Safety *Behaviour* Teamwork *Results* Malpractice claims *Outcomes* AOI	*Safety Attitudes Questionnaire* Data collected on 11 clinical processes measures Claims review Measured retrospectively, review	Positive attitudes towards safety Longer elapsed time from decision to incision for emergency c-section Decrease in malpractice claims 23% decrease in patient safety incidents
	Learning Attitudes and opinions Team Behaviour *Behaviour* ED performance	Pre-post survey Observation Pre-post observation of clinical errors	Positive attitudes towards teamwork Improved after training Clinical error rate decreased from 30.9% to 4.4%
Lifewings	*Reaction* Impressions of training *Learning* Attitudes toward importance of teamwork *Outcomes* Rate of surgical count errors	Survey Survey Pre-post analysis of number of errors	Favourable reactions Improvements in attitudes 50% reduction in number of surgical count errors

Program	Measures taken	Methods used	Effectiveness
TeamPerformancePlus	*Results* Malpractice claims *Outcomes* AOI	Claims review Measured retrospectively, review	Claims dropped by >50% AOI for high-risk premature births improved 47%, term deliveries 14% and 16% overall

Training effectiveness has been evaluated primarily on trainee reactions and learning which typically shows positive effects. This is similar to what was reported in the 2008 RAND report [169], which studied the outcome measures that would represent important patient safety outcomes, expected to be affected by changes in health care teamwork effectiveness. Only TeamSTEPPS performed measurements of patient safety culture. There is more reporting of higher level measures (e.g. results and outcomes) in the proprietary programs, with positive results of decreasing trend of malpractice claims and better maternal and birth outcomes. This may have to do with 1) the nature of a proprietary program needing to prove its value and credibility and/or 2) the lack of support that may be inherent with carrying a non-proprietary program out that is not as heavily invested in as a proprietary one. There is also a decreased rate of surgical count error, rate of medical errors and increased patient satisfaction post-implementation of a program. Thus, there is some evidence suggesting that team training in healthcare can lead to improved patient safety.

Simulation- versus classroom-based training

Simulation-based training employs high-fidelity simulation as a primary method for trainees to develop competencies through practice in a simulated environment representative of actual clinical conditions. It also allows for evaluating team members on multiple levels such as making an inventory of skills and competencies available within the team and using them effectively as well as individual performance and overall team dynamics performance. Debriefing at the end of a session facilitates appropriate feedback [170].

However, there has been some uncertainty as to the value of simulation-based training. This concern relates to the validity of the tools used to measure effectiveness rather than the content of the training. For instance, the effectiveness of assessment instruments used to measure performance during anaesthesia simulation was found to be undetermined [171]. In a more telling example, when information probes were used to assess the effectiveness of sharing crucial pieces of patient information during a simulated crisis among participants, the average sharing episodes was found to be about 27%, irrespective of the simulation type [172]. Yet, despite poor information sharing, participants rated themselves as improved or somewhat improved at the end of training session. Nonetheless, simulator-based performance valuation does demonstrate construct validity, with certain scenarios able to discriminate skill levels between residents and staff without loss of realism [173, 174].

Though studies do show construct validity of simulators, it has been difficult to directly measure human performance and teamwork skills within a simulated setting [126, 175]. Studies often need to use tests that do not examine the range of concepts taught, which show a lack of content validity. As yet, no studies have shown an improvement in patient safety after simulation was used for team training in teamwork principles [136], although there has been improvement in team behaviour. For instance, in Sharpiro et al.'s study [176] which provided an already trained group in didactic sessions with additional simulation education, the quality of team behaviour improved as compared with didactic alone. No team training program using simulation alone has managed to implement training for all personnel in a given patient care environment, diluting the impact of individual members trained by simulation. Despite the weak evidence of its impact on patient safety, simulation has been widely adopted [177].

This is not to suggest that simulation is unimportant. In fact, adult learning theory emphasizes the central role that experience plays in the learning process [178]. With the idea that knowledge comes from grasping experience and transforming it, Kolb's [178] model delineates a four stage learning cycle to include: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations. These are represented in an experiential learning (or training) cycle involving 1) concrete experience followed by 2) observation and experience followed by 3) forming abstract concepts followed by 4) testing in new situations. In other words, immediate experiences provides a basis for observations and reflections, which are then assimilated and distilled into concepts that produce new implications for actions to be actively tested in creating new experiences.

Simulation provides experiential learning; thus, some degree of simulation, or practice, is key to any teamwork training program. Controversy exists over the degree of simulation required (whether in a high-, medium- or low-fidelity simulation setting). Students may participate in scenarios that teach them to use appropriate skills for communication or they may practice conflict resolution in the classroom-setting. Classroom-based training does not require an expensive high-fidelity simulated environment, relying instead on "lectures, instructional vignettes, cases reviews, interactive problem-solving exercises, question-and-answer sessions, and examinations to test knowledge" [179].

Although Gaba argues that high-fidelity simulation is preferred over other education methods as it allows for the realistic environment to practice KSAs [180], this has never been demonstrated. Pratt and Sachs [179] make a compelling case for classroom-based team training with low-level simulation over high-fidelity training. They suggest that the former is more effective to implement given the high costs, including money and manpower, of the latter. In teaching KSAs, classroom-based training has been shown to positively influence team attitudes and skills [6, 181] and offers three advantages in this teaching phase. First, it does not require a specialised environment, which is expensive and must employ staff to operate and maintain it, leading to high implementation costs. At the Beth Israel Deaconess Medical Center of the Harvard Medical School, the direct cost of a one-day session at the obstetrics simulator is $950 and $150, respectively, for attending physicians and for nurses [179], which does not include training residents, unit coordinators, scrub technicians or others on the team that are frequently not included in the simulator-based scenarios. The second advantage is related to cost as it allows more staff to be trained simultaneously. Finally, classroom-based teaching is said to be easy to schedule as part other staff orientation processes [179].

Team training to successfully transfer KSAs to clinical practice and improve patient safety is unlikely to be permanently achieved with any single intervention, regardless of whether it is classroom or simulation-based. In a post-teaching stage, staff will need to integrate teamwork concepts incrementally, with the support of teamwork champions placed to coach the behaviours as they are rolled out and encouragement and feedback to the leadership [179].
Pratt and Sachs [179] discuss the limitations of the overemphasis of high-fidelity simulation on crisis management—the management of major patient safety incidents—instead of the management of the resources, workflow and teamwork on a unit. In most medical environments, teamwork concepts need to be applied to the management of the entire unit, not simply to the patient or procedure to mitigate and/or avoid error, which is usually the case of high-fidelity simulation. Thus, training must create a structure and culture that encourages the tenets of teamwork. They suggest that the best way to teach and implement team training may be through a combination of classroom training to teach KSAs and simulator-based training to practice crisis management, or classroom-based training followed by intensive coaching during implementation.

Interprofessional education interventions

An interprofessional education (IPE) intervention has been defined as "occurring when members of more than one health and/or social care profession learn interactively together, for the explicit purpose of improving interprofessional collaboration and/or the health/well being of patients/clients" [182]. In other words, the professions learn with, from and about each other, looking at a task from the perspective of other professions as well as their own [183]. This is done by using active learner participation and exchange between learners from different professions.

To explore this form of cross-training without doing an exhaustive search of IPE programs, a systematic review [182] in which the inclusion criteria of 1) an interprofessional exchange occurring with 2) education taking place, 3) professional practice, patient care processes or health and satisfaction outcomes being reported, and 4) intervention evaluated using randomised controlled trial, before-and-after or interrupted time series design, identified six studies targeting post-licensure providers. The aims, targets and delivery of each are described below.

Brown et al. [184] implemented an interprofessional communication skills training program for physicians, physician assistants, nurse practitioners and optometrists which aimed to increase patients' ratings of clinicians' communication skills. The IPE intervention consisted of workshops involving a series of didactic components, role-playing activities and interactive dialogue, delivered at a number of health maintenance organisations.

Thompson et al. [185] implemented four seminars to general practitioners and practice nurses to collaboratively establish a clinical practice guideline to improve recognition and management of depression in primary care practices. Using small-group discussion of cases and role-playing, the intervention ensured that facilitators were available after the seminars to facilitate guideline implementation and promote use of teamwork.

In 2000, Thompson and colleagues published a study on an IPE intervention for teams of physicians, nurse practitioners, physician assistants, registered nurses, practical nurses and medical

assistants [186]. The aim was to improve asking about domestic violence, case finding and management in primary care, with the intervention consisting of two half-day IPE sessions, a bimonthly newsletter, clinic educational rounds, system support and feedback of result.

Campbell et al. [187] offered a two-day IPE program, which was developed and implemented by violence prevention organizations and involved didactic instruction, role playing, team planning, and team work to develop a written action plan. The program addressed systems change and coalition building as well as provider attitudes and skill building. The participants, including a physician, nurse, social worker and domestic violence advocate, were expected to collaborate in order to implement system changes in their respective emergency departments. Facilitators were also available for telephone assistance during the implementation phase.

The IPE program Morey and colleagues [6] implemented for staff (physicians, nurses and technicians) in nine emergency department consisted of lectures, interactive discussions, practical exercises and discussion of video segments. This intervention was actually a part of the MedTeams team training program. In addition, each staff member completed a four hour practicum in which teamwork behaviours were practiced and critiqued by an instructor.

Young and colleagues [188] delivered an IPE course aimed at psychiatrists, nurses, therapists, case managers, residential staff, mental health workers and administrative support workers to improve provider quality, empower mental health consumers and promote mutual support. Participants took part in six educational components held over a one-year period that included presentations, discussions, small groups and role-playing techniques as well as full day visits to sites.

These interventions varied in their objectives, duration, format and clinical context in which IPE was delivered in addition to using a number of other strategies. Although all the reported interventions involved interactive components such as role-playing and practicum on teamwork as required by for the IPE, in some studies, IPE was single part of only a single strand of a multi-faceted interventions; this limits the ability to identify the role that IPE plays in the outcomes achieved. Since many of these heterogenic studies had small sample sizes and were not properly randomised, there is weak evidence for the effects of IPE.

Team training within the undergraduate curriculum

Hall and Weaver [189] conducted a review on interdisciplinary education and teamwork in healthcare to discover the major issues and best practices, with two main categories emerging. The first pertains to the system of education and training of healthcare professionals and the second pertains to the content of interdisciplinary education.

System of education and training of healthcare professional

There seems to be some conflict over when interdisciplinary learning should take place. Some authors have suggested that learning to work in an interdisciplinary setting should start early in an education program as the experience of shared learning may facilitate improved collaboration. On the other hand, some authors argue that one's disciplinary competencies must be thoroughly grasped first as it is essential to understanding one's contributions to the team effort. Thereafter,

interdisciplinary learning can be achieved [189]. Problem-based learning (PBL) is a team-based method of learning carried out in a small-group format. PBL offers a means of integrating theory with clinical components. As a structured educational activity, it usually employs case presentations as the stimulus to learning to help students learn to listen to one another and collaborate as they work to solve the problem [189]. The service/learner model of teaching uses a clinical setting to challenge the learners to work together effectively to address clinical problems, patient education or health dilemmas of underserviced populations. Both PBL and service/learner model place the patient at the centre of the team's focus [189].

Team-based learning (TBL), a well-defined instructional strategy developed by Michaelson [190], allows an instructor to teach by conducting multiple small groups simultaneously in the same classroom, acting as both facilitator and content expert. Learners actively participate in and out of the class through preparation and group discussion to apply and integrate information rather than learning facts. TBL offers the opportunity for assessment of both individual and team performance. Students first study independently outside of class to master identified objectives and then individually complete a multiple-choice exam to ensure their readiness to apply their knowledge. Groups then complete assignments that promote collaboration, use of their acquired knowledge and identification of learning deficiencies. A large group discussion is stimulated, with groups defending their answers and instructor helping to consolidate learning. TBL emphasises the importance of individual and group accountability, the need and opportunity for group interaction and the motivation to engage in give-and-take discussion [190]. A number of studies have identified TBL benefits as student engagement, higher quality communication processes and increased National Board of Medical Examiners shelf examination scores [191].

Content of interdisciplinary education

There a paucity of literature regarding other medical school curricula that teaches team training. Charkraborti et al. [192] conducted a systematic review of teamwork training interventions in medical and resident education. Most curricula that were found placed medical trainees in multidisciplinary learning environments that include nurses, social workers, physical and/or occupational therapists, administrators and pharmacists. All curricula employed active learning methods such as critical incident simulations, role-playing, case-based scenarios and actual patient encounters. A few of the interventions used nonmedical teambuilding exercises (e.g. rope course or survival game), with a majority incorporating feedback as an integral part of active learning; seven studies used formal debriefing sessions to provide feedback. Facilitated reflection has been a technique utilized to help learners gain a richer understanding of teamwork. Most of the studies used an uncontrolled pre/post design and none were randomized controlled trials. Measurements taken include knowledge outcomes, self-assessed team skills, observer assessments of team skills and self-assessed attitudinal changes. The reviewers concluded that all of the reported teamwork curricula used "reasonable educational strategies and appeared to be modestly effective in the short term" [192].

Critical factors for successful implementation of team training programs in healthcare

Successful training is dependent on the curriculum and instructional strategies and organisational variables such as leadership support, resource availability, training environment and readiness for change [7, 193, 194]. An understanding of these variables and the strategies for their optimisation is crucial to the success of teamwork training efforts. In Weaver's study evaluating TeamSTEPPS, organisational factors such as buy-in from personnel on every level of management as well as from staff members and a champion who maintained vigilance in keeping the effort alive were mentioned as necessary for its implementation and sustainment [157]. Another important concept in medical education was the need to motivate and educate faculty to learn new tools of team training and the need for administrative support of the educational and clinical institutions involved in changes [189].

Salas et al. [195] provided seven evidence-based practical, systematic success factors for preparing, implementing and sustaining a team training and performance improvement initiative: 1) Aligning team training objectives and safety aims with the organisational goals; 2) Providing organisational support for the team training initiative; 3) Getting frontline care leaders on board; 4) Preparing the environment and trainees for team training; 5) Determining required resources and time commitment and ensure their availability; 6) Facilitating application of trained teamwork skills on the job, and; 7) Measuring the effectiveness of the team training program. Although these seven factors have not yet been well studied in the healthcare environment, early experiences with healthcare teams suggest these organisational factors will prove to be essential for the attainment of permanent team-based improvements in safe patient care [195]. Salas [195] urges healthcare leaders to become familiar with these factors and ensure they are in place before initiating teamwork training effort in order optimise use of limited staff time and resources.

Implementation issues and challenges

While not every team training study reported implementation issues and challenges, those that were described are highlighted below.

Hierarchical professional culture

- Frequent resistance of resident physicians to participate reflects the nature of medical training as cultural tradition [196]
- Traditional hierarchy challenges remained even after training [197]

Logistics

- Need for appropriate space/time and balancing schedules [160]

Practicalities

- Need for creativity in educational offerings because there are a variety of possible team members beyond medicine, nursing, social work [196]
- Training requires concerted and sustained effort, which may not be immediately rewarded [6]

- Creating changes in training of health professionals very difficult and needs more time and effort than is often appreciated at outset [196]
- Need for recognition of skill gaps between learners as that can inhibit effective student teams [196]

Costs

- Infrastructure
  - Direct costs of capital and operation of high-fidelity simulation
  - Proprietary versus non-proprietary programs
- Manpower
  - Replacement staff to cover for individuals in training
  - Staff to run and operate high-fidelity simulation
  - Team training program trainers
- Opportunity costs (time spent in training)
- Direct costs in implementation

Workload

- Staff initially complained that teamwork processes increased workload [167]

Organisational culture

- Lack of leadership and support (financial, manpower) to run non-proprietary team training programs
- Lack of professional incentives
  - Not many programs supported by Continuing Education Units (CEU) or Continuing Medical Education (CME) credits (MORE^{OB} and TeamSTEPPS are accredited programs)

Gaps in knowledge in team training programs

While the literature touches on suitable formats for carrying out team training, recommendations on what constitutes the "best" delivery in terms of how curricula is taught or the "best" length/duration/frequency of training are absent. A theoretical model of team performance in healthcare has yet to be conceptualised thus, existing and emerging team training programs are not necessarily grounded in scientific understanding of what comprises effective teamwork in healthcare [151].

Currently, the idea of effective teamwork is based on the framework advocated by Salas and colleagues. However, the Salas model needs to be tested in healthcare to determine the relations among predictors of performance, team KSAs and the relations between predictors of KSAs and outcome criteria. As well, healthcare team training programs seem to be fixated on adapting CRM programs derived directly from aviation [198], when there ought to be more critical testing and refinement of CRM training to ensure that they effectively generalize to healthcare teams [138]. In addition, there is a gap in team training strategies as they relate to specific health specialty needs,

which vary in size, purpose, duration, redundancy of expertise, consequence of error and diverse contexts. Such training should denote the specific KSA requirements central to teamwork in a given service to maximise team performance. This is especially important as related to HROs since it is suggested that customised solutions tend to achieve high reliability [7]. Finally, there are gaps in the assessment of the training using higher-level measures such as patient safety culture and patient outcome.

3. SPECIFIC TOOLS TO IMPROVE TEAM PROCESSES

There are a number of tools and aids used to improve team processes in simulation within team training, but these can also be implemented within practice. Many of these fall under the domain of communication strategies.

Structured communication techniques

Communication between individuals is often "informal, disorganised and variable" [199]. However, in situations where specific and complex information must be communicated and responded to in a timely manner, combined with the dire consequences of omitting critical information, it is essential to add structure to the exchange. Such structure can ensure that the right information is shared at the right time with the right people. Some specific structured communication techniques that patient care teams can use include: briefings, debriefings, SBAR, assertive language, critical language, common language, closed communication loops, active listening and callouts.

Briefings

Briefings are a critical element in team effectiveness and determine whether people work together as a cohesive team or as a group of individuals in proximity to one another. Briefings quickly set the tone for team interaction, ensuring that care providers have a shared mental model of what is going to happen during a process, identify any risk points and plan for contingencies. When done effectively, briefings can establish predictability, reduce interruptions prevent delays and build social relationships and capital for future interactions [200].

Some environments in which briefings are particularly important include procedural areas. For instance, the Joint Commission requires surgical teams to conduct a specific type of pre procedure briefing called a time-out in which the correct operative site, patient and procedure are verified [199]. An extended surgical time-out is known as a huddle, an ad hoc "touch-base" meeting to regain situational awareness [157]. The World Health Organisation has released a Surgical Safety Checklist for pre procedure briefing that encompasses consistent expectations for preoperative checks, site marking, time-out and perioperative activities [199]. In the intensive care unit [201], the use of multidisciplinary rounds and setting daily goals for each patient should be a fundamental goal. Briefings should also occur when patients are transferred from one team member to another in handoffs to ensure all appropriate information is communicated.

Debriefings

Debriefings are concise exchanges that occur after events have been completed to identify what happened, what was learned, and what can be done better next time. It allows the team to determine how members are feeling about processes and recognises opportunities for improvement and further education. Debriefing may also be an effective tool for problem solving and generating new

solutions, usually with ideas brought from other clinical domains by the experts on the teams to positively engage the collective wisdom of a care team.

The effectiveness of a debriefing depends on the quality of briefing, which should be focused on the common goal and have a positive tone. In facilitating a debriefing, team leaders should be as specific as possible and engage the most junior team members first. The step after debriefing, putting the information into an improvement process, is considered more important than the debriefing itself [202]. Teams should document items that did not go well and make suggestions for improvement; such documentation should be tied to the spontaneous reporting system of a glitch book in which team members write down a problem that needs to be resolved. By documenting problems, teams can move toward fixing them and prevent issues later on.

SBAR

SBAR is a structured communication technique to standardise communication between two or more people. It helps to set the expectation within a conversation that specific, relevant and critical information is going to be communicated every time a patient is discussed. SBAR is an acronym for Situation, Background, Assessment, Recommendation. The communication process involving SBAR is as follows; the Situation is conveyed by the initiating individual and establishes the topic of discussion; the Background involves any information needed to make an informed decision for the patient such as the list of current medication, or recent vital signs; in Assessment, the individual initiating the SBAR report the patient's situation and status; finally, the Recommendation is what the individual initiating the SBAR offers in terms of what they think should take place or be done.

The SBAR model is often used in clinical handoffs and can be particularly valuable during nurse-physician encounters. SBAR clearly conveys that critical thinking about the patient's problem and a potential plan of action were formulated in advance of a discussion. In this way, both parties know that the conversation will include the assessment and recommendation for care that is relevant to the patients' current status. The tool is utilized in perinatal care, emergency rooms, trauma centers [203] and labour and delivery [204].

Assertive language

Because medicine has an inherent hierarchal structure with power distances between individuals, it is important that, when necessary, health care providers politely assert themselves to support patient safety. Effective assertion is pleasant, persistent, timely and clear in offering solutions to presenting problems. Organisations can help ensure appropriate assertion in team communication by training staff in assertion techniques.

The two-challenge rule, where a concern is stated at least two times to ensure it has been heard, is a form of assertive language. The CUS program of United Airlines escalates communication from an expression of concern through a command to stop. The escalation of concern consists of, "I'm concerned," "I'm uncomfortable," "this is unsafe," or "I'm scared" to mean "This is a potential serious problem. Stop and listen to me." Frankel and Leonard [202] suggest that the true "test" of teams and leaders occurs when someone raises a concern and the "line is stopped", yet the concern

was inaccurate. The response from team members and leadership to this situation will define the health of the team and serve as a marker to determine whether there will be a learning and supportive environment going forward.

Critical language
Sometimes, using assertive language may not be strong enough to signal a problem. Critical language may include such language may include a phrase such as, "I need a little clarity" [199] as a strategy to garner another's attention. Teams that respond to agreed upon critical language recognize the immediacy of a concern and direct their attention to resolving the situation. Critical language should be neutral and foster an environment in which there is no threat to any individual's competence or expertise. Critical language is described in non healthcare industries as "stopping the line." It is important to have a standard agreed-upon phrase because individuals are often hesitant to voice a concern directly or indirectly [1].

Common language

Using a common language, which is agreed upon by all providers in a particular setting to describe critical issues or observations, may be helpful to ensure consistency and comprehensiveness in communication. By committing to using common language, organisations can ensure consistent communication about a critical issue across all types of providers and within many different types of situations [199].

Closed communication loops

Closed communication loop improves the reliability of communication by having the receiver of communication restate what was said by the sender to confirm understanding. One specific type of closed loop communication is repeat back, with four distinct actions: 1) the sender concisely states information to the receiver, 2) the receiver then repeats back what was heard, 3) the sender then acknowledges the repeat back was correct or makes a correction, 4) the process continues until a shared understanding is verified. Check-back is a similar type of closed communication loop. Organisations requiring this type of closed-loop communication can help smooth the communication process and ensure critical information is correctly conveyed and understood. This seems to be most useful during surgery to confirm sponge count, during high-risk patient handoffs to ensure comprehensive information exchange and during medication ordering.

Active listening

A critical component of communication is listening. Active listening entails maintaining a comfortable level of eye contact, monitoring body language, listening completely without framing a response while the individual is still speaking and repeating back information to confirm understanding [199].

Callouts

Callouts are clearly spoken phrases that indicate a phase of a process. Callouts are often used in the OR at the start and closing of procedure, but may also be used at other times.

DESC

DESC stands for *Describe* the situation, *Explain* concerns, Suggest alternatives, Consequences stated and is a communication tool for managing and resolving conflict [205]. It is particularly useful when confronting unprofessional behaviour.

Observational instruments to measure team processes

Two current methods of direct observation to measure teamwork processes are the TiCOT Model and the CATS model.

TiCOT , or the Teamwork in Context ***Observation*** Tool, is a behavioural instrument with 21 observable metrics to identify and track behavioural markers that are associated with "driving higher levels or risk" [199]. It is a relatively new instrument used to rate the clinical complexity, leadership behaviours and information exchange of surgical teams in an unpublished study by Knight et al. [206]. Team climate and processes such as clinical complexity, briefings and leadership were rated with single items while the quality of information exchange was measured using a composite scale score of observer ratings of "Sharing Information," "Asking for Information," and "Assertion and Challenge."

The Communication and Teamwork Skills (CATS) Assessment was developed through rapid-cycle improvement and piloted through observation of videotaped simulated clinical scenarios, real-time surgical procedures and multidisciplinary rounds [207]. It was developed with an aim to provide evidence of the presence and quality of particular skills and to reinforce those skills by providing useful feedback to the observed team. Specific behavioural markers are clustered into four categories: coordination, cooperation, situational awareness, and communication. Teams are scored in terms of the occurrence and quality of the behaviours. Results from the CATS tool enable clinicians to view a spectrum of scores, from the overall score for the categories to specific behaviours.

Effectiveness of specific tools to improve team processes

It is difficult to uncover the effectiveness of these tools, mainly because there are not many studies in the literature that evaluate them individually. However, their global effects may be seen as a part of the TeamSTEPPS program which incorporates many of these communication tools.

Studies evaluating the effectiveness of tools include briefing, SBAR, assertive language and information technology.

Briefings

Perioperative briefings were associated with a 31% reduction in unexpected OR delays and 19% reduction in communication breakdowns leading to delays [208] and seemed to improve OR staff teamwork behaviours and self-assessment accuracy [209]. Perioperative team checklists have been implemented by multidisciplinary OR teams and have been found to improve information exchange and team cohesion [210], reduce the number of communication failures and promote proactive and collaborative team communication [211] using observational methods.

OR briefings are found to have a positive impact on wrong-site surgery [212] and OR culture [213]. Meanwhile, implementation of daily goal sheets in multidisciplinary critical care teams was found to improve perception of communication and care (in surgical service) [214] and increase the percentage of nurses and resident who understood the goals of care for the day as well as a decrease of length of stay in the ICU [215].

SBAR

SBAR provides a common and predictable structure to communication and patient safety incidents have been reported to decrease with its use. The rate of patient safety incidents decreased at OSF St Joseph Medical Centre, as measured by a Global Trigger Tool [216]. An adapted SBAR has also been implemented in the rehabilitation setting and found to be helpful in both individual and team communications, which ultimately affected perceived changes in the safety culture of the study team. There was a positive but not significant impact on patient safety, improvements also seen in safety reporting of incidents and near misses across the organization and within the study team [217].

ISBAR (Identify, Situation, Background, Assessment, Recommendation), a modification of SBAR, was taught to final-year medical students who were found to have higher communication content in a patient simulator in a mock clinical environment compared to those who were not taught [218]. Students in the intervention arm also had a higher delivery of information than in the control [218].

Assertive language

The two-challenge rule was taught in a simulated operating room, in which anaesthesiology trainees were presented with opportunities to challenge coworkers, including attending faculty anaesthesiologist, attending faculty surgeon and nurse, all of whom were confederates [219]. Overall, the use of the two-challenge rule increased after debriefing and instruction directed toward superordinate physicians, without improving challenges toward nurses [219].

Information technology

An electronic whiteboard in a general internal medicine inpatient unit of an acute care hospital was implemented [220]. The whiteboard displays relevant, real-time patient information, in a single, highly visible, user-friendly display. One glance at the whiteboard will allow a provider to get an accurate snapshot view of patient activity in the unit. Approximately 71% of the survey participants believed that the whiteboard improves and standardises communication within the care team. Further, approximately 62% of the participants agreed that the whiteboard saves them time when searching for information on a patient. In addition, the whiteboard had an impact on the work practices of many care providers.

Gaps in knowledge in tools for improving team processes

There are major gaps in the reporting of critical factors for implementation in the papers or implementation challenges, which may have practical implications. Empirical data to support the evidence of effectiveness of the different tools is mostly lacking. Of the studies that had empirical

evidence to support the effectiveness of a specific tool, only one used patient outcomes as a measure, while the others used lower order measures. Many of the tools studied were implemented in the clinical setting while some were uses as a component of medical education.

4. CHANGES IN THE CULTURE

Characteristics of patient safety culture

Within healthcare, there is no common view or definition of patient safety culture. Patient safety culture encompasses 1) a shared belief that healthcare is a high-risk undertaking, 2) a commitment to detecting and analysing patient injuries and near misses, and 3) an environment that balances the need for reporting of events and the need to take disciplinary action [221]. Some patient safety culture dimensions include leadership, risk analysis, workload management, sharing and learning as well as resource management [222].

Kirk et al. [223] developed a theoretical framework for patient safety culture in primary care, but there has been no other attempts found in the literature, with a list of dimensions such as: overall commitment to quality; priority given to patient safety; perceptions of the causes of patient safety; investigating patient safety incidents; organisational learning following; communication about safety issues; personnel management and safety issues; staff education and training about safety issues; teamwork around safety issues.

Culture vs climate

Patient safety culture is often used interchangeably with patient safety climate, with implications for the former's measurement, as will be seen in the next section. The literature brings the discussion back to safety culture, seen as safety attitudes values and practices that exist at a deeper level than safety climate, which is used to describe the sum of employee perceptions regarding overall safety within the workplace [224]. More specifically, climate reflects employee perceptions about what gets rewarded, supported and expected in a particular setting and changes faster and more immediately reflects the attention of leadership than safety culture [225]. While the safety climate of an organisation may change on a daily basis, the underlying beliefs, values and behavioural norms – the safety culture – will remain largely unchanged. The dynamic nature of safety climate means that there is a need for reliable tools to measure it, which can be used to determine the effectiveness of safety programs and inform on how to improve future programs [226].

The implications of these constructs is that safety-related behaviours are influenced by workers' perceptions and attitudes toward safety [102], and safety climate would have a significant impact on communication and teamwork, which will have resultant impact on patient outcomes.

Improving patient safety culture

Moving away from cultures that increase the likelihood of risks and errors

To achieve a culture of patient safety, a shift is required from a culture of blame to one in which errors are treated as opportunities to improve the system and prevent harm, as advocated by the Institute of Medicine. Congruent with Reason's model of safety culture [104], this entails moving in the direction of a just culture, an informed culture, a reporting culture, in which people are prepared

to report their errors, and a learning culture, described earlier in this paper.

In addition, the flattening of any hierarchical culture must take place. In a study exploring how aspects of general organisational culture relates to hospital patient safety climate [227], a higher level of group culture correlated with a higher level of safety climate. A more hierarchical culture was associated with a lower safety climate.

Baseline safety culture measurements are a necessary first step for organizational cultural change.

Fleming [228] discussed a 10-step process of lessons learned from industries that have implemented safety culture measurement and improvement initiatives.

1. Build capacity of internal expertise to decide if a safety culture measurement is appropriate, select the most suitable measurement approach and an external provider
2. Select an appropriate survey instrument
3. Obtain informed leadership support because even though it is accepted that management support is needed for such an intervention, it is not uncommon for it to be missing [229]
4. Involve healthcare staff as a key component of positive safety culture
5. Survey distribution and collection to gain a high response rate
6. Data analysis and interpretation
7. Feedback results
8. Agree interventions via consultation so that information produced can readily be turned into an action plan
9. Implement interventions
10. Track changes

Initiatives already carried out and key ingredients for success

Ginsburg et al. [230] conducted a thorough review for their study on enhancing perceptions of patient safety culture, highlighting three areas in which efforts are needed in order to improve patient safety and reduce patient safety incidents. The first is improved measurement and feedback to increase the detection of patient safety incidents and to guide interventions to improve systems and care processes. The second is tools and change strategies to redesign care and support teams and individual practitioners in identifying and preventing patient safety incidents. The third is visible leadership supporting patient safety improvement efforts.

This is reflected in practice, where initiatives taken to move in the direction of patient safety culture have included a mixture of incentivising a fair and just culture, implementing teamwork training and/or tools to improve teamwork processes, explicitly re-aligning their corporate vision to place emphasis on patient safety and highlighting the commitment of leadership to safety [121, 123, 232-234].

Leadership is considered the single most important success factor to turning the barriers of diminished awareness, accountability, ability, and action into accelerators of performance

improvement and transformation [231]. Leaders must be aware of performance gaps and need to be directly and personally accountable to close these gaps. Organisations must then have the ability to adopt new practices and technologies, which entails investing in knowledge, skills, compensated staff time and budget allotted to pursuing the pervious costs. Finally, organisations need to take explicit actions toward line of sight targets that close performance gaps that can be easily scored.

Leaders drive values which drive behaviours. Behaviours, in turn, drive the performance of an organization. Without the right values supported by robust structures and systems established and sustained by the governance boards, senior administrative leaders, and clinical leaders it will be impossible to become a high reliability organization that embodies a true culture of patient safety.

While teamwork training can be implemented as a part of culture change, it is not a panacea. Evidence suggests that team training accounts for approximately 20 percent of the variance in team performance [232, 233]. As specific events occur that influence the organization, the climate for safety (or for any other factor) changes [225]. The most striking example is the impact on safety climate immediately following a serious injury or fatality. Such an event typically triggers a strengthening of the safety climate. However, this change often does not last over the long term. This is the same with teamwork training.

Strong leadership on patient safety can effect change through the safety climate or peoples' perception of the change in culture. However, this needs to be sustained (along with any other patient safety initiatives) and supported for the long term to ensure the safety climate does not revert to past patterns in a sort of equilibrium with the cultural characteristics of the organisation [225]. If enough changes are made, sustained and supported in the safety climate, it is likely that culture can be shifted.

Instruments to measure patient safety culture and climate

There are many instruments to measure patient safety culture and climate [234]. Early instruments were adapted versions from other industries [228]. Recently, instruments have been developed specifically for healthcare, with a range available to healthcare organisations [228], such as the Safety attitudes questionnaire [235], Stanford Instrument [236] and the Hospital Survey on Patient Safety Culture [229]. In addition, a modified Stanford instrument has been used in many Canadian hospitals [230].

The Safety Attitudes Questionnaire (SAQ) takes a snapshot of the safety culture of an organization using frontline worker perceptions. The instrument contains items with close-ended responses and asks respondents to indicate their level of agreement with each item on a 5-point scale, [235]. The SAQ can be easily modified to learn about safety climates. Responses to SAQ can be summarised into six factors, perceptions of management (unit or hospital), safety climate, teamwork climate, working conditions, stress cognition and job satisfaction [237]. The SAQ exists in different versions (e.g. ambulatory, ICU and pharmacy) specific to different clinical settings, with minor modifications in the content to reflect the clinical area.

The Stanford instrument [236] measures elements such as organisation, department, production, reporting/seeking help and shame/self-awareness. It was adapted from five existing surveys, including the OR management attitudes questionnaire, anaesthesia work environment survey and safety orientation in medical facilities. This survey has 30 items and is freely available. Though it has been tested on a large sample, the reliability scores are not published.

The modified Stanford Instrument [230] measures the value of safety, fear of negative repercussions and perceived state of safety by hospital workers using 32 items. Its reliability ranges from an alpha of .66 to .86. Several strengths of the instrument include having good psychometric properties and being freely available. However, the measures taken are considered to be a small number of safety culture dimensions.

The Hospital Survey on Patient Safety Culture (HSOPSC), a questionnaire from the Agency for Healthcare Research and Quality [238, 239], measures multiple dimensions of patient safety culture in hospitals and places emphasis on error and event reporting. Health care organisations can use this survey tool to assess their patient safety culture, track changes in patient safety over time and evaluate the impact of patient safety interventions. The survey measures seven unit-level aspects of safety culture: 1) Supervisor/Manager Expectations & Actions Promoting Safety, 2) Organizational Learning - Continuous Improvement, 3) Teamwork Within Unit, 4) Communication Openness, 5) Feedback and Communication About Error, 6) Non-punitive Response to Error and 7) Staffing. In addition, the survey measures several hospital-level aspects of safety culture, taking into account outcome variables such as overall perceptions of safety and number of events reported. Like other safety culture questionnaires, the HSOPS has to be administered individually to employees at a hospital or hospital unit [240].

While the above are mainly for assessing patient safety culture, the Patient Safety Culture Improvement Tool (PSCIT) [222] was developed to help healthcare organisations identify practical actions to improve their culture. The tool is based on a safety maturity model, which describes five stages of cultural evolution, from pathological to generative. The PSCIT consists of nine elements that cover five patient safety culture dimensions. Each element describes the systems in place at each level of maturity, enabling organisations to identify their current level of mature and actions to move to the next level. To date, reliability and validity data are not published for this tool.

A systematic review of instruments to measure patient safety climate [238] found nine surveys that measured this construct. All used Likert scales to measure attitudes of individuals. Nearly all covered five common dimensions of patient safety climate: leadership, policies and procedures, staffing, communication, and reporting. The strength of psychometric testing varied. While all had been used to compare units within or between hospitals, only one explored the association between organizational climate and patient outcomes.

Gaps in knowledge in patient safety culture

There is a theoretical gap in the lack of a common definition of patient safety culture or common view of its dimensions/components in healthcare. There is also a research gap in the lack of measures

of patient outcomes related to a patient safety culture. There is a lack of knowledge regarding how diversity in the workforce, as a component of organisational culture, affects patient safety culture.

5. CONCLUSION

Major finding

Team training in healthcare

There are many training programs in health care. Most teamwork training programs are premised on CRM principles. Most of the measured outcomes used to evaluate training programs are reactions and behaviours of trainees. Most team training programs tend to be effective based on measures of reactions and behaviours. Though some training programs are effective based on outcomes, many of these tend to be proprietary programs. Finally, there is a controversy over the level of simulation that is the most appropriate for team training, taking into account effectiveness, practicality and costs.

Specific tools to improve team processes

Most of the tools used to improve team processes fall under domain of communication: briefings, debriefings, SBAR, assertive language, critical language, common language, closed communication loops, active listening and callouts.

Changes in the culture

In order to create changes in patient safety culture, patient safety climate must be addressed. There must also be sustained leadership to bring about change to complement this change.

Major gaps in the literature

Team training in healthcare

There is a lack of programs based on the ITEM model, the only model to be target healthcare teams and a lack of higher order measures of outcome in evaluating effectiveness of team training.

Specific tools to improve team processes

There were not many studies carried out on individual tools such as common language or closed communication loops. There was a marked lack of reporting on implementation of tools, and effectiveness measures were generally not on patient outcomes.

Changes in the culture

There is a lack of common definition of patient safety culture as well as insufficient theory on how to achieve patient safety culture. There is also a lack of research examining the effects of workforce diversity on teamwork and communication. In studies examining changes in culture, not many evaluated effectiveness of patient safety culture in terms of patient outcomes.

Future work

It is clear from the previous section on major gaps that there remains much potential work. There needs to be more theory development around constructs of teamwork and team effectiveness for

healthcare that is not just lifted from aviation (CRM principles). Perhaps the ITEM model can be built upon. There is also insufficient theory on the framework of patient safety culture and how to achieve such culture.

Also, in order to be able to glean the practicality of implementation of specific tools to improve team processes, there needs to be better reporting in the literature.

Finally, the research needs to take into account patient outcomes as measures of effectiveness of team training, specific tools to improve team processes and patient safety culture. Furthermore, there should be evaluations of individual tools such as common language or closed communication loops.

6. APPLICATION TO CANADIAN FRAMEWORK

In Canada, teamwork is promoted in healthcare, with best practices set out from selected Canadian initiatives for its facilitation [241]. Though mainly from primary care, they are nonetheless useful to this review. These include: improved communication and partnerships among all health providers and patients; clarity on the role of all health providers working within team environments; better response processes in addressing determinants of health; improved coordination in the provision of healthcare services; high levels of satisfaction on delivery of services; effective utilization of health resources. Safety culture is advocated in healthcare, as well. Creating a culture of safety is one of Accreditation Canada's five patient safety goals and required organisational practices.

Thus, the findings in this broad-based literature review may enable senior administrators and clinical managers in addition to healthcare frontline and support staff to have a better understanding of teamwork, communication and safety culture, so that they can make informed decisions about and/or participate in improvement strategies.

Recommendations based on findings

Education

- integrate teamwork training into undergraduate education of healthcare professionals

Theory

- identify the critical teamwork competencies within the specific healthcare team to use as a focus for training content
  - emphasise teamwork over task work when designing for training to improve team processes
  - use simulation, whether high-fidelity or low-fidelity as a part of experiential learning, with the given resources available

Policy

- create incentives for professionals to take up teamwork training

Practice

- implement structured communication tools, especially briefings and SBAR
- assess the patient safety culture of your healthcare organisation

Research

- evaluate teamwork, team training, structured tools and patient safety culture using clinical outcomes, learning and behaviour on the job

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