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ENHANCING PERIOPERATIVE PATIENT SAFETY: A COLLECTIVE RESPONSIBILITY

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ABSTRACT:

Teamwork, patient advocacy, and high quality safe care are at the core of the perioperative nursing profession. Although perioperative health professionals endeavour to provide high quality and safe patient care the prevalence of preventable adverse events (AEs) in the perioperative setting reflects an emergent need to improve perioperative patient safety. Remarkably, studies related to preventable AEs consistently describe teamwork challenges to be responsible. A review and appraisal of the literature associating a multidisciplinary perioperative team training intervention with patient safety outcomes of morbidity and mortality bring attention to the benefits of team training. The importance of a collaborative approach to perioperative patient safety is highlighted to motivate healthcare professionals to engage with enhancing a collective perioperative safety culture. Enhancing perioperative patient safety also requires a multifocal approach and collective commitment to a patient safety culture.

Collaborative practice and its challenges in the context of the perioperative setting are explored, followed by a review and evaluation of the literature measuring an association between a team training intervention and patient safety. Implications of findings to practice are discussed, whereas Wenger's Communities of Practice (CsOP) and Gittell's Relational Coordination (RC) theories offer innovative perspectives to understand team potential. Considerations for further enhancing a collective perioperative safety culture are also provided.

INTRODUCTION

Patients, and their families, trust perioperative healthcare professionals to provide high quality and safe care. This trust is a privilege and requires professional accountability for patient advocacy and continual practice enhancement. Both the Nightingale Pledge and Hippocratic Oath entrust healthcare professionals' dedication to the advancement of human welfare and knowledge and affirm the fundamental principle to first do no harm. This is also commonly known by the Latin phrase Primum non nocere.[1,2] Although perioperative healthcare professionals endeavour to provide high quality and safe patient care there is, paradoxically, a prevalence of adverse events (AEs) in the perioperative setting.[3] AEs are unintended and "undesirable outcomes attributed to medical care rather than to the underlying disease process."[4] Safety is, conversely, defined in terms of risk resilience such as the prevention of AEs and harm.[5,6]

Perioperative safety literature commonly references the Institute of Medicine (IOM)'s 1999 landmark report To Err is Human: Building a Safer Health System which highlighted patient deaths due to error and recognized the operating room (OR) as a dominant setting for unintended harm.[7] Baker et al.'s 2004 Canadian AE study revealed that 7.5% of hospitalized patients experienced an AE of which 36.9% could have been prevented.[8] In this same study, surgical services were in the lead as the most responsible service for delivery of care at the time of an AE. More recent studies demonstrate continued, or increased, levels of AE occurrence related to hospitalization. Data from 2014 and 2016 supports that AEs occur in at least 30% of American hospital admissions,[9,10] with an estimated 400,000 preventable premature deaths per year occurring as a result of hospitalization.[11] Literature from 2014 also supports that the OR remains a dominant AE setting.[9] A 2009 study of self-reported medical errors included Canada among seven industrialized countries reporting rates of errors from 12 to 20%.[12] A mean post-operative in patient mortality rate of 4% was, furthermore, described in a 2012 European study.[13] Research has additionally demonstrated that many AEs are not being captured by the voluntary or retrospective measuring methods that are utilized by many healthcare organizations. A recent inquiry comparing the use of a direct observational measuring tool, versus retrospective measurements, to measure AEs suggests that the number of AEs is, in actuality, substantially higher than reported.[14] Moreover the scientific community has implied that practically half of the AEs related to surgery are avoidable.[4,15]

Preventable errors, such as unintentionally retained surgical items, are detrimental to patients and their families and consume valuable healthcare resources.[16] The most common root causes of perioperative errors relate to team dynamics, and include human factors, leadership, and communication challenges.[17,18] In a recent retrospective seven center study, of the natural history of retained surgical items in the USA, most cases involving retained surgical items were related to team or system error.[19]

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The literature increasingly documents that improving teamwork, communication patterns, and the safety culture of healthcare professionals will positively impact the safety of perioperative patients.[17,20] It is valuable to evaluate the evidence on the topic of inter-professional team training and perioperative patient safety, to inform future decisions about investing to improve patient safety. Teamwork is an inviting concept in healthcare but there are barriers to effective inter-professional collaborative practice in the perioperative context.

The purpose of this article is to discuss the importance of a collaborative approach to perioperative patient safety, bring attention to the benefits of team training, and motivate healthcare professionals to engage with enhancing a collective perioperative safety culture. In this article, collaborative practice and its challenges in the context of the perioperative setting are explored, followed by a review and evaluation of the literature measuring an association between a team training intervention and patient safety. Implications of findings to practice are discussed, whereas Wenger's Communities of Practice (CsOP) and Gittell's Relational Coordination (RC) theories offer innovative perspectives to understand team potential. Considerations for further enhancing a collective perioperative safety culture are also provided.

Within this article the terms teamwork and collaborative practice are used interchangeably.

COLLABORATIVE PRACTICE

Perioperative context

The perioperative setting is a continually evolving, highly technical and fast paced environment, with an often unpredictable and urgent nature, where team members rely strongly on each other. Although contemporary, the OR remains an environment that is described

by perioperative professionals as regulated, restrictive, and confined. In addition to the focused and prolonged attention to detail required of health professionals in the perioperative setting, the modernization of patient care raises the knowledge and expertise expectations on health professionals. As they provide increasingly complex care to surgical patients perioperative nurses remain strong advocates for patients.[21] Volume and acuity of patients, staffing shortages, expanding number of learner and novice health professionals, and the importance of efficiency and time management in the OR impose additional pressures.[22,23] Expectations on health professionals also include assignment flexibility and adapting to work demands of various highly specialized perioperative services. This can create situations where team members are unfamiliar with each other. Perioperative team members include surgeons, anaesthesiologists, surgical assistants, perioperative nurses, perfusion technologists, respiratory technologists, educators, managers, medical device reprocessing (MDR) personnel, support personnel, and learners from the various disciplines. While the dynamic nature of the perioperative environment can create a context conducive to tension[23] concurrently, the interdependence of team members is vital to ensuring safe, precise, and timely responses. In the perioperative context the surgical team is central and integral to quality and safe patient care.[20]

Teamwork and collaborative practice

A healthcare team is most commonly defined as a group of interdependent individuals with specialized knowledge and skills who collaborate to achieve a common goal.[24] Team interdependency requires individuals to concurrently be accountable, flexible, and to adapt to each other to attain the same objective.[25] Teamwork relates to "the behaviors, cognitions and attitudes that make interdependent performance possible."[26] Team cohesiveness and team norms are important influential factors in the achievement of high performance.[27] Team cohesiveness is dependant on attraction, motivation, and commitment to the team. Norms refer to acceptable and expected team behaviour.[28]

Inter-professional collaborative practice is a partnership of shared knowledge and decision making between members of various healthcare disciplines to optimize patient health outcomes.[29,30] Successful inter-professional collaborative practice is, indeed, contingent on the quality of working relationships.

CHALLENGES TO COLLABORATIVE PRACTICE

Promoting teamwork may seem a rather simple endeavour. Teamwork, however, requires more than multidisciplinary healthcare professionals working independently towards a common

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purpose.[30] Physical proximity of team members does not necessarily translate to effective teamwork.

Learning and working in silos

Health disciplines have traditionally learned and defined practice boundaries independently from each other with ensuing differences in perceptions of power, status, and teamwork, and with a subsequent fragmentation of care.[23] Knowledge and practice boundaries have served to control decision-making and protect the financial, political, and social interests of the various professions. These delineations have thus supported a distorted understanding of other professional roles.[31] Healthcare research has demonstrated that individuals attribute greater weight to maintaining disciplinary professional identity than to collaboration.[31] Communication patterns in the OR continue, for example, to reflect professional hierarchy in practice.[32] Learning and working within the confines of respective health disciplines results in what is commonly known as 'practicing in silos'.[30] The lack of educational exposure to developing the knowledge and skills necessary to work effectively within inter-professional teams results in frequent duplication of tasks and inconsistencies in patient care between the various disciplines. Emphasis on technical skills in healthcare education, and the independent socialization to practice of each discipline, segregate professional cultures, which contribute further obstacles to learning and working together.[17,33]

Human factors

The science of human factors offers a different perspective for understanding collaborative practice challenges. It explains the interrelationships between components of work systems and the limitations of human performance, which assist with understanding the fact that nullifying human error is unrealistic.[24] Rather than define individual reasons for error, the science of human factors considers fundamental human limitations which include memory and vulnerability to effects of distraction, stress, and fatigue. For example, the vital need to be attentive in healthcare has been associated with situational awareness, and is influenced by how one perceives, comprehends and projects information within a defined context.[34]

Workforce shortage and capitalizing on efficiency

It is predicted that Canada will be short 60,000 nurses by 2022.[35] In addition, recruiting and retaining nurses to highly specialized areas such as the OR is particularly challenging.[29,36] Lack of the necessary human resources has been correlated with the prevalence of medical errors as well as decreased job satisfaction, creating a cycle of high absenteeism and turn overs, and increased workloads.[37] In the OR large numbers of novice professionals create additional ongoing responsibility for current staff to support and train. Decreased funding and healthcare restructuring further impose continual administrative pressures to capitalize time management and increase efficiency. Understanding challenges to collaborative practice opens opportunities to explore solutions, such as team training interventions, to enhance patient safety.

REVIEW OF LITERATURE

To find solutions to imminent patient safety concerns, healthcare leaders and professionals have aligned their thoughts on the notion that collaborative perioperative practice is vital to ensure safe surgical processes and positive outcomes for patients. They have engaged in evaluating perioperative team training interventions that draw on concepts of teamwork, inter-professional practice, human factors, and safety check list implementation.[3,38] As it is, however, essential to invest both human and financial healthcare resources and time if and where evidence suggests promising results,[39] a focused research question was formulated to further inform perioperative health professionals. The question "What is the quality of the evidence that supports a positive relationship between perioperative team training and patient

safety?" became the focus of this study. Literature search methods and results of the author's research process are outlined in the remainder of this article.

Methods

The literature was initially searched using the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and MEDLINE/PubMed applying key words and Boolean operators. Search terms included "(team training) AND (operating room OR perioperative OR surgery AND safety". The process was then repeated in each of the databases with each search adding one of the alternate search words of "collaboration, inter-professional, team skills, human factors, and evidence". Search terms "team training, collaborative, operating room, and safety", were applied to Cochrane Library databases as well as with Excerpta Medica Database Guide (EMBASE), ProQuest Nursing and Allied Health Source, and Google Scholar.

Inclusion criteria consisted of articles published from 2006 to 2016 in English in peer-reviewed journals. Articles associating a multidisciplinary perioperative team training intervention with patient safety were selected. Opinion papers and position statements were not included. Articles were excluded if interventions were restricted to a specific healthcare discipline, if their main purpose was the evaluation of measuring tools, if they did not pertain to the OR, or did not represent a team approach. To maintain focus on lower cost and practical interventions, and because simulation was felt to be a field of its own, articles pertaining to simulation were excluded.

After omitting recurrent documents, 510 articles, with an additional six articles identified through the reference list of published articles, were scanned and categorized according to inclusion and exclusion criteria.

Results

Full text of 37 papers, meeting the established criteria, were reviewed to explore work done on this topic, and to search for papers measuring a correlation between a perioperative team training intervention and patient safety.

Six literature reviews[14,40,41,42,43,44] and seven explanatory papers,[3,17,45,46,47,48,49] from among the 37, supported teamwork in the perioperative setting. Three studies measured compliance with a safe surgery check list (SSCL),[38,50,51] and one linked patient outcomes with surgical team behaviour without specifying an intervention.[52]

The remainder of papers applied a team training intervention described either in general terms (as the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program), human factors based Crew Resource Management (CRM) training (such as the Veteran Health Administration (VHA) Medical Team Training (MTT) program), or the application of SSCL. Safety outcomes measured included a variety of themes. A general team training intervention was presented in five articles -- four with outcome measurement of teamwork safety climate[53,54,55,56] and one measuring team function and performance.[57] The TeamSTEPPS program was the intervention of choice in two articles; one measuring outcomes of the safety culture of surgical team members,[26] and one measuring safety culture as well as patient morbidity and mortality.[58] The human factors/CRM training intervention was the most prominent team training intervention found in the literature with appearance in nine studies. The outcomes measured with CRM included teamwork and efficiency in one paper,[59] teamwork safety climate in one paper,[60] communication and safety attitudes in two papers,[61,62] quality of team based behaviour in one paper,[63] safety culture in one paper,[64] compliance with safety practices in two papers,[65,66] and patient mortality in one paper.[59] Team training interventions pertaining to SSCL were represented in five research studies. One study offered practical challenges to implementing a check-list and did not provide measurement of outcome,[67] one study

measured safety culture of team members[68] and three studies measured patient morbidity and mortality.[69,70,71]

Studies were ranked by considering research design hierarchy, quality and rigour of methodology, internal and external validity, statistical strength, and outcomes measured.[39] Although the Randomized Control Trial (RCT), Meta-analysis, and Systematic review of RCT, are preferred research designs, studies using these research methods were not available with this literature review. Cohort studies and observational/ controlled, pre- and post-interventional designs were, however, identified. To select studies most pertinent to the research question, these latter studies were assessed for choice of patient safety outcome, sample quality and control group, duration and clarity of study, and whether interventions were single or multifaceted.

Diversity of team training interventions and outcomes measured was apparent in the literature. Articles with team training interventions found to be similar in nature were compared. Interventional papers were also grouped according to outcomes measured as outlined above. A total of five research studies were found to be most rigorous and compared patient morbidity and mortality following a perioperative team training intervention. As these studies also provided objective and limited bias of measurement of outcome they were selected for appraising the quality of the evidence demonstrating a relationship between perioperative team training and patient safety.

ANALYSIS

Five research studies comparing patient morbidity and mortality following a perioperative team training intervention[58,59,69,70,71] were identified and appraised. Research quality was assessed considering study design, validity and relevance of studies, as well as distorting influences and reliability of outcomes.[39] Studies included four cohorts and one pre- and -post intervention study. Interventions consisted of the TeamSTEPPS program, VHA MTT program, SURgical PAtient Safety System (SURPASS) checklist and World Health Organization (WHO) SSCL. Appendix A provides a summary of the five identified appraised studies incorporating author, year, and title of papers with respective team training intervention description and duration, involved team members, and outcomes. Outcomes were assessed considering quality and strength of results, including statistical and clinical significance.[39]

Evaluation of outcomes

Statistical measurements quantify effect size, precision, and probability that results are real (as opposed to reflective of chance).[72] The results section in Appendix A summarizes outcomes measured based on statistical and clinical significance. Although a variety of measuring instruments were utilized, within the five identified studies, outcome measurements were found to be well defined in most studies with predetermined 95% Confidence Intervals (CIs) in four studies, and p-values of 0.05 or less.

Within the five studies a number of associations between team training and surgical morbidity and mortality rates were identified by authors.

Armour Forse et al.[58] associated a TeamSTEPPS training program with reduction in surgical morbidity and mortality from 20.2% to 11.0% ($P<0.05$) and from 2.7% to 1% ($P<0.05$) respectively, nine months after intervention. Although one year later they measured an increase in surgical morbidity and mortality, 11% to 13% ($P<0.05$) and 1% to 1.5% ($P<0.05$) respectively, results were still lower rates than pre-intervention. Armour Forse et al also noted a reduction in benefit when the intervention was not sustained.[58]

Neily et al.[59] correlated a VHA MTT program with an 18% decrease in surgical mortality (rate ratio 0.82, 95% CI, 0.76-0.91, P=0.01), one year following intervention. After risk adjustment, the intervention group was

compared to a control group. The comparison showed a 50% decline in mortality (rate ratio 1.49, 95% CI, 1.10-2.07, P=0.01). For every three months of additional training, a reduction of 0.5 deaths per 1000 procedures (95% CI, 0.2-1.0, P=0.01) was noted.[59]

After adjusting for confounding factors, de Vries et al.[69] found an Absolute Risk Reduction of surgical complications that was 9.7 (95% CI, 7.8-11.5), representing the difference in rates between control group and interventional group, three months following introduction of a comprehensive multidisciplinary check list for the entire surgical pathway. Post intervention adjusted mortality rate ratio was 0.54 (95% CI, 0.33-0.88). Compliance to check list above median versus below median was associated with a rate ratio of 11.7 (95% CI, 7-9-15.6).[69]

Haynes et al.[70] associated a reduction in rate of death from 1.5% before intervention to 0.8% after (P=0.003), as well as reduction in post- surgical complications from 11% to 7% (P<0.001) following introduction of the WHO SSCL. Post intervention adherence to check list was measured at 56.7% (P<0.001).[70]

After adjustment for baseline differences, Van Klei et al.[71] found a mortality odds ratio of 0.85; 95% CI, 0.73-0.98 with introduction of the WHO SSCL. Outcome effect was strongly correlated with compliance to the check list. With full check list compliance, for example, outcome rate ratio was 0.44 (95% CI, 0.28-0.70).[71] Appendix B provides an analysis summary of study design, validity, distorting influences, and relevance as well as strengths and limitations of papers. Overall, team training interventions demonstrated positive results.

IMPLICATIONS OF FINDINGS TO PRACTICE

Key interventional components from the five identified studies are outlined below and are followed by a discussion on perioperative safety checklists and multifaceted team training programs. Wenger's Communities of Practice and Gittell's Relational Coordination theories, and their potential application to future research will also be discussed.

With the goal of improving teamwork dynamics and patient safety, the TeamSTEPPS intervention provided teaching pertaining to leadership, situational awareness, mutual support, communication techniques, as well as briefing and debriefing. Based on CRM the VHA MTT program provided education related to communication, assertiveness, conflict resolution, brief and de-brief, work load distribution, and fatigue management. Extent of safety checklists varied among the studies but all applied a team brief that was assumed to promote inter-professional team communication and collaboration. The comprehensive SURPASS checklist, however, introduced additional variables such as structured handovers within the surgical pathway and reinforcement of

strict hand hygiene rules. This addition reduced comparison capabilities. When, however, specifically comparing impact of respective team training intervention, on surgical morbidity and mortality, all interventions demonstrated benefits for patients.

Checklists and perioperative team compliance

In 2004, the WHO established the World Alliance for Patient Safety (WAPS) to create global initiatives for patient safety.[73] Recognizing that communication challenges, between team members in the OR, were significant contributing factors in perioperative patient AEs, the WAPS launched the Safe Surgery Saves Lives (SSSL) challenge in 2008.[73] Haynes et al's 2009 research, which was appraised as part of this article, was a response to this initiative to improve patient safety. Intended to address key issues, including anaesthesia safety practices, surgical infections, and communication inefficiencies, the SSCL was created and evaluated.[73] The SSCL is a tool comprising critical information in the form of safety checks. This tool is intended to initiate, guide, and formalize communication among surgical team members, during every surgical procedure, at three different intervals that are designated as "brief, time out, and debrief".

Standardization of practice, such as consistent check list implementation, among team members promotes human interactions of high reliability and aligns with the science of human factors philosophy.[44] Haynes et al.'s[70] research results set precedence and initiated a global trend toward systematically adopting simple and cost-effective interventions, such as a checklist tool, to improve surgical patient safety. Standardizing practice contributes partially to solutions but balancing five human factor elements, within the perioperative work system, has been proposed as a way to further promote patient safety.[74] These elements are skills and experience, multitasking and task prioritization, tools and technologies, physical environment, and organizational factors (such as safety culture and attitudes toward team work). Studies appraised in this article demonstrate that using a safety checklist provides substantial benefits for patients and an increased patient benefit was correlated with high SSCL compliance levels. SSCL compliance varies significantly among the various healthcare organizations worldwide.[50,75,77] While the WHO SSCL continues to be implemented internationally the consistent engagement and compliance with practice is questionable,[76] and it is challenging to measure without bias.[38] Using the SSCL as a documenting check box exercise has been identified to be a potential safety concern by members of the surgical team, if not all members of the surgical team are engaged in this practice.[78] Whereas checklists are practical for standardizing important safety elements they are not necessarily a complete solution.[79] Building team skills further promotes inter-professional communication and collective efficiency[80] and so team training is considered a strong support to other practices such as the use of the SSCL.

Team training programs and patient safety

In the appraised studies TeamSTEPPS and VHA MTT programs demonstrated positive results on patient safety. These programs, however, required significant preparation time as they were multifaceted and contained many components. While these comprehensive team training interventions measured reductions in patient mortality it is difficult to identify if a particular component of the program was responsible for the identified outcomes. In addition the external validity of the study that represented the greatest impact[59] was compromised. Within the appraised studies that discussed a safety check list as the team training intervention, staff preparation needs were also noted. Positive associations found with TeamSTEPPS and VHA MTT programs suggest that educating inter-professional perioperative team members on the concept of human factors and in team skills that include

communication, can potentially enhance team awareness and increase team engagement with using tools such as the SSCL. Staff preparation was also noted in studies discussing a safety checklist as the team training intervention. Successful application of practices such as the SSCL necessitates collaborative transformation towards a safety culture.[48]

It is improbable that a single intervention can be isolated as the causal factor for safety improvements and, thus, multifaceted interventions are likely to better address a range of system flaws.[17] Evidence appraised in this literature review is of moderate strength and limitations include applicability of studies to the local population and anticipated associated cost to the healthcare system.

Replication of the research process or application of RCT design, with respective interventions such as TeamSTEPPS and VHA MTT programs across various local perioperative settings, is necessary to increase the strength of the findings. Recent application of the TeamSTEPPS intervention in the perioperative setting was clearly associated with an impact on patient safety issues, as well as improved operating room efficiency, although patient morbidity and mortality rates were not specifically measured.81 Hughes et al., in their recent meta-analysis of team training in healthcare, stated that "team training is a valuable human resource capital strategy in healthcare that can affect organizational and patient outcomes."[82]

Further research and dissemination of evidence-based perioperative team training interventions could result in further enhancement of surgical patient safety. The framework for future research can be developed based on a number of theories. Drawing on theoretical concepts such as Everett Rogers' theory of diffusion of innovation[48,83] can, for example, assist with understanding variables such as beliefs and perception of benefit, which can influence engagement and compliance with innovative practice. Studies discussing the preparation of team members for practice change suggests a potential association between transforming surgical team members' beliefs and positive outcomes. Etienne Wenger's Communities of Practice theory and Jodi Gittell's Relational Coordination theory offer additional understanding of team potential and could support future research.[84]

Wenger's Communities of Practice (CsOP) Theory

Wenger's theory draws on social learning and, therefore, provides a framework for understanding how perioperative team members' interconnectedness can foster effective teamwork and a shared commitment to safety practices. For example, learning through socialization processes contributes to shaping professional identity.[84,85] CsOP are groups of individuals with a common goal who engage with, interact with, and learn with and from each other in practice.[84] CsOP supports an approach to social learning where health professionals gain new perspectives as they relate to one another, create shared meaning, and negotiate new ways of interacting as a team.

Wenger's principles of mutual engagement, joint enterprise and shared repertoire in CsOP offer opportunity for new insight with learning collaboratively in the perioperative setting.[84]

Mutual engagement refers to how individuals interact with each other to create shared meaning. In the perioperative context team members share ideas, stories, and patient concerns. Joint enterprise refers to how individuals work together to achieve a common goal. In the perioperative COP each individual is accountable for being competent within his/her scope of practice. This is expected by COP participants and necessary in order to establish mutual respect and trust. Shared repertoire refers to resources used by participants of a COP to discuss and agree on what is meaningful and will facilitate learning. Roles and expectations are defined, and various working systems are in place to encourage efficient use of time and resources.

Multiple CsOP can be interrelated to each other.[84] In the perioperative environment, various respective CsOP, such as the surgical team, management team and MDR team, interact and aim to understand each other. Although communities can be very close-knit they also need to remain open to accepting new members (such as learners from various healthcare disciplines). Wenger's theory guides our understanding of how learning is created through social participation in communities. For example, taking an inclusive approach (obtaining input from all disciplines that form the perioperative team), sharing ideas, and creating inviting learning environments where everyone feels supported, can enhance the team learning process. Context therefore plays a key role in learning.[86]

Gittell's Relational Coordination (RC) Theory

Jody Gittell's Relational Coordination (RC) theory is a concept offering further understanding of team member interdependencies.[87] RC is "the coordination of work through relationships of shared goals, shared knowledge, and mutual respect" that includes communication that is frequent, accurate, timely, and problem solving.[88] RC recognizes that connecting health professionals from various disciplines can be challenging where practicing in silos has been the tradition. Drawing on the social capital of professional relationships[88] the RC theory recognizes relational, structural, and work process interventions that promote RC to foster sustainable high performance and resilient work systems in healthcare.[89] High levels of RC, in healthcare environments, have been associated with fewer errors and improved efficiency.[90]

Gittell's validated measuring tool can be practical for evaluating RC at multiple levels in an organization.[88] The tool includes questions that pertain to the quality of working relationships, as well as the frequency, timeliness, accuracy, and problem-solving nature of communication.[90] Gittell's evaluation tool can serve as a baseline to identify RC strengths and weaknesses as well as to evaluate teamwork outcomes following team training intervention. Building and sustaining perioperative RC provides a means to coordinate the efforts of all perioperative team members and work towards a collaborative safety culture.

FURTHER CONSIDERATIONS

Recognizing that cohesive healthcare teams enhance the safety of surgical patients, promoting collective efficacy in the operating room could be further supported through a multifocal approach. Additional considerations for enhancing a collective safety culture in the perioperative context include team leadership, inter-professional continuing education, and reporting and learning from adverse events.

Team Leadership

Leadership is "an influence relationship among leaders and followers who intend real changes and outcomes that reflect their shared purposes."[27] High performing team leaders maintain strong relationships with team members, inspire team members to attain shared goals, are integral to their team, foster team commitment, build trust, remove obstacles, and create opportunities.[28] As perioperative nurses, it is imperative that we embrace leadership and followership opportunities to influence each other towards betterment. For example, perioperative team members must be able to hold each other accountable for conformity to established safety practices and for maintaining collective engagement with standards of care. Perioperative practice is a privilege encompassing advocacy for patient safety which needs to be ensured rather than assumed.

Organizational support theory explains that employee perceptions of the organization's caring and support fosters trust which increases resilience and work performance.[91] Creating healthy work environments supports safety of team members and thus the safety of patients. A healthy work environment is physically and psychologically safe, respectful, transparent, inviting, supportive, and

stimulating.[92] Supporting a just cultural organizational philosophy enables all individuals to feel safe and encouraged to discuss issues of concern. For example, flattening hierarchy of power creates psychological safety to promote healthy dialogue and encourage team members to voice safety issues.[25]

Motivation is the result of internal or external drives that stimulate interest and perseverance towards a particular direction.[93] Leaders can motivate surgical team members to collectively engage with safety practices by aligning personal and organizational values and interests, which can serve as intrinsic motivators. Whereas engagement relates to work satisfaction, a feeling of belonging, caring, and enthusiasm with reaching goals; empowerment is the sharing of power within members of an organization.[27] Empowering surgical team members can motivate them by satisfying higher level needs such as self-efficacy, control, and autonomy. Sharing knowledge, providing opportunities for teams to learn together and connect with a meaningful purpose, can foster multidisciplinary team commitment with creating a culture of patient safety in the OR.

Organizational citizenship behavior, which refers to an employee's commitment and performance within an organization, is enhanced when employees are recognized for their contributions with meaningful rewards, and experience control and empowerment within a collaborative environment.[28] As compliance can be temporary, leaders can instead foster commitment to produce enduring results. Generating commitment aligns with patient advocacy and can also assist with moving towards a culture change. Culture refers to how beliefs and values are conveyed in a system of collective meaning, which impacts patient care outcomes.[28,94] An inclusivity approach with decision making and knowledge sharing builds a strong collaborative foundation. Role flexibility and mutual trust that develop in an interdependent work environment foster collective accountability as well as ethical and altruistic behavior which are valuable elements to construct a safety culture.[95]

Inter-professional Continuing Education

With the goal of promoting collaborative practice between healthcare professionals the WHO developed a framework for action on inter-professional education and collaborative practice stating that this movement is "a key step in moving health systems from fragmentation to a position of strength."[30] The Canadian Interprofessional Health Collaborative (CIHC) subsequently developed a National Interprofessional Competency Framework that promotes mutual learning and draws on team work principles such as responsible communication for collaborative practice, shared accountability, and constructive conflict resolution.[29] These global movements provide direction for further enhancing collaborative practice. Inter-professional education allows health professionals of various disciplines to learn with, from, and about each other to advance collaborative practice.[30] Drawing on the principle that knowledge is socially constructed inter-professional education is aligned with Wenger's CsOP and Gittell's RC and can support the achievement of individual and team competencies necessary for effective collaborative practice. Inter-professional education can lead to the exploring of professional differences and the diverse clinical approaches in a way that results in combining knowledge and capitalizing on competencies of various professions.96 Exploring continuing inter-professional education in the perioperative context can, therefore, enable further improvements in team practice and safety levels.

Although simulation was initially identified as an exclusion criteria for this article's literature review, it is notable to mention that perioperative team training using simulation is increasingly supported as an effective continuing education strategy to improve patient safety.[97,98,99] Technical as well as non-technical skills, such as team competencies, can be developed with simulation and the method is applicable to inter-professional training.

Reporting and Learning from Adverse Events

Reporting perioperative patient harm is imperative to advancing learning and preventing future errors.[10] Challenges associated with reporting errors are related to organizational cultural barriers such as fear of disciplinary procedures, competing priorities, and lack of coordination and consistency with reporting.[105] Promoting a safety culture in the perioperative context also requires collectively learning from errors.

A collective safety culture requires openness to learning from one's own errors and the errors of others and adopting a systems perspective that allows for exploring root causes rather than assigning individual blame for error.[10] Adopting a collaborative safety culture requires transparent accountability from team members for reporting patient harm. At the forefront of patient care, perioperative nurses are strong advocates for enhancing patient safety by identifying and sharing opportunities to learn from previous errors, sharing concerns, and reporting harm or close call events which create opportunities for improvement. To enhance collective reporting of adverse events local reporting systems can be standardized, user-friendly, and involve providing feedback to team members where applicable.

CONCLUSION

The prevalence of AEs in the perioperative setting reflects an imminent need to improve perioperative patient safety. In this environment, where successful inter-professional collaborative practice is central and integral to quality and safe patient care, teamwork challenges are commonly identified as a root cause of preventable AE. Barriers to collaborative practice are plentiful in this setting.

A review and appraisal of the literature associating a multidisciplinary perioperative team training intervention with patient safety outcomes of morbidity and mortality brought attention to the benefits of various team training

Appendix A: Summary of Appraised Studies

Author/Year/ Title Research Design	Intervention Description, Identified Team Members, Training Duration	Outcomes
Armour Forse, R., Bramble, J. D., & McQuillan, R. (2011) TEAM TRAINING CAN IMPROVE OPERATING ROOM PERFORMANCE **Research Design** Prospective Cohort study	**Intervention Description** The Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program Stems from department of defense and adapted for health care Emphasizes concepts of leadership, situation awareness, team support, communication Includes briefing & debriefing Federally sponsored, resource-based, evidence-based approach to team training Includes training of mentors and coaches, top down approach Systematic approach for training staff Encourages active participation **Identified Team Members** All members of operating room (OR) team including scrub technicians, nurses, certified registered nurse anesthetists, anesthesiologists, surgeons, all anesthesiology and surgical resident staff **Training Duration** 2 days training session	**9 Months After Training Intervention** Teamwork 53.2 to 62.7 (P<0.05) OR communication 47.5 to 62.7 (P<0.05) OR first case starts 69% to 81% Antibiotic administration 78% to 97% (P<0.05) Venous thromboembolism administration 74% to 91% (P<0.05) Beta blocker administration 19.7% to 100% (P<0.05) Patient satisfaction 77% to 89.3% (P<0.05) Surgical morbidity 20.2% to 11.0% (P<0.05) Surgical mortality 2.7% to1% (P< 0.05) **Additional Year Later** Surgical Quality Improvement Program measures (SQIM) (linked to safety check list, time out) demonstrated continued improvement OR first case start 81% to 69% (P<0.05) (note additional measurement of 96% in 2009 & 98% in 2010 with added policy of removing surgeon OR time with start delays & bonus to OR staff for meeting start time targets) Patient satisfaction 89.3% to 80.8% (P<0.05) Surgical morbidity 11% to 13% (P<0.05) Surgical mortality 1% to 1.5% (P<0.05)
de Vries et al. (2010) EFFECTS OF A COMPREHENSIVE SURGICAL SAFETY SYSTEM ON PATIENT OUTCOMES	**Intervention Description** Surgical Patient Safety System (SURPASS) Comprehensive multidisciplinary surgical safety checklist, including medication, marking of operative side, review of imaging studies, accounting of necessary equipment and materials, hand off of post-operative instructions, provision of prescriptions to patient at discharge	**Complications** Post intervention, complications absolute risk reduction(ARR) = 10.6 (95% CI, 8.7-12.4), uncorrected rate ratio=0.613 (95% CI, 0.545-0.681) After adjusting for confounding factors, ARR=9.7 (95% CI, 7.8-11.5), rate ratio=0.646 (95% CI, 0.579-0.714) Proportion of patients with complication(s) decreased from 15.4% to 10.6% (P<0.001)

Author/Year/Title Research Design	Intervention Description, Identified Team Members, Training Duration	Outcomes
Research Design Prospective Cohort study Controlled before & after intervention study with control group Observational, before & after	Check list divided into parts corresponding to stages of care in surgical pathway (pre-operative, operative, recovery or intensive care, post-operative) 124 items collected at 6 time points from hospital admission to discharge **Identified Team Members** Multidisciplinary **Training Duration** 9 months	**Mortality** Post intervention in-hospital mortality ARR=0.7 (95% CI 0.2-1.2), uncorrected rate ratio=0.52 (95% CI, 0.34-0.81) Adjusted mortality rate ratio=0.54 (95%CI, 0.33-0.88) **Control Group** No change in outcomes in control group **Compliance** Compliance to checklist post implementation =80% completion Compliance to check list above median vs below median was associated with ARR=11.7 (95 % CI, 7.9-15.6)
Haynes et al. (2009) A SURGICAL SAFETY CHECKLIST TO REDUCE MORBIDITY AND MORTALITY IN A GLOBAL POPULATION Research Design Prospective study of pre-intervention & post-intervention periods	**Intervention Description** World Health Organization (WHO) Safe Surgery Checklist 19 item surgical check list designed to improve team communication and consistency of care Oral confirmation by surgical team of completion of basic steps for ensuring safe delivery of anesthesia Antibiotic prophylaxis Focus on team work and other essential surgical practices Used before anesthesia (briefing with team introductions), immediately before incision (time out), and before patient taken out of OR (debriefing) Used lectures, written materials, or direct guidance Primary investigators distributed recorded video to study sites, participated in teleconference with each local study team, made a visit to each site Identified Team Members Multidisciplinary Training Duration 1 week to 1 month	Rate of death =1.5% before intervention & 0.8% after intervention (P=0.003) In patient complications=11.0% at baseline & 7.0% post intervention (P<0.001) Adherence to 6 safety indicators performed for 34.2% of patients at baseline, & for 56.7% of patients post intervention (P<0.001)

Enhancing - Appendix A cont.

Author/Year/Title Research Design	Intervention Description, Identified Team Members, Training Duration	Outcomes
Neily et al. (2010) ASSOCIATION BETWEEN IMPLEMENTATION OF A MEDICAL TEAM TRAINING PROGRAM AND SURGICAL MORTALITY **Research Design** Retrospective Cohort study using contemporaneous control groups	**Intervention Description** Veteran Health Administration (VHA) Medical Team Training (MTT) program Nation wide Uses Crew Resource Management (CRM) theory derived from aviation and adapted to health care Aimed to facilitate open communication Includes pre-operative briefings and post-operative debriefings and check lists Encourages speaking up with safety concern Clinicians trained to work as team, challenge each other when identifying safety risks, implement communication strategies such as recognizing red flags, rules of conduct for communication, stepping back to reassess situation, effective communication during care transitions Lectures, group interactions, videos, provided sample check list and referred to internal VHA web site containing briefing, debriefing and check list tools used at VHA facilities, used laminated check list cards, whiteboards, paper forms and wall mounted posters Follow up quarterly interviews for one year to support, coach and assess intervention **Identified Team Members** Surgeons, anesthetists, nurses, technicians **Training Duration** 2 months of preparation and planning, one day conference and one year of quarterly coaching	**Primary Outcome** Hospitals with Intervention N=74 Baseline risk adjusted mortality rate of 17/1000 Post intervention mortality rates of 14/1000 After baseline adjustment, 18% decrease in mortality (rate ratio 0.82, 95% CI 0.76-0.91, P=0.01) After risk adjustment/propensity matching, mortality rates declined by 50% greater in intervention group (rate ratio 1.49, 95% CI, 1.10-2.07, P=0.01) For every quarter of additional training, a reduction of 0.5 deaths per 1000 procedures (95% CI, 0.2-1.0, P=0.01) **Control Group Hospitals N=34** Baseline adjusted mortality rates 15/1000 Post intervention period mortality rates of 14/1000 After baseline adjusted, 7% decrease in mortality (rate ratio 0.93, 95% CI, 0.81-1.06, P=0.59) **Secondary Outcomes** Overall efficiency improved by 66.2% Briefing/debriefing associated with reduction in mortality for 0.6/1000 procedures With interviews post intervention, 47% reported improved communication, 46.0% reported improved OR staff awareness, 64.9% reported improved OR team work

Author/Year/Title Research Design	Intervention Description, Identified Team Members, Training Duration	Outcomes
van Klei et al. (2012) EFFECTS OF THE INTRODUCTION OF THE WHO "SURGICAL SAFETY CHECKLIST" ON IN-HOSPITAL MORTALITY Research Design Retrospective Cohort study	**Intervention Description** Adaptation of WHO Safe Surgery Checklist 22 item check list Structured handover from ward to OR holding area and from OR to recovery Briefing Strict hygiene rules re-enforced Information provided through regular meetings and extra meetings with entire OR staff, emphasized importance of check list Check list made available in poster format in every OR as well as electronically in scheduling system **Identified Team Members** Surgeons, anesthesiologists, nurses **Training Duration** No specified time frame	**Post intervention** **Primary outcome** Crude mortality decreased from 3.13% to 2.85% (P=0.19), odds ratio 0.91, CI 0.78-1.05 After adjustment for baseline differences, mortality odds ratio 0.85; 95% CI, 0.73-0.98 **Secondary Outcome** Effect strongly related to checklist compliance With full checklist compliance, outcome was 0.44 (95% CI, 0.28-0.70) With partial compliance, outcome was 1.09 (95% CI, 0.78-1.52) With non-compliance, outcome was 1.16 (95% CI, 0.86-1.56)

Appendix B: Analysis Summary of Study Design, Validity, Distorting Influences, Relevance, & Limitations & Strengths of Appraised Papers

Study Design

Among the five research papers appraised, study designs varied between prospective and retrospective cohorts, and a prospective pre-post intervention study. Neither design is at the highest hierarchical level to study outcomes of safety, such as systematic reviews of Randomized Control Trials (RCTs) and RCTs.[39] Cohort studies, next in line within the hierarchy, are rated at the top of observational research designs and are a suitable option when it is not possible to perform a RCT.[107] Pre-post intervention research is an experimental design also at a lower level within the design hierarchy but nevertheless has potential to provide valuable information.[39] Although both designs are highly susceptible to bias,[108] they are evaluated as appropriate for exploring the relationship between team training intervention and safety outcomes.[109]

Validity

Validity reflects sample representation both internally with research population, and externally with local population of interest.[39] In non-RCTs, because samples are assigned and likely incomparable, attention to sample selection bias is necessary with evaluating internal validity, as bias can lead to confounding of outcomes.[108] With the appraised studies, source to obtain sample size of surgical team members and surgical patients varied between a single hospital center,[58,71] and multiple centers fluctuating between six hospitals,[69] eight global hospitals,[70] and 108 hospitals.[59] Inclusion and exclusion criteria of samples were described in all papers. Baseline adjustment measures included Mann Whiteney, Pearson chi-square or Student t test,[59,69,71] alpha level at 0.05,[71] as well as propensity matching.[59] A control group was utilized with two of the studies.[59,69] Groups were found to have comparable characteristics and to be treated equally. Additionally, statistical techniques such as regression adjustment[69] and stratification[59] were applied to adjust for differences between groups.[72] Control group selection however remains biased due to observational designs. Nevertheless, sample sources are evaluated as representative of respective study populations for all five papers.

Appendix B cont.

External validity implies generalizability of study to a population of interest, defined in this article as perioperative team members and surgical patients. Surgical specialties and patient populations in appraised studies were for the most part, representative of surgical patients in a Canadian urban teaching hospital where patients tend to have higher co-morbidities, with exception of potential differences with older, predominantly male patients with higher co-morbidities of the Veteran Health Administration (VHA) population.[59,110] The population in the Hayne et al.[70] study was global, also encompassing urban tertiary hospitals representing a local industrialized population.

Distorting Influences

Distorting influences impact interpretation of results. Influences related to research design, control group, objective measurement, bias, confounding, time variables, generalizability, and effect modification are discussed. Although validated measurement and analytical tools were well identified, and results were calculated as anticipated in all five studies, objective measurement such as blinding of researchers was discussed in only one study.[59] Assessing outcomes objectively or blindly and according to protocol increases reliability of results.[108] Protocol with measurement of outcomes was however not discussed in any of the research papers.

Observational studies are subject to potential systematic error, also known as bias or quantitative error.[111] For example, within the appraisal context, there exists bias related to unknown potential differences between surgical patient populations and surgical team populations when comparing studies. Pre-post experimental designs can be influenced by outside factors which may impact results as evidenced in the Haynes et al.[70] study with possible Hawthorn effect, learning curve for data collectors, and extended time necessary to obtain data. Additionally, the pre-post study within this appraisal[70] had no control group thus limiting the ability to conclude if reduction in complications and deaths would have occurred regardless of intervention. Characteristics of pre-post groups may also differ, leading to confounding.

Confounding bias relates to imbalances which can influence outcome of interest.[108] As randomization was not performed, control methods such as stratification,[59] standardization,[70] regression analysis[69,70,71] and cross-validation[70] were applied. Additionally, bias exists related to other potential influences impacting associations made, such as potential other causes of morbidity and mortality which were not discussed. Another confounding factor is variation of time allowed for training, as demonstrated with anesthesiologists and surgeons receiving an abbreviated version of the training intervention[58]. Further potential confounders include possible influence of other sequential changes over period of measurement,[69,71] outcomes not captured after discharge from hospital, and potential variations with correctness of outcome documentation.[69]

Another distorting influence is how effect modification impacts generalizability[111] with the study by Neily et al.[59] Here, strength of association between team training intervention and mortality was specific to the VHA population consisting of a greater percentage of older male patients when compared with the private sector population,[110] making it challenging to apply results to the population of interest.

Relevance

Relevance refers to applicability and reproducibility of study findings. Overall, statistical strength of results provides confidence that results represent a benefit for the populations studied. Geographical locations of studies varied between Netherlands, United States of America (USA), and global representation distributed between Canada, India, Jordan, New Zealand, Philippines, Tanzania, England and Washington. The majority of facilities encompassing surgical patients, specialties, and team members in the samples studied comprised teaching hospitals, found to be representative of procedures performed locally in Canadian teaching hospitals. Characteristics of patient populations were assumed to be similar between study samples and local population with reservations for the VHA patient population. It is assumed that perioperative health care professionals in studies have comparable educational backgrounds, experience, professional culture and standards of practice as the local population. It is probable that surgical team members in studies had not previously been exposed to a team training intervention, although pre intervention variations with patient safety policies were noted among centers in the Haynes et al. study,[70] generating consideration of this potential confounding factor with all studies. Measurement of baseline knowledge was not noted to be performed. The outcomes measured in appraised studies are relevant to a national surgical patient population given the global concern for perioperative patient safety.

Appendix B cont.

Reproducing results of studies would requires leadership support, a multidisciplinary team for leading project, involvement of multiple departments for the surgical patient safety system (SURPASS) check list, identifying and training teachers for the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) and VHA Medical Team Training (MTT) interventions, time away from duties for staff, and significant financial and human resources investment. Strong organizational support as demonstrated with the TeamSTEPPS[58] and VHA MTT[59] interventions is anticipated to be influential to success of implementation. Additional challenges include time period necessary for collecting data, as well as inconsistencies and high turnover of perioperative staff. Selecting measurement tools and measuring benefits or harm as well as compliance would be necessary. Furthermore, although results suggested prolonged benefit with additional post-intervention support, long term sustainability of positive results is unknown. The team training interventions identified in appraised studies present positive outcomes, thus benefits for patients who are cared for by surgical team members exposed to an intervention. Team training can potentially represent an investment, if increased patient safety is demonstrated locally. Potential harm consists of removing resources from other health care needs.

Limitations and Strengths

Limitations of appraised studies include potential bias related to publication, grey literature, potential unpublished research, studies not captured through search process, peer review, and language as literature search is limited to English written papers.[39] Ethnicity bias should also be considered if applying research findings to unindustrialized populations. Although the study by Haynes et al.[70] represents a global population, the remainder of studies is from the developed world. The moderate strength of the cohort and pre-post intervention study design brings numerous potential bias and confounders which weaken cogency of evidence. For example, control is limited with the retrospective cohort which relies on past data. Moreover, only one of the studies identifies blinding with data collection and only two use control groups, thus promoting additional bias influencing interpretation of results. Strengths nevertheless include internal validity of respective studies, positive associations with team training interventions, and reduction of patient outcomes of morbidity and mortality in all studies.

approaches. While safety check lists are practical they contribute partially to the solution. Team training interventions within the appraised studies included educational components related to building team skills such as communication techniques, assertiveness, conflict resolution, situational awareness, mutual support, human factors, and structured handover of patient care. All interventions supported an inter-professional collaborative approach to perioperative patient safety.

Replication of the research process, or application of RCT design with respective interventions within local settings, could further strengthen correlations between team training and patient safety. CsOP and RC can provide theoretical support for understanding team potential.

Further considerations for enhancing a collective safety culture in the perioperative context include team leadership, inter-professional education, and learning from AEs. Perioperative team members can promote patient safety by collectively committing to a patient safety culture.

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