Review Article

Teamwork and patient safety in dynamic domains of healthcare: a review of the literature

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Aims/Background: This review examines current research on teamwork in highly dynamic domains of healthcare such as operating rooms, intensive care, emergency medicine, or trauma and resuscitation teams with a focus on aspects relevant to the quality and safety of patient care.

Results: Evidence from three main areas of research supports the relationship between teamwork and patient safety: (1) Studies investigating the factors contributing to critical incidents and adverse events have shown that teamwork plays an important role in the causation and prevention of adverse events. (2) Research focusing on healthcare providers’ perceptions of teamwork demonstrated that (a) staff’s perceptions of teamwork and attitudes toward safety-relevant team behavior were related to the quality and safety of patient care and (b) perceptions of teamwork and leadership style are associated with staff well-being, which may impact clinician’ ability to provide safe patient care. (3) Observational studies on teamwork behaviors related to high clinical performance have identified patterns of communication, coordination, and leadership that support effective teamwork.

Conclusion: In recent years, research using diverse methodological approaches has led to significant progress in team research in healthcare. The challenge for future research is to further develop and validate instruments for team performance assessment and to develop sound theoretical models of team performance in dynamic medical domains integrating evidence from all three areas of team research identified in this review. This will help to improve team training efforts and aid the design of clinical work systems supporting effective teamwork and safe patient care.

Learning from other high-risk industries has inspired research efforts in healthcare and has contributed to significant improvements. In recent years, a number of articles on teamwork and team training in high-risk industries other than healthcare have been published in medical and interdisciplinary journals. Some of these articles have not referred to any of the researches on teamwork that have already been carried out in healthcare and that are the focus of this review.

The process of providing healthcare is inherently interdisciplinary, requiring physicians, nurses, and allied health professionals from different specialties to work in teams. In the patient safety literature, it has been widely recognized that team performance is crucial to providing safe patient care.1 Poor coordination among providers at various levels of the organization appears to affect the quality and safety of patient care (e.g. delays in testing or treatment, conflicting information).2,3 Therefore, teamwork has become a focus of system-based interventions to improve patient safety and of medical education standards.

In general, teams are defined as two or more individuals who work together to achieve specified and shared goals, have task-specific competencies and specialized work roles, use shared resources, and communicate to coordinate and to adapt to change.4 Compared with teams in other industries, medical teams especially in the dynamic domains of healthcare such as operating rooms, intensive care, emergency medicine, or trauma and resuscitation teams5 work under conditions that change frequently, may be assembled ad hoc, have a dynamically changing team membership, often work together for a short period of time, consist of specialists or several specialist crews, and have to integrate different professional cultures. In the team literature, such teams are known as ‘action teams’.6 When investigating effective teamwork in medical teams, it is important to consider the specific requirements a team is confronted with.
Not all medical teams are ‘action teams’ and teamwork requirements may vary depending on the situation (e.g. routine vs. emergency).

Focusing on the dynamic domains of healthcare, this review aims to provide an overview of (a) the methods used and (b) the questions addressed by teamwork research focusing on the time between 1998 and 2007, (c) identify aspects of teamwork that have been shown to correspond to the quality and safety of care, and (d) explore perspectives for future research.

**Materials and methods**

A literature search was carried out consulting the databases PubMed (1950–2007), MEDLINE via OVID (1966–2007), ISI Web of Knowledge, and PsychINFO. The following search terms were used: teamwork, leadership, collaborative work, collaborative activity, interdisciplinary practice, team training, and cross training. In addition, the initial database search was limited to the dynamic domains of healthcare such as operating rooms, intensive care, emergency medicine, or trauma and resuscitation teams. Figure 1 provides an overview of the process of identifying the publications included in this review.

In a first step, references were screened for relevance in the context of this review. The criteria for inclusion in this review were (a) addresses teamwork in the dynamic domains of healthcare, (b) published journal article, and (c) published in English.

In a second step, abstracts of the 277 articles fulfilling the inclusion criteria were used to categorize publications; full-text articles were retrieved when there was insufficient information in the abstract. To assure reliability of this categorization, an independent reviewer categorized a randomly selected 20% subset of the abstracts (Cohen’s κ.89). The categorization showed that (a) the majority of articles were empirical studies of teamwork, followed by theoretical papers describing basic concepts of teamwork and their relevance in healthcare and (b) the relative importance of topics has shifted over the years (see Fig. 2). For example, the proportion of theoretical papers highlighting the importance of teamwork decreased whereas team training became more prominent, first in terms of...
course descriptions (1988–1997) and then in terms of evaluations of team training interventions (1998–2007). Also, along with the increased number of empirical studies of teamwork, an increase in methodological papers describing, validating, or discussing methods for team research can be noted. Given these trends in the available literature, it was decided to focus on recent empirical studies of teamwork.

In a third step, a total of 101 empirical studies of teamwork published between 1998 and 2007 were sorted into thematic groups and reviewed in detail. In the following, an overview of the studies investigating teamwork in relation to patient safety will be given.

Results

Methods applied in studying the relationship between teamwork and patient safety

The studies included in this review have applied a broad spectrum of methodological approaches. Besides retrospective case analysis based on documents such as patient records or incident reports (sometimes in combination with interviews) that have been used to identify factors contributing to the causation and/or prevention of adverse events, two main approaches can be distinguished.

(a) Methods used to study attitudes and perceptions: Interviews, focus groups, and (attitude) surveys can provide useful diagnostic information relating to the perception of teamwork behavior. Over the past 10 years, a number of survey instruments have been adapted to and applied in healthcare. Some of these instruments that measure safety climate to diagnose the underlying safety culture include teamwork as one major aspect, whereas others specifically measure the perceived quality of teamwork.

(b) Methods used to describe and assess behavior: Although clinicians' attitudes and perceptions are very important aspects of teamwork, positive attitudes toward teamwork are not necessarily accompanied by appropriate behavior. Observation studies of patient care teams provide complementary information on effective team behavior such as coordination and leadership. For example, prospective observational studies have been used to identify medical errors and to describe the development of critical incidents. Over the past 10 years, significant progress has been made concerning the development and evaluation of instruments to

systematically describe team processes and assess team performance. Two main approaches can be identified: (a) systems to describe team processes (either applying an ethnographic approach or categorizing behaviors using a predefined observation system) and (b) rating systems to assess teamwork skills (often referred to as behavioral or non-technical skills) in various medical specialty areas including anesthesia, surgery, operating room teams, intensive care, operating room teams, intensive care, neonatal resuscitation. These instruments have been evaluated successfully as research tools but also as feedback tools that can be used for teaching in various clinical settings.

Teamwork as an important contributing factor to adverse events

This review identified a number of empirical studies investigating the role of teamwork issues in the causation of adverse events in dynamic domains of healthcare. These studies fall into two main groups: (a) retrospective analyses of incident and adverse event reports or malpractice claims and (b) observational studies.

Retrospective analyses of incident and adverse event reports found communication and teamwork issues to be among the most frequent contributory factors (i.e. in 22–32% of reports). These results are not surprising because the provision of healthcare is an inherently communicative and team-based activity.

Observational studies found similar results. In the operating room, Lingard et al. observed a failure in 30% of communication events during surgical procedures. Of these failures, 36% had observable consequences such as delay, tension among team members, or procedural error. These results are supported by another observational study focusing on the effects of disruptions of the surgical process (e.g. communication failures, equipment problems). The study found that surgical errors increased significantly with increased disruptions and that teamwork and communication problems were the strongest predictors of surgical errors. An observational study in pediatric cardiac and orthopedic surgery found that effective teamwork was associated with fewer minor problems per operation (i.e. negative events that were seemingly innocuous but many of which contributed to major problems), higher intraoperative performance (i.e. less key operating tasks were disrupted), and shorter operating times.
In summary, observational studies and retrospective analyses of incidents or adverse events indicate that many of the contributing factors originate from flawed teamwork rather than from a lack of clinical skills. One difficulty is, however, that most of these studies do not make it explicit exactly which aspects of teamwork have to be improved. In addition, few empirical studies systematically investigated the role of teamwork in preventing minor problems from escalating to more serious situations. Nevertheless, it is often claimed that many adverse events could have been prevented by improved teamwork.

Healthcare providers perceptions of teamwork in dynamic medical domains

Surveys and interview studies regarding attitudes toward teamwork indicate that – consistent with many other high-risk industries – healthcare providers attribute a high degree of importance to teamwork aspects such as communication or coordination. In a qualitative study on the meanings attached to teamwork in the operating room, coordination, leadership, and its role in assuring patient safety and staff well-being were identified as the most prominent meanings.

Different groups of healthcare providers perceive the quality of teamwork differently. Studies investigating clinicians’ perceptions of teamwork found that the quality of leadership, the openness of communication, etc. were generally rated positively. However, most studies identified marked differences in the perceived quality of teamwork between professional groups (i.e. nurses reported lower levels of quality of teamwork than doctors), within disciplines (i.e. trainee doctors reported lower levels of quality of teamwork than senior doctors), and between specialties. These differences in the way members of different professional groups perceive interpersonal interactions are also supported by a study investigating how different members of an operating room team perceived the same situation. The results of this study showed that surgeons, nurses, and anesthesiologists independently rated tension levels of three video-based scenarios similarly, but rated each profession’s responsibility for creating and resolving tension differently, often rating their profession as having relatively less responsibility than the others.

One aspect of teamwork for which most studies identified differences between professional groups is the quality of collaboration and communication between team members. However, in some studies healthcare providers rated a peer and in other studies another type of caregiver. In one study, nurses’ ratings of the quality of collaboration and communication with physicians (33% positive ratings) were compared with physicians’ ratings of the quality of collaboration and communication with nurses (73% positive ratings). Another study contrasted surgeons’ ratings of their collaboration with other surgeons (85% positive ratings) with nurses’ ratings of their collaboration with surgeons (48% positive ratings).

Besides these methodological issues, there is no consensus about the optimal level of cohesiveness and shared understanding of team structure, team tasks, and team roles in patient care teams. Human factors research in other high-risk industries suggests that a shared mental model of teamwork is essential for effective team performance. Therefore, the result that operating room teams deemed the quality of the teamwork acceptable, despite marked differences in team members’ understanding of team roles, and team structure, may indicate the need to raise awareness of the importance of teamwork in patient safety.

Staff’s perceptions of teamwork are related to the quality and safety of patient care. Little empirical evidence exists on the relationship between staff’s perceptions of the quality of teamwork (or their attitudes toward teamwork) and the perceived or objectively measured quality and safety of patient care. For example, studies using clinicians’ attitudes toward safety-relevant behaviors as indicators of safety found that although attitudes to these behaviors were generally positive, staffs’ responses also indicated a belief in personal invulnerability to stress and fatigue. This result was more pronounced in healthcare than in aviation. Research in intensive care found that the perceived communication openness among team members predicted the degree to which individuals reported to understand patient care goals.

Studies using objective measures of the quality and safety of patient care also indicate an association with (certain aspects of) teamwork. For example, relational coordination (measured by frequency of communication, strength of shared goals, degree of mutual respect among care providers, etc.) was found to be associated with improved quality of care, reduced post-operative pain, improved post-operative functioning, and
decreased lengths of hospital stay. Another study in intensive care comparing the perceived quality of team functioning with predicted and actual mortality rates of the unit during the study period found that for units with mortality rates that were lower than predicted, staff's perceptions of teamwork were more positive (e.g. team members were seen as less dependent and more trusting).

Perceptions of teamwork and leadership style impact staff well-being. Besides known contributors to staff well-being such as workload, time pressure, and job control, perceptions of teamwork and leadership behavior were found to be associated with employee outcomes such as emotional exhaustion, burnout, job satisfaction, and organizational commitment. For example, a survey of ICU nurses showed that leadership styles that seek and value contributions from staff promote a climate in which information is shared effectively, promote decision making at the staff nurse level, and influence coordination of work to provide a milieu that increases nurses' intent to stay.

Although empirical results directly linking staff well-being to patient safety are not available, human factors research indicates that, for example, burnout symptoms such as emotional exhaustion, fatigue, inability to concentrate, and aversion to patients decrease clinicians' ability to assure patient safety. In order to decrease the likelihood for negative employee outcome, leadership behavior creating an atmosphere where team members feel they can communicate openly and participate in decision making is essential. Moreover, first studies on the effects of changes in the design of work systems and processes indicate that re-structuring toward a team-based approach improves staff well-being and the quality and safety of patient care.

Teamwork behaviors related to patient safety
Observational studies of teamwork have identified patterns of communication, coordination, and leadership that support effective teamwork. However, only a few studies could establish a direct link between specific teamwork behaviors and clinical performance or patient outcome.

Communication patterns supporting effective teamwork.
Among the most prominent themes in communication research in healthcare are the effects of interruptions and tensions on effective team functioning. For example, ethnographic studies showed that tensions in team communications in the operating room often evolve around the issues of time, safety and sterility, resources, and work roles.

Another focus of communication research is concerned with the frames of reference that clinicians with different professional backgrounds refer to when discussing patient care decisions. Studies in intensive care found that breakdowns in teamwork were often related to different types of knowledge referred to by nurses and physicians when discussing clinical problems and that the proximity to the patient played an important role in shaping clinicians’ perspectives. A qualitative study in an emergency room found that the use of different frames of reference in patient care decisions within a team decreases the recognition of uncertainty and may compromise patient safety.

So far, no direct link between communication patterns and patient outcomes has been established. However, Lingard et al. have proposed a model of the relationships among specific communication practices (i.e. pre-operative team briefing), intermediary processes (e.g. increased team member knowledge, improved team behavior), and the quality and safety of patient care. Theoretical models of communication in medical teams will enable the development of training curricula that will improve team functioning and patient safety.

Coordination strategies supporting effective teamwork.
Coordination is essential to teamwork because different team members routinely perform multiple interdependent tasks simultaneously. Ethnographic research in anesthesia has highlighted that teams coordinate not only through verbal communication but also through their work environment (i.e. the precise alignment of team members bodies, tools, and the patient's body). This coordination strategy, which requires an intimate knowledge of work roles and procedures, enables smooth team performance in most routine situations. However, during unfamiliar, ill-structured, or critical situations, more explicit forms of coordination may be necessary. Grote et al., for example, observed that anesthesia teams adopt to situational requirements such as the levels of standardization of the work process. Higher levels of standardization were associated with more implicit coordination and less leadership behavior. These results are in line with human factors research in other high-risk industries, indicating that effective teams adapt their coordination strategies to the
situational requirements (i.e. more implicit coordination during routine situations and more explicit coordination during critical situations). Leadership behaviors supporting effective teamwork. Leadership is a special means of coordination that has received considerable attention in research on trauma and cardiac arrest teams. These teams are prototypical examples of action teams because team members perform urgent and highly consequential tasks while simultaneously coping with frequent changes in team composition. In addition, these teams rarely communicate before attending to a cardiopulmonary arrest.

Video analyses of resuscitation attempts showed that the degree to which resuscitation team leaders built a structure within the team correlated significantly with task dynamics and task performance. If resuscitation team leaders participated ‘hands-on’, they were less likely to build a structured team, the team was less dynamic (i.e. less adaptability and coordination), and the resuscitation tasks were performed less effectively. These results are supported by other studies, showing that successful resuscitation teams exhibited significantly more leadership behavior and explicit task distribution and a positive effect of ‘directive leadership behavior’ and ‘structuring inquiry’.

Based on video analysis, Xiao et al. identified six leadership functions in trauma teams (e.g. information request, strategic planning, critiquing plans) that were frequently triggered by specific characteristics of the situation (e.g. arrival of a new team member, completion of a sub-task, detection of an error). The systematic mapping of leadership functions to task situations provided evidence of adaptive leadership in trauma teams. The importance of adaptive leadership is further supported by observational research showing that senior team leaders dynamically assign leadership tasks to team members and that leadership roles change dynamically when new team members join the team.

These results suggest that adaptive leadership enhances teams’ ability to perform reliably in the face of dynamically changing task requirements.

In summary, these studies provide evidence of the importance of adaptive and effective leadership in resuscitation teams. Survey results indicate that many residents (50%) feel unprepared to take on a leadership role in cardiac arrest teams due to perceived deficits in their training, especially a lack of leadership training (51%), and in their supervision including post-event debriefing and performance feedback. Although trainees’ confidence in their ability to lead a resuscitation team often increases after advanced life support (ALS) training, observational studies found no improvement in leadership performance after ALS training without specific leadership training.

Conclusion

This review of teamwork demonstrates the critical importance of teamwork in assuring patient safety in the dynamic domains of healthcare. Table 1 summarizes safety-relevant aspects of teamwork identified by the studies included in this review.

Research on attitudes toward teamwork indicates that healthcare providers do not seem to fully appreciate the impact of psychological factors on clinical performance and that improved teamwork may contribute to increased staff well-being as well as improved patient outcome. Observational studies found weak to moderate associations between ratings of teamwork skills and measures of technical and clinical performance. Empirical evidence also supports the argument that system improvements such as formal practices to strengthen communication and relationships among healthcare providers and specific team
training interventions have the potential to raise clinicians’ awareness of these issues and to support effective team behavior.72–74

Although there has been significant progress in research on teamwork in healthcare, methodological and theoretical challenges remain to be addressed by future research.75 In order to effectively teach and reliably assess the quality of teamwork, it is necessary to identify the behaviors associated with effective teamwork and their interplay in relation to clinical performance ratings and ultimately to patient outcome. Various research groups have successfully developed instruments to describe team processes and evaluate teamwork skills. An important next step is to determine whether there are generic team skills and behaviors that contribute to effective team performance in different domains of healthcare, to different types of teams, and in different situations such as routine and emergency patient care. So far, few of the psychological concepts explaining successful teamwork in various high-risk industries such as team situation awareness, shared mental models, and adaptive coordination and leadership have been investigated systematically in healthcare.76,77 However, these concepts provide useful heuristics to understand effective coordination in dynamic medical domains and a systematic comparison of findings on effective teamwork across industries may be an important next step. In addition, future research should explicitly refer to theoretical frameworks of teamwork.78,79 This approach will allow for an integration and systematic comparison of available evidence on team behaviors and their impact on patient safety. This will further the development of refined models of team processes in healthcare62 and of specific training concepts that complement existing team training.

References


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