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THE RELATION BETWEEN TEAMWORK AND PATIENT SAFETY

David P. Baker
American Institutes for Research

Eduardo Salas
University of Central Florida

Paul Barach
University of Miami

James Battles
Agency for Healthcare Research and Quality

Heidi King
Department of Defense, TRICARE Management Activity

This chapter reviews the empirical evidence concerning the relation between teamwork and patient safety. The available evidence suggests that training teams of health care providers constitutes a pragmatic, effective strategy for enhancing patient safety by reducing medical errors.

BACKGROUND

In 1999, the Institute of Medicine (IOM) published *To Err is Human: Building a Safer Health System,* a frightening indictment of the inadequate safety that the United States medical establishment too often provides its patients (Kohn, Corrigan, & Donaldson, 1999). Extrapolating from data gathered through the Harvard Medical Practice Study (HMPS) and the Utah-Colorado Medical Practice Study (UCMPS; Studdert, Brennan, & Thomas, 2002), the IOM report concluded that medical errors cause between 44,000 and 98,000 deaths annually (Kohn et al., 1999). The report also noted that medical errors are financially costly. The IOM estimated that, among U.S. hospital inpatients, medication errors alone cost approximately $2 billion annually. Besides their direct costs, errors result in opportunities lost, given that funds spent in correcting mistakes cannot be used for other purposes, as well as in higher insurance premiums and co-payments. In addition, because of their effect on diminished employee productivity, decreased school attendance, and a lower state of public health, such errors exact a

price from the society at large. Specifically, the IOM estimated that the total indirect cost of medical errors that result in patient harm lies between $17 and $29 billion annually. Finally, medical errors undermine patients' and health professionals' confidence in the health care system itself.

Key to this chapter's orientation toward teamwork-related research, the IOM noted that the majority of medical errors result from health care system failures, rather than from individual providers' substandard performance. Thus, in conjunction with its drive to implement organizational safety systems by delivering safe practices (Tier 4), the IOM recommended establishing interdisciplinary team-training programs (Kohn et al., 1999).

The primary responsibility for conducting and supporting research to address the IOM's recommendations currently rests with the Agency for Healthcare Research and Quality (AHRQ). This responsibility encompasses three broad areas: (a) identifying the causes of errors and injuries in health care delivery; (b) developing, demonstrating, and evaluating error-reduction and patient-protection strategies; and (c) distributing effective strategies throughout the U.S. health care community (AHRQ, 2000). One of AHRQ's initial efforts to address the patient safety crisis was to commission a review of the existing evidence base for different safe patient practices. Evidence Report 43 titled, *Making Health Care Safer: A Critical Analysis of Patient Safety Practices,* presents existing data on practices viewed as having the potential to improve patient safety. Within this report, Pizzi, Goldfarb, and Nash (2001) identified crew resource management (CRM)—a team training approach—as a strategy that has tremendous potential to improve patient safety based on its success in aviation.

STRUCTURE OF THIS CHAPTER

The next sections of this chapter review the evidence concerning the extent to which training medical personnel as teams is likely to improve patient safety outcomes. This chapter extends the work of Pizzi and colleagues (2001) by providing a more comprehensive review of the evidence base that supports the importance of teamwork in high-risk industries and presents a compelling argument for teamwork's relation to patient safety. In the next section, we define the key characteristics of a team and discuss the principles that underlie successful teamwork. Next, we describe and evaluate research concerning the relation between teamwork and safety in real world, high-risk settings. Third, we introduce current trends and issues in medical team training. Finally, we offer a set of conclusions and recommendations for future research.

TEAMWORK

Definitional Issues Concerning Teams and Teamwork

Teams and teamwork have received an increasing amount of attention over the last 20 years (Driskell & Salas, 1992; Dyer, 1984; Foushee, 1984; Salas, Bowers, & Cannon-Bowers, 1995; Stone, 2000). Numerous chapters (Dyer, 1984; Salas et al., 1995) and books (Brannick, Salas, & Prince, 1997; Guzzo & Salas, 1995; Salas, Bowers, & Edens, 2001a; Wiener, Kanki, & Helmreich, 1993) have specifically addressed critical issues related to team performance. In fact, organizations that do not rely on teams, at least to some extent, are scarce.

Given the prevalence of teams in the workplace, the literature reflects substantial agreement regarding their defining characteristics. Any inconsistencies among definitions are due, at least in part, to the reality that teams reflect a variety of purposes (e.g., learning, producing a product, solving problems, gaining acceptance), forms (e.g., virtual, co-located), sizes, and longevity (e.g., ad hoc, long term) (Cohen & Bailey, 1997).

What Is a "Team"? To identify the key features of a team, we reviewed several often-cited definitions (Dyer, 1984; Guzzo & Shea, 1992; Mohrman, Cohen, & Mohrman, 1995; Salas, Dickinson, Converse, & Tannenbaum, 1992), as well as other relevant literature. The definition we adopted includes the following four characteristics: (a) teams consist of a minimum of two or more people; (b) team members have specific roles, perform specific tasks, and interact or coordinate to achieve a common goal or outcome; (c) team members possess specialized knowledge and skills and often work under conditions of high workload; and (d) teams embody the coordination that results from task interdependency, which distinguishes teams from small groups.

The Nature of Effective Teamwork. Teamwork has traditionally been described in terms of classical systems theory, which posits that team inputs, team processes, and team outputs are arrayed over time. In particular, team inputs include the characteristics of the task to be performed, the elements of the context in which work occurs, and the attitudes team members bring to a team situation. Team process constitutes the interaction and coordination required among team members if the team is to achieve its specific goals. Team *outputs* consist of the products that result from team performance (Hackman, 1987; Ilgen, 1999; McGrath, 1984). Thus, teamwork per se occurs in the process phase, during which team members interact and work together to produce team outputs. Finally, teamwork does not require team members to work together permanently; it is sustained by a shared set of teamwork skills, not by permanent assignments that carry over from day to day.

However, simply installing a team structure in an organization does not automatically result in effective teamwork. Effective team performance requires team members' willingness to cooperate for a shared goal. Moreover, effective teamwork depends on effective within-team communication and adequate organizational resources and support. In short, teamwork requires team members to develop a shared awareness of one another's roles and abilities. Without this awareness, serious but avoidable adverse outcomes may result from a series of apparently trivial errors that effective teamwork would have prevented.

Extensive research has yielded numerous models of effective teamwork (Campion, Medsker, & Higgs, 1993; Fleishman & Zaccaro, 1992; Hambrick, Cho, & Chen, 1996; Stevens & Campion, 1994; West & Anderson, 1996). Historically, this literature has sought to identify generic teamwork skills associated with most teams. However, the focus has more recently shifted toward identifying the specific *competency requirements* that team members exhibit (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; O'Neil, Chung, & Brown, 1997; Stevens & Campion, 1994). Although the term *competency* signifies a variety of meanings, it is generally used to denote the qualities needed by a jobholder (Boyatzis, 1982).[1] Specifically, Parry (1998) defined the term "competencies" as a cluster of related knowledge, skills, and attitudes that affects a major part of one's job (e.g., represent one or more key roles or responsibilities; correlate with successful job performance; can be measured against well-accepted standards; and can be improved through training and development).

Generally speaking, team competencies are the attributes team members need to engage successfully in teamwork: As has been suggested, " ... It is essential to understand the nature of competencies required to function in a team as a means to define selection criteria, design and conduct training, and assess team performance" (Cannon-Bowers et al., 1995, p. 334). To explicate this understanding, Cannon-Bowers and colleagues identified three types of competencies that are critical for effective teamwork: (a) teamwork-related knowledge (K), (b) teamwork-related skills (S), and (c) teamwork-related attitudes (A).

In summary, teams know things, do things, and feel things; moreover, they know, do, and feel within specific environments. Thus, their effective performance depends on integrating a host of interrelated personal and situational characteristics.

Training Teams

Team training can be defined as applying a set of instructional strategies, that rely on well-tested tools (e.g., simulators, lectures, videos), to specific team competencies (Salas & Cannon-Bowers, 2000; Salas, Rhodenizer, & Bowers, 2000; Salas, Rozell, Mullen, & Driskell, 1999). Effective team training reflects general principles of learning theory, presents information about requisite team behaviors, affords team members the opportunity to practice the skills they are learning, and provides remedial feedback.

A great deal of research has been devoted to the most effective strategies and techniques for training specific team knowledge, skill, and attitude (KSA) competencies. A comprehensive review of this research has presented an extensive collection of principles and guidelines concerning the design and delivery of team training. For example, guidelines exist for assertiveness training (Smith-Jentsch,

[1]Boyatzis (1982, p. 10), in his seminal work on competencies, defined a job competency as "an underlying characteristic of a person, which results in effective or superior performance in a job."

KNOWLEDGE COMPETENCIES	
Competency	**Definition**
Shared Task Models/Situation Assessment	A Shared understanding of the situation and appropriate strategies for coping with task demands
Teammate Characteristics Familiarity	Knowing the Task-related competencies, preferences, tendencies, strengths, and weaknesses of teammates.
SKILL COMPETENCIES	
Mutual Performance Monitoring	Tracking fellow team members' performance to ensure that the work is running as expected and that proper procedures are followed
Flexibility/Adaptability	Ability to recognize deviations from expected course of events to readjust one's own actions accordingly
Supporting/Back-Up Behavior	Providing feedback and coaching to improve performance or when a lapse is detected; assisting teammate in performing a task; and completing a task for the team member when an overload is detected.
Team Leadership	Ability to direct / coordinate team members, assess team performance, allocate tasks, motivate subordinates, plan/organize, and maintain a positive team environment.
Closed-Loop Communication/ Information Exchange	The initiation of a message by the sender, the receipt and acknowledgement of the message by the receiver, and the verification of the message by the initial sender
ATTITUDE COMPETENCIES	
Team Cohesion	The total field of forces that influence members to remain in a group; an attraction to the team as a means of task accomplishment
Mutual Trust	A positive attitude held by team members regarding the aura, mood, or climate of the team's internal environment
Collective Orientation	The belief that a team approach is better than an individual one
Importance of Teamwork	The positive attitude that team members exhibit toward working as a team

Exhibit 17–1. Essential Team Knowledge, Skill, and Attitude (KSA) Competencies—adapted from (Salas et al., 2001a)

Salas, & Baker, 1996), cross-training (Volpe, Cannon-Bowers, Salas, & Spector, 1996), stress management training (Driskell & Johnston, 1998), and team self-correction (Smith-Jentsch, Zeisig, Acton, & McPherson, 1998).

In addition to the available team training research and practical guidance, the team competencies presented in Exhibit 17–1 provide an excellent resource for designing team training programs. Cannon-Bowers and colleagues contended that team KSA competencies should serve as the starting point for conducting training needs analyses. After establishing a team's specific competency requirements, trainers must specify appropriate training strategies

To meet this requirement, Cannon-Bowers and colleagues offered detailed information on the nature of training required for developing particular team competencies and the strategies that are likely to be successful (Cannon-Bowers et al., 1995).

Finally, a successful team training program constitutes more than developing team members' KSAs. For example, because organizational factors outside the training program itself affect the program's success, conducting a needs analysis before designing a training intervention is essential to determining the best delivery method or instructional strategy. In addition, training developers should take advantage of the increased practice opportunities provided by certain training tools, such as advance organizers (e.g., outlines, diagrams, graphic organizers), preparatory information, prepractice briefs, attentional advice, goal orientation, and meta-cognitive strategies (Cannon-Bowers & Salas, 1998).

SUMMARY

The preceding section discussed the elements that typify effective teamwork and effective team training. High-performing teams exhibit a sense of collective efficacy, are dependent on each other, and believe that they can solve complex problems. Moreover, effective teams are dynamic: they optimize their resources, engage in self-correction, compensate for each other by providing back-up behaviors, and adapt as necessary. Because they can often coordinate without communicating overtly, effective teams can respond efficiently in high-stress, time-restricted environments.

Designing training that will improve teamwork skills on the job is a challenge. In virtually any field, team training requires a comprehensive, sustained strategy that targets many aspects of teamwork. Teams operate in complex environments. Yet team training is charged with improving trainee KSAs and facilitating desirable performance outcomes (e.g., safety, timely and accurate responding, patient welfare) under these conditions. Therefore, effective training programs must (a) systematically represent sound theory and a thorough needs analysis; (b) provide trainees with information, demonstrations, guided practice and timely diagnostic feedback; and (c) reflect organizational cultures that encourage the transfer of the trained competencies to the task environment.

TEAMWORK IN HIGH-RISK CONTEXTS

Commercial Aviation

Because aviation constitutes a field in which mistakes can cause an unacceptable loss of life and property, the flight industry has been on the forefront of developing teamwork training to reduce risk. Among the team training programs that have evolved within aviation, the best known is crew resource management (CRM) training.

Recent research suggests that CRM training results in heightened safety-related attitudes; improved communication, coordination, and decision-making behaviors; and enhanced error-management skills (Helmreich & Merritt, 1998; Wiener et al., 1993). CRM training also has demonstrated consistently positive results across a wide range of team structures, including pilot crews, maintenance crews, dispatch crews, and air traffic control teams (Helmreich & Foushee, 1993; Oser, Salas, Merket, & Bowers, 2001; Smith-Jentsch, Baker, Salas, & Cannon-Bowers, 2001).

CRM has grown from focusing solely on awareness and attitude change, to incorporating behavioral skills training, to integrating training in teamwork with training in technical flying skills, as is the case with the U.S. Federal Aviation Administration's new Advanced Qualification Program (AQP). Recent reviews suggest that CRM training results in positive reactions to teamwork concepts, increased knowledge of teamwork principles, and improved teamwork performance in the simulator (Salas, Burke, Bowers, & Wilson, 2001b).

CRM's effect on the ultimate criterion—a reduction in the number of accidents—has yet to be empirically established (Salas et al., 2001b). However, accidents represent a poor criterion methodologically, because they exhibit an extremely low base rate (Helmreich & Foushee, 1993). Thus, researchers have relied on surrogate measures—like improvements in teamwork-related knowledge and skills, behavioral demonstrations of CRM skills on simulated flights, instructor evaluations of trained versus untrained crews, and changes in an organization's safety culture—to demonstrate the effectiveness of CRM training.

Viewed in isolation, each piece of evidence concerning the effectiveness of CRM training can be disputed; nevertheless, the pattern of results suggests that CRM training does improve the margin of aviation safety. In short, the reasonable inference is

that if trainees demonstrate improvement in critical teamwork-related competencies and if they apply these skills in the posttraining environment, the ultimate outcome will be safe flights.

As practiced currently, CRM training meets the criteria we mentioned in our discussion of team training. CRM focuses on trainable, measurable skills that are crucial to successful performance. As such, CRM's methodologies could theoretically apply to virtually any medical domain in which effective teamwork minimizes error and enhances patient safety.

Military

The other high-risk industry in which team training has grown to prominence is the military. The watershed for this research was USS Vincennes' accidentally shooting down an Iranian Airbus in the Persian Gulf in 1988. In response to this incident, the Navy began a multiyear, multimillion-dollar research program to formally study teamwork and team training interventions. The program, called Tactical Decision Making Under Stress (TADMUS), began in 1990 and led to breakthrough advances in the science and practice of team training. Results of the program have highlighted new approaches, such as interpositional knowledge (cross-) training, mental-model training, and team self-correction training.

Following the Navy's lead, the U.S. Air Force and the U.S. Army also supported research on team performance and team training (Keesling, Ford, & Harrison, 1994; Siebold, 1994). In fact, as Salas and colleagues (1995, p. 71) pointed out, "Much [had] been accomplished since Dyer's (1984) seminal review." These research and practice results were incorporated into what has become the current state of military team training.

Some type of formal team training is now a major component of training in most branches of the U.S. Armed Forces. For example, all branches of the U.S. Armed Forces give pilots and other aircrew CRM (Spiker, Silverman, Tourville, & Nullmeyer, 1998). Current military aviation team training is again adopting the best practices of civil aviation, such as AQP, and combining these practices with traditional military training and cutting-edge technology.

In addition to pilots and other aircraft crewmembers, many sailors, soldiers, airmen, and Marines receive team training. For example, the U.S. Navy has recently adopted an approach called Team Dimensional Training (TDT), which resulted from the TADMUS program (Cannon-Bowers & Sales, 1998). TDT addresses team-related KSAs, provides practice in briefing and debriefing, and trains trainers and team leaders to evaluate and critique team skills (Tannenbaum, Smith-Jentsch, & Behson, 1998). It has been tested in teams as different from one another as submarine attack center teams, seamanship and shipboard damage control teams, naval aircrews, and surface warfare teams. In short, TDT trains teams to correct themselves, in addition to training team leaders to guide their members through the self-correction process (Smith-Jentsch et al., 1998).

Summary

This section briefly examined the empirical evidence concerning team performance and team training in high-risk contexts. Given that serious misfortunes resulting from human error are relatively rare in aviation and in military forces not involved in warfare, empirically linking team performance to the "ultimate criterion" of reducing these errors is difficult. Nevertheless, taken as a whole, research on teams has demonstrated a strong relation between effective team performance and desirable "proxy" criteria, such as flexibility, adaptability, ability to reallocate resources, and resistance to stress. In addition, teams yield valuable process-oriented benefits, such as cohesion, retention, and morale (Gully, Devine, & Whitney, 1995; Gully, Incalcaterra, Joshi, & Beaubien, 2002).

Given the pervasiveness of these findings, inferring that successful teamwork might substantially reduce severe life-threatening medical errors is not unreasonable. Thus, we view the relations documented in this section as relevant to medical team training. Now we turn to a discussion of existing medical team training programs.

TEAMWORK AND HEALTH CARE

The Case for Teamwork

Throughout the health care community, small groups of people work together in intensive care units (ICU), operating rooms, labor and delivery wards, and family medicine practices. To make safe and efficient patient care a priority, physicians

nurses, pharmacists, technicians, and other health professionals must coordinate their activities. However, even though a myriad of the conditions addressed by health care professionals require interdisciplinary teams, members of these teams are rarely trained together; furthermore, they often come from separate disciplines and diverse educational programs.

Given the interdisciplinary nature of the work, teamwork is critical to ensuring patient safety. Teams make fewer mistakes than do individuals, especially when each team member knows his or her responsibilities, as well as those of other team members. Consistent with health care's increased emphasis on teamwork, AHRQ advocates a cultural shift from denying the presence of medical errors to discussing, learning about, and preventing them. CRM training—which falls under the domain of "team training"—is one means for helping to bring about this cultural shift.

Moreover, AHRQ is not alone in recognizing the importance of teamwork for improving the performance of medical professionals. In concert with AHRQ's goals, the Accreditation Council for Graduate Medical Education (ACGME) recently identified several teamwork-related competencies that residents must master. These competencies include communication with patients and significant others, patient counseling and education, working with other health care professionals, and facilitating the learning of students and other health care professionals (Dunnington & Williams, 2003).

Similarly, the Association of American Medical Colleges (AAMC) funded a "critical incident" analysis to investigate the behaviors that result in successful and unsuccessful performance during medical school and residency. The results revealed the importance of a number of teamwork-related competencies, including interpersonal skills and professionalism, interactions with patients and family, ability to foster a team environment, and ability to mentor or educate other students (Adams, Goodwin, Searcy, Norris, & Oppler, 2001).

Medical team training programs derived from CRM began with the introduction of anesthesia crisis resource management (ACRM) training at Stanford University School of Medicine and at the Anesthesiology Service at the Palo Alto Veteran Affairs Medical Center (Howard, Gaba, Fish, Yang, & Sarnquist, 1992). AHRQ's 2001 review of in-place patient safety practices critiqued the ACRM model, citing it as high in impact but low in evidence supporting its effectiveness (Pizzi et al., 2001). More recently, the Department of Defense (DOD) funded several other CRM-derived team training initiatives. Specifically, MedTeams™ (Morey, Simon, Jay, & Rice, 2003) has been implemented in a number of U.S. Army and U.S. Navy hospitals.

ACRM Program

Developed by David Gaba and his colleagues at Stanford University and the Palo Alto Veteran Affairs (VA) Medical Center, ACRM is designed to help anesthesiologists effectively manage crises by working in multidisciplinary teams that include physicians, nurses, technicians, and other medical professionals (Gaba, 1998; Gaba, Howard, Fish, Smith, & Sowb, 2001a; Howard et al., 1992). To facilitate this goal, ACRM training provides trainees with critical incident case studies to review (Davies, 2001). In addition, ACRM provides training in technical skill and in team KSAs. Training in the selected teamwork skills is intended to enable trainees to learn from adverse clinical occurrences and to work more effectively with different leadership, followership, and communication styles (Gaba, Howard, Fish, Smith, & Sowb, 2001b).

ACRM training takes place in a simulated operating room (OR), after completing the reading assignments that precede each module. The simulated OR includes actual monitoring equipment, a full-patient simulator, a video station for recording the team's performance, and a debriefing room that is equipped with a variety of audiovisual equipment. The full-patient simulator incorporates a series of complex mathematical models and pneumatic devices to simulate a patient's breathing, pulses, heart and lung sounds, exhaled CO_2, thumb twitches, and other physiological reactions (Gaba, Howard, Fish, Smith, & Sowb, 2001a; Murray & Schneider, 1997).

The ACRM curriculum comprises 3 full separate days of simulation training, over 3 years of anesthesiology training. Day 1 provides an introduction to ACRM principles and skills. Day 2 provides a refresher on these skills and analyzes clinical events from the perspective of the clinician's technical and teamwork skills and from the perspective of the organization as a larger system. Day 3 emphasizes leadership training, debriefing skills, and adherence to the procedures established to deal with adverse clinical events. Each training module consists of a similar structure: preassigned readings, course introduction and review of materials,

familiarization with the simulator, case study analysis and videotape reviews, and 6 hr of participating in simulator scenarios, followed by an instructor-led debriefing and a postcourse data collection. Each scripted training scenario is approximately 45 min long; each debriefing session lasts approximately 40 min (Gaba et al., 2001a).

Several instructors are required to run the ACRM training scenarios. They might include a retired OR nurse who role-plays the circulating nurse and an anesthesiologist instructor who role-plays the operating surgeon. In addition, a director monitors and records the simulation from another room, communicating with the instructors via two-way radios. Throughout the simulation, trainees rotate through various roles, such as "first responder," "scrub technician," and "observer"(Gaba et al., 2001a).

ACRM training, complete with yearly refresher training, is currently used at several major teaching institutions in the United States and around the world (Australia, Israel, Denmark). At some centers, ACRM training is offered for experienced practitioners as well as for trainees. Moreover, some malpractice insurers (i.e., Harvard Risk Management Foundation) have lowered their rate structure for ACRM-trained anesthesiologists (Gaba et al., 2001a).

An ACRM evaluation typically assesses a variety of process-oriented criteria. *Teamwork performance* is typically assessed using behavioral markers of the 10 teamwork skills specified in the previous section (Gaba et al., 1998). One measure of these teamwork behaviors consists of a checklist, which, as noted previously, is analogous to the Line/LOS Checklist used in CRM programs (Helmreich, Butler, Taggart, & Wilhelm, 1995). Using a 5-point rating scale, trained raters evaluate team performance on each dimension (Gaba et al., 1998). Measures of interrater agreement exhibited r_{wg} values (James, Demaree, & Wolf, 1984) ranging between .60 and .93 (Gaba et al., 1998); an r_{wg} of .70 is considered sufficiently high to reflect a satisfactory degree of agreement among raters.

Most of the thousands of participants who have undergone ACRM training evaluate it favorably, even the "death scenario," which is specifically designed to assess how trainees handle losing a patient; these positive responses generally last for up to 6 months after training (Gaba et al., 2001b). Furthermore, recent research suggests that participation in ACRM training also increases trainees' self-efficacy and decreases their self reported anxiety (Tays, 2000).

Despite these positive assessments, to our knowledge, no studies have taken the next logical step of directly investigating the link between team process and patient-safety criteria. In fact, virtually no research has tested the effect of any aspect of ACRM training on actual performance outcomes. With respect to *individual* (i.e., technical) performance, this lack of outcome-related validity derives, at least in part, from the difficulties associated with quantifying the performance of anesthesiologists (Gaba et al., 1998).

However, with respect to assessing the effects of *team process*, the lack of outcome-related validity cannot be explained so easily because programmed outcomes are embedded into the ACRM training scenarios (e.g., the "death scenario"). Thus, we believe that developing measures to assess the effectiveness of teamwork in facilitating positive outcomes and in successfully managing, if not avoiding, negative outcomes would constitute a constructive focus for future research. Furthermore, given the current state of simulation, devising training scenarios for which the outcome is contingent on the level of trainees' demonstrated teamwork skills might be worthwhile.

MedTeams' Purpose and Strategy

The primary purpose of MedTeams is to reduce medical errors through interdisciplinary teamwork. MedTeams was initially developed for emergency departments (EDs) on the premise that most errors result from breakdowns in systems-level defenses that occur over time (Simon et al., 2000). According to the MedTeams' ED curriculum, each team member has a vested interest in maintaining patient safety and is expected to take an assertive role in breaking the error chain. MedTeams defines a core ED team as a group of 3–10 (average = 6) medical personnel who work interdependently during a shift and who have been trained to use specific teamwork behaviors to coordinate their clinical interactions. Each core team includes at least one physician and one nurse. A coordinating team that assigns new patients to the core teams and provides additional resources as necessary manages several core teams.

MedTeams' training was developed from an evaluation-driven course design. Based on needs-analysis data, five critical dimensions were identified. Then, 48 specific, observable behaviors were linked to these dimensions and Behaviorally Anchored Rating Scales (BARS; Smith & Kendall, 1963) were constructed. Finally, to establish its content validity, the MedTeams curriculum was

reviewed and refined during three 5-day expert panel sessions that included ED physicians and nurses from 12 hospitals of various sizes (Simon et al., 1998). Expert panel review and modification of the curriculum were used to create labor and delivery and OR versions of MedTeams.

MedTeams uses a train-the-trainer approach to implement the training. Trainers, designated by their facility, receive comprehensive training on how to teach MedTeams and are certified as MedTeams' instructors. The course consists of an 8-hr block of classroom instruction that contains an introduction module, five learning modules, and an integration unit. After completing the classroom training, each team member participates in a 4-hr practicum that involves practicing teamwork behaviors and receiving feedback from a trained instructor. Coaching, mentoring, and review sessions also are provided during regular work shifts (Simon et al., 1998).

MedTeams' training has been evaluated using a quasi-experimental research design (Morey et al., 2002, 2003) in which a variety of process factors (e.g., quantity of teamwork behaviors) and enabling factors (e.g., attitudes toward teamwork, staff burnout) were measured over a 1-year period. An analysis of these data indicated a positive effect of training on *outcome criteria* (e.g., medical errors, patient satisfaction; Morey et al., 2002). However, this study suffered two significant limitations; participating hospitals self-selected into either the experimental or control groups, and observers were not blind to the experimental conditions. To address this limitation, a subsequent evaluation of MedTeams in labor and delivery units is in progress, using a randomized clinical trial design (Goldman, Shapiro, Mann, Risser, & Greenberg, 2002).

Summary

This chapter has summarized the general state of medical team training. We concentrated our discussion on ACRM and MedTeams, because these are the most thoroughly documented medical team training programs. These programs have made progress in improving patient safety; nevertheless, despite the encouraging nature of the extant data, the degree to which medical, CRM-inspired training will enhance patient safety remains in question. Thus, to provide a strategy for further investigation, the final section of this chapter integrates our findings into conclusions and recommendations relevant to medical team training.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion 1: The Medical Field Lacks a Theoretical Model of Team Performance.

To date, research has not developed a comprehensive model of team performance in medical settings; consequently, medical team training programs have not been grounded in a scientific understanding of effective teamwork in the medical community. Given this gap in knowledge, the first research effort we advocate is to develop a theoretical medical team performance model that hypothesizes (a) the relations among predictors of performance and (b) the relations between predictors and outcome criteria. Nevertheless, despite the absence of a team performance model that focuses on medical teams per se, previous research has provided considerable relevant knowledge; the availability of this knowledge underlies several of the remaining conclusions.

Conclusion 2: The Science of Team Performance and Training can Help the Medical Community Improve Patient Safety.

As discussed in this chapter, a more general science of team performance and training has evolved and matured over the last 20 years. This science has produced a number of principles, lessons learned, tools, and guidelines that will serve the patient safety movement. Our recommendations are as follows: (a) that the medical community continue to inform itself of the progress of this science through a variety of venues (e.g., specialized workshops, books) and (b) that the medical community enlist the help of team training experts to apply to patient safety the principles, guidelines, and learning afforded by previous research.

Conclusion 3: Research Has Already Identified Many of the Competencies Necessary for Effective Teamwork in Medical Environments.

Previous investigations have identified the competencies required for effective team functioning in a number of complex settings. Many of these

competencies apply to the medical community. However, as Cannon-Bowers and colleagues (1995) noted, the team skills literature is confusing, contradictory, and plagued with inconsistent labels and definitions. For example, across studies, different labels are used to refer to the same teamwork skills, and the same labels are used to refer to different skills. Thus, we recommend using a two-step process to develop a taxonomy with standard nomenclature; this taxonomy would name and define teamwork-related KSAs that constitute the core *competencies* related to successful teamwork in the medical domain.

The first step in developing such a taxonomy is to determine an appropriate level of explanation; the constructs included in the taxonomy must be conceptualized broadly enough to span the medical field yet be specific enough to facilitate valid measurement. Further, although this list of core competencies should reflect all relevant aspects of team performance, it must be concise enough to generate teamwork and team training research and to facilitate team training needs analyses in organizations.

The second step, determining relevant core competencies, encompasses two activities. One task is to establish which of the many competencies manifested in previous research are relevant to virtually all medical teams; another task is to identify core medical team competencies that have not emerged from team research in other domains. We believe that using task analytic techniques (e.g., survey questionnaires, structured interviews, and unobtrusive observations) will yield the most valid information. We also emphasize the importance of large-scale, stratified data collections, because the goal is to identify generic competency requirements with which the medical community at-large concurs.

Conclusion 4: A Number of Proven Instructional Strategies are Available for Promoting Effective Teamwork.

The science of team performance and training has developed and validated numerous training strategies that can provide requisite competencies to teams who perform in complex environments. Through a variety of formats and objectives, these strategies extend beyond CRM training. We recommend (a) that the medical community use these strategies wherever possible, given that some are relatively easy to design and deliver and (b) that the community explore strategies other than CRM to improve patient safety.

Conclusion 5: Team-Training Strategies Must Be Further Adapted to Medical Needs.

We are convinced that no single model of team training can be applied across all medical practices and contexts. For the purposes of this discussion, we define a "practice" as a medical specialty or subspecialty, such as emergency medicine, general or family medicine, intensive care, surgical medicine, or obstetrics. Medical practices differ dramatically across a variety of criteria: size, purpose, duration, redundancy of expertise, decision time, and consequence of error, to name but a few.

Moreover, a particular practice may operate in a number of diverse contexts. As an example, emergency medicine providers function in hospital EDs, in emergency-response mobile units, and on battlefields. Similarly, to mention several obvious distinctions, urban and rural general providers operate in independent or multipractitioner offices, as well as in community walk-in clinics. Neither the competencies that impel successful teamwork nor an optimal team-training strategy can be expected to generalize across all these contexts. And, of course, not all members within the same team will necessarily need the same KSAs.

Therefore, in addition to the core-competency taxonomy, we also recommend developing practice-specific taxonomies. These putative taxonomies would not be redundant with the generic, core-competency taxonomy. Rather, a practice-specific taxonomy would denote the specific KSA requirements that are central to teamwork in a given practice. The medical content and procedures that define this practice would drive the identification of relevant team competencies.

Virtually no previous research has addressed the manner in which differences within and between medical practices should be reflected in practice-specific taxonomies. Yet we find this issue sufficiently compelling to warrant further investigation. Because these taxonomies are derived from the medical characteristics of specific practices (and contexts within them), subject-matter experts who represent each practice might be invaluable in identifying practice-specific team competencies that are not redundant with the generic core-competency taxonomy. Nevertheless, we also suggest that researchers avail themselves of survey questionnaires, structured interviews, and unobtrusive observations.

Conclusion 6: The Medical Community Has Made Considerable Progress in Designing and Implementing Team Training Across a Number of Settings.

Our review of team training programs clearly shows that the medical community is striving to implement CRM training across a number of medical domains. We recommend that this trend be continued. However, the extent to which these programs are being implemented with the help of what we know from the science of learning, of team performance, and of training is less clear. Thus, we recommend strengthening the link between scientific knowledge and medical team training. Furthermore, as noted previously, the medical community should explore other strategies that can be effectively applied to medical team training. Specifically, we first recommend that medical team training be *developed* to reflect the established instructional principles that underlie team-training research. Second, we recommend that the quality of these programs be *evaluated* on the basis of confirmed scientific criteria (e.g., assessing the degree to which training transfers to the actual work environment).

Conclusion 7: The Institutionalization of Medical-Team Training Across Different Medical Settings Has Not Been Addressed.

Our final conclusion focuses on what we consider the imperative need to embed medical team training in professional development. By "embedding" we mean implementing and regulating medical team training throughout a health care provider's career. As noted earlier, the ACGME identified several teamwork-related competencies that residents must master. Similarly, AAMC funded a "critical incident" analysis to investigate the behaviors that result in successful and unsuccessful performance during medical school and residency. Although not originally targeted toward team performance, the results revealed the importance of a number of teamwork-related competencies.

Simply stated, for medical team training to deliver the impact that it can potentially exert on patient safety, it must be instantiated at every stage of a provider's working life. For example, certain medical school assignments might require students to prepare team projects. Interns and residents might observe, participate in, and evaluate practicing teams in hospitals. The larger challenge, however, occurs after providers have completed their formal training.

We believe that the structure of health care, as currently conceptualized, does offer appropriate junctures where teamwork skills could be evaluated. For example, like the examinations that are constructed for board certification in medical specialties, it might ultimately be useful to develop a board certification test for teamwork. Such an exam might combine a written test of knowledge and situational judgment with performance in a simulated scenario. Because the board examinations are practice specific, their teamwork component could assess practice-specific teamwork competencies. In addition, the Joint Commission on Accreditation of Healthcare Organizations currently evaluates hospitals on criteria that range from medical practices to managerial systems to facilities maintenance. At some point in the future, folding generic competency criteria into the Joint Commission evaluation might focus providers' attention on the importance of teamwork in medical settings, as well as yielding valuable research data.

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