

Teaching Teamwork in Medical Education

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ABSTRACT

Teamwork has become a major focus in healthcare. In part, this is the result of the Institute of Medicine report entitled *To Err Is Human: Building a Safer Health System*, which details the high rate of preventable medical errors, many of which are the result of dysfunctional or nonexistent teamwork. It has been proposed that a healthcare system that supports effective teamwork can improve the quality of patient care and reduce workload issues that cause burnout among healthcare professionals. Few clear guidelines exist to help guide the implementation of all these recommendations in healthcare settings. In general, training programs designed to improve team skills are a new concept for medicine, particularly for physicians who are trained largely to be self-sufficient and individually responsible for their actions. Outside of healthcare, research has shown that teams working together in high-risk and high-intensity work environments make fewer mistakes than individuals. This evidence originates from commercial aviation, the military, firefighting, and rapid-response police activities. Commercial aviation, an industry in which mistakes can result in unacceptable loss, has been at the forefront of risk reduction through teamwork training. The importance of teamwork has been recognized by some in the healthcare industry who have begun to develop their own specialty-driven programs. The purpose of this review is to discuss the current literature on teaching about teamwork in undergraduate medical education. We describe the science of teams, analyze the work in team training that has been done in other fields, and assess what work has been done in other fields

about the importance of team training (ie, aviation, nonmedical education, and business). Additionally, it is vital to assess what work has already been done in medicine to advance the skills required for effective teamwork. Much of this work has been done in fields in which medical professionals deal with crisis situations (ie, anesthesia, trauma, and labor and delivery). We describe the current programs for teaching medical students these essential skills and what recommendations have been made about the best ways to introduce teaching this skill set into the curriculum. Finally, we include a review on assessing teamwork because one cannot teach team training without implementing an assessment to ensure that the skills are being learned. *Mt Sinai J Med* 76:318–329, 2009. © 2009 Mount Sinai School of Medicine

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Teamwork has become a major focus in healthcare. The impetus for this new interest in teamwork is the Institute of Medicine (IOM) report entitled *To Err is Human: Building a Safer Health System*,¹ which details the high rate of preventable medical errors, many of which are the result of dysfunctional or nonexistent teamwork. This report suggests that teamwork is required for effective patient management because of the increased specialization of tasks, the increased complexity and risks associated with treatment options, and the need to ensure appropriate healthcare outcomes and patient safety. As the report states, “beyond their cost in human lives, preventable medical errors exact other significant tolls . . . total costs of between \$17 billion and \$29 billion per year . . . loss of trust in the healthcare system by patients and diminished satisfaction by both patients and health professionals.” A variety of factors have contributed to this tragedy, but an important component seems to be the “decentralized and fragmented nature of the healthcare delivery system—a nonsystem,” that is, a system that lacks

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essential organization.¹ It has been proposed that a healthcare system that supports effective teamwork can improve the quality of patient care and reduce workload issues that cause burnout among healthcare professionals.²

One of the problems identified by the IOM was “the lack of a single designated government agency devoted to improving and monitoring safety throughout the healthcare delivery system.”¹ It went on to suggest that

Congress should create a Center for Patient Safety that would set national safety goals and track progress in meeting them; develop a research agenda; define prototype safety systems; develop, disseminate, and evaluate tools for identifying and analyzing errors; develop methods for educating consumers about patient safety; and recommend additional improvements as needed.

The IOM also concluded that research has not yet developed a comprehensive model of team training performance in medical settings.¹ However, analyzing the science of team performance and training can help the medical community to improve patient safety. In addition, its report suggests implementing and regulating team training throughout each healthcare provider’s career.³

In his November 2007 Association of American Medical Colleges (AAMC) presidential address, “Culture and the Courage to Change,” Darrell Kirch, MD, argued that organizational culture is every bit as important as organizational strategy for academic medical centers. Kirch called for a redirection of the medical culture to one that is focused upon “collaboration, shared accountability, and team performance”.⁴ Basic assumptions of how the medical community provides the highest quality care with respect to patient safety are changing, and team approaches are central to those changes.

Therefore, it is imperative to develop and implement a curriculum that teaches and promotes teamwork within medical education. Medical organizations and teaching institutions must take the lead in developing and teaching team training in healthcare, but there is insufficient direction about how this should take place. Most teamwork training in medicine has been done in fields that deal with crisis situations (ie, anesthesia, trauma, and labor and delivery). This article reviews the science of team performance and team training as these provide the foundation for creating models that will work in the healthcare profession. We analyze the efforts in other fields (ie, aviation, nursing, and business) and assess the contribution and applicability of these efforts in medicine. We conclude by describing existing

programs for teaching medical students about these essential skills and by providing recommendations for introducing the teaching of this skill set into the curriculum.

DEFINITION AND SCIENCE OF TEAMS

In interviews with hundreds of people in more than 50 different teams in 30 companies, Katzenbach and Smith discovered what differentiates various levels of team performance, where and how teams work best, and how to enhance their effectiveness, and they wrote this in their book, *The Wisdom of Teams: Creating the High-Performance Organization*.⁵ They developed the frequently quoted definition of a team as “a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable.” Moreover, they wrote that “teams outperform individuals acting alone or in larger organizational groupings, especially when performance requires multiple skills, judgments, and experiences.”

Teams must also have meaningful task interdependencies (ie, the job cannot be done by a single individual), and usually task-relevant knowledge is distributed among the team members.⁶ In addition, researchers have described the knowledge, skills, and attitudes (ie, competencies) necessary for effective team performances. These team competencies allow organizations to establish the appropriate requirements for their teams and strategies to enhance teamwork and performance. Knowledge-based competencies (what team members know) refer to the necessity of understanding facts, concepts, relations, and underlying foundations of information that a team member must have to perform a task. Skill-based competencies (what team members do) are the necessary behavioral sequences and procedures needed for task performance. Attitude-based competencies (how team members feel) refer to the affective components needed to perform the task. Teamwork is greatly affected by how team members feel about one another and the task.⁶

Even though all teams are different in terms of membership, group dynamics, and goals, they go through similar processes as they develop from an immature team into one that is mature and productive.⁷ Wells,⁸ a writer about teaching teamwork in information systems, stated that teams are thought to develop in stages. These stages are team forming, team building, team management, and team/project assessment. She suggested that there are several conditions that promote team effectiveness.

Teams should be formed as early as possible to allow some time for the team building stage before the real work begins. In addition, many believe that teams should not be self-selected because this tends to produce homogeneous units. Also, Katzenbach and Smith⁵ stated that

Conflict, like trust and interdependence, is also a necessary part of becoming a real team. Seldom do we see a group of individuals forge their unique experiences, perspectives, values, and expectations into a common purpose, a set of performance goals, and approach without encountering a significant conflict. And the most challenging risks associated with conflict relate to making it constructive for the team instead of enduring it.

The effectiveness of a team's work depends on the internal group processes: the ways in which conflicts are managed, the amount of trust between members, and the use of an appropriate leadership style.⁷

Katzenbach and Smith⁹ described further in an article in the *Harvard Business Review* "what makes the difference between a team that performs and one that doesn't."⁹ They proposed that

The essence of a team is common commitment. Without it, groups perform as individuals; with it, they become a powerful unit of collective performance. This kind of commitment requires a purpose in which team members can believe. By contrast, failed teams rarely develop a common purpose.

Finally, they added that no group ever becomes a team until it can hold itself accountable as a team.

Kirkman and Rosen¹⁰ studied 100 teams in 4 organizations and described the association between team empowerment and team effectiveness. They concluded that empowered teams share 4 experiences: potency, meaningfulness, autonomy, and impact. They suggested that team members must believe in their team's capabilities, find meaning in their team's tasks, and fully realize the impact of their work if they are to become truly high-performance teams. Teams need supportive leaders who will trust them to make important decisions, celebrate their successes, and learn from their mistakes. In addition, they suggested that leaders of empowered teams must play the role of coaches and facilitators, helping teams define tasks, structure activities, and monitor their own progress.

Evaluating the effectiveness of a team requires that the team members be willing and equipped to engage in a process of team evaluation and self-analysis. Team evaluation involves assessing both the process (ie, team interactions) and outcomes (ie, accomplishments). Criteria need to be established,

and the team processes and outcomes need to be measured against these criteria to confirm and document team effectiveness.⁷ In studying the effectiveness of building designers, Busseri and Palmer¹¹ showed a positive correlation between ratings of the team's design and ratings of the team's processes. They suggested that assessing team performance during a task positively affects how well the team functions. Teams that periodically self-assess their teamwork processes will work more effectively and have higher levels of member satisfaction than teams that do not.

Teamwork can be defined as the ability of team members to work together, communicate effectively, anticipate and meet one another's demands, and inspire confidence resulting in a coordinated collective action.⁶ *Collective action* is defined as the pursuit of a goal or set of goals by more than 1 person. According to Salas and Cannon-Bowers,⁶ teamwork is a critical component of team performance and is composed of 4 key behavioral characteristics. These are performance monitoring (the ability to apply appropriate task strategies to develop common understandings of the team environment, including an understanding of teammate workload, fatigue, stress, and skills and the environment external to the team itself), feedback, closed-loop communication (the exchange of information between a sender and a receiver), and backup behaviors (a person's ability to anticipate other team members' needs through knowledge about their responsibilities).

Researchers and medical professionals agree that patient treatment and safety are improved through multidisciplinary teamwork, but as Salas *et al.*¹² stated, "the reality is that teamwork occurs infrequently, is fraught with difficulties, and is misunderstood." It does not require that one like or feel close to one's team members; however, it does rely on one's willingness to cooperate for a shared goal. In the healthcare field, that goal is maintaining the patient's health status and avoiding errors.¹² Teamwork is a set of interrelated behaviors, cognitions, and attitudes. It is more than knowledge and skills. Teamwork depends on the ability of each team member to (1) anticipate the needs of others, (2) adjust to each other's actions and to the changing environment, and (3) have a shared understanding of how a procedure should happen in order to identify when errors are occurring and how to correct for these errors.¹²

Another challenge of team management is not simply to execute existing processes efficiently; it is also imperative to implement new processes and to learn how to implement new processes

quickly. Edmondson *et al.*¹³ described in the *Harvard Business Review* how her group studied surgical teams at 16 major medical centers to see how they implemented a difficult new procedure for performing cardiac surgery. What they found was evidence about a team's ability to adapt to a new way of working. First, they identified factors that did not seem to matter in how quickly teams learned the new techniques: the educational background and surgical experience of the team, high-level management support for the new technology, the status of the surgeon, and finally debriefings and project audits. What did matter was the way in which teams were put together and how they drew on their combined experiences. Teams that learned the new procedure most quickly shared 3 essential characteristics: they were designed for learning, their leaders framed the challenge in such a way that team members were highly motivated to learn, and the leaders' behavior created an environment of psychological safety that fostered communication and innovation.

TEAMWORK TRAINING

Teamwork is not an automatic consequence of placing people together.¹² Team members need training to learn how to work together and understand the professional role and responsibility of each person.² Team training can be defined as a set of tools and methods that form an instructional strategy in combination with requisite competencies and training objectives. Team training has 1 basic objective: to affect crucial team competencies.⁶ Changes in how healthcare professionals are trained to view teamwork may reduce conflict and improve team performance. Optimal interdisciplinary training begins early in medical education.¹² This concept of training about teamwork has been embraced by the medical community. The Accreditation Council for Graduate Medical Education echoes that teamwork is a skill that needs to be taught and assessed. It identifies interpersonal and communication skills as 1 of 6 core competencies in graduate medical education and requires residents to demonstrate skills that "result in effective information exchange and teaming with . . . professional associates."¹⁴ The AAMC issued the Medical School Objectives Project, which sets forth "the ability to communicate effectively with patients, patients' families, colleagues, and others with whom physicians must exchange information in carrying out their responsibilities" as one of the core skills that students should possess prior to graduation from medical school.¹⁵ Team training is also currently suggested as part of a comprehensive

patient safety plan published by the Joint Commission on Accreditation of Healthcare Organizations, the regulatory agency charged with hospital accreditation in the United States.¹⁶

Few guidelines exist to help implement these recommendations in healthcare settings. In general, programs designed to improve team skills are a relatively new concept for medicine, particularly for physicians who are trained largely to be self-sufficient and individually responsible for their actions.¹⁶ Additional training needs to be done to promote interprofessional training in medicine. There needs to be a willingness to work together toward the common goal of patient safety. If a team member decides to work independently, then the effectiveness and success of the team are placed in jeopardy.¹⁷

Outside of healthcare, research has shown that teams working together in high-risk and high-intensity work environments make fewer mistakes than individuals. This evidence arises from commercial aviation, the military, firefighting, and rapid-response police activities. Simulation is the primary educational component of many of these programs. Simulation refers to the re-creation of an actual event that has previously occurred or could potentially occur. One of the greatest values of simulation is that it can be used over and over again to perfect an action, a procedure, or a conversation without the providers or patients ever being exposed to harm.¹⁸ Debriefing is of vital importance after a team simulation experience. Debriefing allows the team to learn where errors occurred and how they could potentially have been prevented, and it also allows recognition of areas of appropriate performance. Simulation without debriefing has been shown to be ineffective because errors can be repeated if team members have not been informed that they were making mistakes.¹⁸

Commercial aviation is an industry in which mistakes can result in unacceptable loss. This industry has been at the forefront of risk reduction through teamwork training. The aviation industry and the National Aeronautics and Space Administration determined that the human error aspects of the majority of air crashes were due to failures of interpersonal communication, decision making, and leadership. As a result, training programs were developed to make communication more effective on the flight deck in order to reduce error.¹⁹ One of the best known team training strategies to emerge from the aviation setting is crew resource management (CRM) training. This training focuses on behavioral skills and teamwork training.²⁰ CRM teaches that all members of a team are vital. If a team member at any level believes that something is not being done

appropriately or in the best interest of the team or other people that have put their trust in the team, then that member must speak up. The fact that humans make mistakes but are able to learn from these errors and prevent their repetition is an important tenet of CRM training.²⁰

Although some of the concepts of CRM may be communicated in a didactic setting, experts in CRM training suggest that they should be practiced simultaneously with more technical skills, often with high-fidelity simulators. The cognitive stress associated with crisis situations can be created or re-created through the use of simulated events to determine where, when, and why errors occur in these situations.²⁰ Pilots are given feedback not only on their technical skills and decision making strategies but also on crew management and resource utilization.¹⁸ CRM programs teach aviation crews about human limitations and involve participants in assessments of their own behavior and the behavior of their peers. Concepts that are taught include those related to making inquiries, seeking relevant data, advocating actions, communicating proposed action plans, resolving conflicts, and making decisions. Additionally, participants learn to understand cognitive errors and are taught how stressors, such as fatigue, crisis, and work overload, contribute to human error.¹⁹

Many healthcare organizations have set up team training programs based on the principles of CRM.²⁰ In particular, CRM training programs have been used in operating rooms, anesthesia departments, emergency departments (EDs), intensive care units, and labor and delivery units. The principles of CRM and their effect on safety have not been completely evaluated in aviation or in healthcare.¹⁹ Researchers caution that although many of the lessons learned in aviation will have counterparts in medicine, trying to directly apply one industry's practices to the other risks both the application of unwarranted elements and the omission of aspects specific to medical practice.¹⁸

Military service is a second high-risk context in which the consequences of error can be dire. Military team training research is fairly recent and led to the development of a program known as Tactical Decision Making Under Stress (TADMUS) in 1990. The program was launched as a result of 2 tragic incidents at sea. Specifically, a missile struck the USS Stark in 1987, resulting in the deaths of 37 American servicemen. This incident led to a heightened readiness and tension aboard all US military ships operating in the Persian Gulf. In July 1988, with tensions in the area already high, the USS Vincennes, mistakenly believing it was under

attack, shot down an Iranian airbus, killing all 290 people onboard. The Navy investigation concluded the commanding officer had acted properly, given all the information he had received, but noted that stress, task fixation, and unconscious distortion of data may have played a significant role in the incident. The investigations into these 2 incidents revealed the need to know more about the behavior of teams and to improve decision making under stress. The TADMUS project was launched, and Navy researchers began the comprehensive task of studying teams to determine "what makes a team of experts an expert team."²⁰ Through observations of highly functioning teams and poorly functioning teams, the researchers were able to identify specific dimensions of effective teamwork.

Team dimensional training (TDT) incorporates these research findings and focuses on 4 areas (or dimensions) essential for effective teamwork. These areas are information exchange, communication, supporting behavior, and initiative/leadership. TDT helps team members to diagnose and correct their own performance problems, thereby enabling them to adapt quickly to unfolding events and to learn from and build upon their previous experiences together. The TDT process involves a structured approach, which includes a prebriefing observation of team performance, a diagnosis of performance, and a debriefing. In the prebriefing, the team members are introduced to or reminded of the various team dimension elements. Observations of team performance may be made during training exercises or actual incidents. The observations are recorded for use in the debriefing session. Generally, a tactical debriefing is conducted first to clarify and familiarize all team members with the events that took place and to address tactical areas for positive reinforcement and/or improvement. The TDT debriefing does not address tactical issues but focuses the team on the various dimensions of effective teamwork. This process involves self-analysis by the team and is facilitated in a way that allows the team to self-correct problem areas. Goals are set by the team to work on improving problem areas of teamwork. The process helps teams to analyze their operational mistakes while teaching team leaders to guide their members through the self-correction process. New training development and delivery technology, including scenario generation software, virtual environments, and distributed simulation facilities, has made it possible for widely dispersed personnel and units to train together and to exchange feedback.²⁰

The oil and gas industry is also striving to improve health and safety performance to reduce errors and incidents. Oil and gas exploration

uses drilling project teams who come together to develop a planning program for drilling a well and overseeing drilling operations. Crichton²¹ studied drilling team members and identified several of the same themes that have arisen elsewhere in the context of a team working in a complex, uncertain, hazardous environment. He identified the specific areas (teamwork, leadership, stress, and communication) that could benefit from training interventions in order to maximize safe and effective performance.

TEAMS IN HEALTHCARE

In healthcare, common examples of teams include project teams (eg, quality improvement teams), care delivery teams, and management teams. Care delivery teams can be subdivided according to patient population (eg, geriatric teams), disease types (eg, stroke teams), or care delivery settings (operating room or intensive care unit).² A wide range of collaboration can occur, depending on the type of care required. Higher levels of collaboration are often needed when complex medical problems require care by several healthcare professionals. Collaboration among health professionals forms a dynamic spectrum ranging from independent parallel practice to consultation and referral (where health professionals exchange information) to interdependent coprovision of care with interdependent decision making.² The multidisciplinary team allows for each discipline to independently contribute its particular expertise to an individual patient's care. Team members in this situation work in parallel to one another, and direct communication between disciplines is minimal except through the physician in charge. Members of the team may be of the same or different disciplines. The interdisciplinary team refers to a team whose members work together closely and communicate freely to optimize care for the patient. The team is organized around solving a common set of problems instead of being organized around a single physician. Each member of the team contributes his knowledge and skill set to augment and support the others' contributions.²

CRM principles borrowed from aviation have been applied to the development of programs, both simulator-based and non-simulator-based, to train medical teams. High-acuity environments, such as the operating room, the intensive care unit, the emergency room, and the labor and delivery suites, are constantly changing, complex environments in which it is crucial that all personnel operate as a team to maintain patient well-being and safely deliver

healthcare. A subset of CRM concepts, when applied to high-acuity situations in healthcare, is called crisis resource management.¹⁷ In order for these programs to be successful, organizations must acknowledge that errors occur and deal with errors in a nonpunitive manner in which errors are viewed as an opportunity for learning and improvement.¹⁹

The Anesthesia Crisis Resource Management (ACRM) program, developed by Gaba and colleagues,²² is one of the most well-known simulator-based team training programs. In 1987, Gaba and his team began a set of studies of decision making by anesthesiologists, using a patient simulator that they invented. In those experiments, anesthesiologists of different levels of experience managed a simulated patient during a surgical procedure in which multiple medical and equipment faults were triggered. An analysis of videotapes from these early experiments suggested that the training of anesthesiologists contained gaps concerning several aspects of decision making and crisis management that were not systematically taught during training. In 1989, they began to develop a simulation-based curriculum modeled in part on the key principles of CRM in aviation. The first course using the new curriculum was held in September 1990 and was called ACRM. They considered each discipline in healthcare to be a crew containing 1 or more individuals. Several crews may work together closely as a team. For example, the operating room team consists of an anesthesia crew, a surgery crew, and a nursing crew. In ACRM, they opted for a strategy of training crews to work in teams. ACRM uses crew training to provide comprehensive teaching and practice in the integrated use of technical, cognitive, and behavioral skills in managing crises relevant to their domain. Training crews to work in teams also provides a degree of cross-discipline understanding by allowing participants to discuss other team members' views of the same activity or event. In this version of the CRM, simulated scenarios are planned to evaluate teamwork and team performance with planned feedback sessions for process evaluation. A number of behaviors are evaluated, including how efficiently the team performs, how the teams build trust among members, and how members work toward the common goal of patient safety. The debriefing session allows team members to recognize and reinforce appropriate performance while understanding how mistakes occurred and collaborating on how to prevent these errors from recurring in the future. The debriefings last approximately 40 minutes and allow participants to explore alternatives and to recognize and discuss principles of ACRM as they were either executed or ignored in the scenario.

The operating room is a high-risk environment requiring close coordination among all team members. Important characteristics of a reliable team include the ability to adapt to changes within the work environment, to maintain open and flexible communication, and to anticipate the needs of each member of the team. The operating room is a diverse environment, with staff and trainees from different disciplines. Although each of these team members is well trained in clinical task work, most are not explicitly trained in applying these skills in a team environment in which there is a high degree of task interdependence and team coordination. CRM was used in Kantonsspital at the University of Basel (Basel, Switzerland) to develop the Team Oriented Medical Simulation program. This model includes a variety of operating room personnel participating in the simulation simultaneously.¹⁷

Simulation-based operating room team training was further studied by Paige *et al.*²³ A simulation-based interdisciplinary team training program for the operating room was developed by the authors, and it was focused on the behavioral competencies associated with highly effective teams. Two primary hypotheses guided this work: (1) operating room team member participants would perceive the simulated scenarios as authentic and worthwhile, and (2) participants would perceive the interdisciplinary simulation training as an effective method for enhancing communication and teamwork during an operating room crisis. Three interdisciplinary operating room teams participated in the training model. Each team completed the training in a virtual minimally invasive operating room using a standardized operative scenario. Each team participated in a debriefing activity immediately after completion of the scenario. An important component included observation of the video-taped performance. Guided by the trainer/facilitator, the team used the videos to identify and discuss specific performances regarding teamwork, communication, and situational awareness. Upon completion of the training, participants completed a voluntary and anonymous training effectiveness questionnaire. Across the 3 teams, all participants felt that the training was worthwhile and would participate again. Eighty percent felt that the session would change their practices in the operating room. All participants felt that the session was effective in promoting team communication skills and crisis-related teamwork. Ninety percent felt that the training model was effective in recognizing operating room errors.

CRM techniques have also been initiated in ED settings, in which similar stressful, dynamic, and

high-stakes environments exist. Many contextual factors characterize the ED and affect how healthcare providers make decisions. These include unclear diagnoses, incomplete or conflicting information, dynamic situations, multiple competing goals, intense time pressure, and serious consequences of error. Three additional CRM principles take these factors into account: triage/prioritization, efficient management of multiple patients, and effective coping with disruptions/distractions.²⁴ Courses have focused on teamwork curricula, training, and refresher training and simulation. Research in ED settings has shown that teamwork skills help decrease clinical errors in the ED.¹⁹

A specific program, the MedTeams team coordination course, was designed by Dynamic Research Corp. (a corporate trainer), which adapted CRM principles from aviation to emergency medicine. It encourages team members to actively coordinate and support one another in the course of clinical task execution by using the structure of work teams. This program operates on the principle that teams and teamwork behavior do not replace clinical skills but instead teamwork actions ensure that clinical activities are properly integrated and executed to deliver effective emergency care.²⁵ In the MedTeams system, a work team, referred to as an ED core team, is a set of 3 to 10 clinically skilled caregivers who work together during a shift and have been trained to use specific teamwork behaviors to tightly coordinate and manage their clinical actions. The team contains at least 1 physician and 1 nurse, and the most experienced physician on the team is designated as the team leader. The team leader serves as leader to only 1 team during a work shift. Team members always know who is on their team and who the team leader is. The team training is organized around 5 team objectives: establishing and maintaining a team structure; planning and problem solving; communicating with the team; managing work load and resources; and improving team skills by review, debriefing, coaching, and teaching.²⁵ The team coordination course has now been adapted for use in labor and delivery units in an attempt to decrease adverse outcomes and improve the process of care in this setting as well.

Neonatal resuscitation has many similarities to medical crises in the ED or operating room. Neonatal resuscitations are often unpredictable, and teams from multiple departments must coordinate and at times compete with little or no preparation. The Neonatal Resuscitation Program (NRP) is the standard curriculum used to teach caregivers how to treat newborns in the delivery room. Thomas *et al.*²⁶ from the University of Texas observed that approximately

30% of NRP steps are not performed or are performed incorrectly. They reported that neonatal resuscitation should be a team activity and that breakdowns in teamwork may contribute to some of the quality problems that are observed. This group conducted a study with 2 specific aims: to incorporate teamwork skills and information about human error into the 1-day NRP training program for interns and to randomize interns to this new version of NRP or the standard NRP and measure the effects on teamwork during the simulated resuscitation following the program. Interns who were randomized to an NRP course with a teamwork and human error curriculum exhibited more team behaviors during the simulated resuscitation than interns in the standard NRP course. This is one of the first studies to document that team training for neonatal resuscitation, and perhaps any healthcare process, can result in more frequent utilization of team behaviors. Other strengths include the random allocation of subjects to the intervention and control groups; the use of trained, blinded observers to rate the frequency of team behaviors; and teaching and measurement of team behaviors that were developed on the basis of research in commercial aviation and neonatal resuscitation. One of the important highlights of this study is that the training curriculum was firmly grounded in the context and processes of neonatal resuscitation. The authors suggest that this grounding for a team training program in specific healthcare processes will be more effective than using generic team training processes and skills.

Teamwork among nursing staff is another area to which attention has been directed. Kalisch *et al.*²⁷ studied a series of interventions to enhance teamwork and staff engagement in a medical unit in an acute care hospital. The interventions involved focus group discussions of perceptions of the level of teamwork in the unit and issues that inhibit and enhance teamwork. These focus group data were compiled into a report that was presented in several feedback sessions. The next step was to conduct sessions to discuss values, visions, and goals, and then a gap analysis was conducted of where they were and where they wanted to be. Each staff member then attended a team training program. Guiding teams were then created to address the specific project goals, and rapid testing and implementation of ideas ensued. The results showed that the intervention resulted in a significantly lower patient fall rate, staff ratings of improved teamwork on the unit, and lower staff turnover and vacancy rates. Improvements in patient satisfaction ratings approached, but did not reach, statistical significance.

TEAMWORK TRAINING IN MEDICAL EDUCATION

There is some existing literature, although limited, concerning how to teach about teams in medical education. Hall and Weaver²⁸ performed a review of the literature on interdisciplinary education and teamwork in healthcare to discover the major issues and best practices. Two main categories emerged from their search: one pertaining to the system of education and training of healthcare professionals and the other pertaining to the content of interdisciplinary education. Several studies have suggested that learning to work in an interdisciplinary milieu should occur early in the education of the healthcare professional (eg, within the first 2 years) because experience of shared learning at an early stage may better facilitate interdisciplinary collaboration. Others have cautioned, however, that one must first be secure in the competency of one's discipline and that a thorough knowledge of one's own discipline is essential to understanding contributions to the team effort.²⁸ Problem-based learning (PBL) is an example of a team-based method of learning. PBL, done in a small-group format, offers a means of integrating theory with clinical components and demands knowledge acquisition and attitudinal and psychomotor skills from its learners. PBL is a structured educational activity, usually employing case presentations as the stimulus to learning. This approach helps students learn to listen to one another and to collaborate as they work to resolve the problem.²⁸ The service/learner model is another teaching method that uses a clinical setting to challenge the learners to work together effectively to address real clinical problems, patient education, or health dilemmas of underserved populations. Both of these methods place the patient at the center of the team's focus.²⁸ Other important concepts addressed in these articles include the need for motivating and educating faculty to learn new tools of team training and the need for the administrative support of the educational and clinical institutions involved in changes.²⁸

Team-based learning (TBL) has become another commonly used curriculum tool. Team learning is a well-defined instructional strategy developed by Larry Michaelson.²⁹ The TBL method allows a single instructor to teach by conducting multiple small groups simultaneously in the same classroom. Learners must actively participate in and out of the class through preparation and group discussion. Class time is shifted away from learning facts and toward the application and integration of information. The

instructor retains control of the content and acts as both facilitator and content expert. The team learning method affords the opportunity for assessment of both individual and team performance. Learners first study independently outside of class to master identified objectives. The individual learners then complete a multiple-choice examination to ensure their readiness to apply their knowledge. Groups of 6 to 7 learners then retake the examination and turn in their consensus answers. Groups then complete class assignments that promote collaboration, use of their acquired knowledge, and identification of learning deficiencies. At designated times; all groups simultaneously share their answers with the entire class for comparison and feedback. This stimulates a large group discussion, with groups defending their answers and the teacher helping to consolidate learning. TBL emphasizes the importance of individual and group accountability, the need and opportunity for group interaction, and the motivation to engage in give-and-take discussion.²⁹ A number of studies that have appeared in the medical literature provide empirical evidence of potential benefits from TBL. Such benefits include increased student engagement, higher quality communication processes, and increased National Board of Medical Examiners shelf examination scores.³⁰

There is little literature about other medical school curricula that teach team training. Charkraborti *et al.*³¹ conducted a systematic review of teamwork training interventions in medical student and resident education. They found 13 studies by searching multiple databases. Most curricula that exist place medical trainees in multidisciplinary learning environments that include nurses, social workers, physical/occupational therapists, administrators, and pharmacists. All curricula employed some active learning methods; these included critical incident simulations, role playing, case-based scenarios, and actual patient encounters. No curriculum described using standardized patients in teamwork training. Three of 13 curricula employed nonmedical teambuilding exercises, such as a rope course or a survival game. The majority of the curricula incorporated feedback as an integral part of active learning. Seven used formal debriefing sessions to provide feedback for learners in the curriculum. Five used facilitated reflection as a technique to help learners gain a richer understanding of teamwork. Three studies used a controlled pre/post evaluation design. Ten used an uncontrolled pre/post design. There were no randomized controlled trials. Five studies were multi-institutional.³¹ Four of the curricula used self-reported measures of knowledge, and none used an objective test of knowledge. None of the knowledge assessments that were described

had been previously validated. Most commonly, knowledge outcomes demonstrated improvements in group awareness. Eight curricula showed improvements in self-assessed team skills. Four curricula included observer assessments of team skills. Nine of the curricula assessed attitudinal changes: all were self-assessed. The reviewers concluded that all of the teamwork curricula analyzed used reasonable educational strategies and appeared to be modestly effective in the short term.³¹

The Agency for Healthcare Research and Quality and the Department of Defense have collaborated to explore the field of medical teamwork. The 2 agencies have developed a new resource training tool for training healthcare providers in better teamwork practices: Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS).³² TeamSTEPPS offers a flexible, evidence-based toolkit to improve patient safety through enhanced communication and other teamwork skills. TeamSTEPPS initiatives occur in 3 continuous phases: assessment; planning, training, and implementation; and reinforcement and sustainment. TeamSTEPPS promotes competency in 4 course areas: team leadership, situation monitoring, mutual support, and communication.³² TeamSTEPPS provides an environment of open communication in which everyone, including the patient, is made to feel comfortable speaking up, regardless of the situation or the complexity of the procedure.³²

The AAMC has implemented the TeamWorks! program, which guides faculty and staff in health professions through approaches to improve the effectiveness of team dynamics and task management. TeamWorks! scholars and faculty coaches provide consultation and support for adapting team behaviors to institutional work.³³

Interprofessional education (IPE) occurs when 2 or more professions learn with, from, and about each other in order to improve collaboration and the quality of practice. IPE helps students to look at a task from the perspective of other professions as well as their own. It enables students to acquire knowledge, skills, and attitudes that they could not acquire in a uniprofessional education.³⁴

Pawlina *et al.*³⁵ at the Mayo Clinic College of Medicine aimed to provide an IPE opportunity to first-year physical therapy and medical students by combining a portion of their respective anatomy laboratory and lecture sessions. Faculty from both disciplines were used, as were formal and informal student interactions between the disciplines. Students from both programs recognized the importance of teamwork across disciplines and appreciated the opportunities to learn from one another and to share

the responsibilities for patient care. This study is a good indication that early introduction to teamwork before the clinical setting is beneficial and well accepted by the students.

Hallin *et al.*³⁴ evaluated whether students perceived that they had achieved interprofessional competence after participating in clinical teamwork training. Six hundred sixteen students from 4 undergraduate educational programs—medicine, nursing, physical therapy, and occupational therapy—participated in an interprofessional course. The interprofessional learning took place in a real clinical work place. The interprofessional student teams collaborated in taking care of and treating patients. The students performed all medical, nursing, physical therapy, and occupational therapy work and care of the patients. The students filled out prequestionnaires and postquestionnaires. All student groups perceived that they had increased their knowledge of the other 3 professions' work and assessed that the course had contributed to the understanding of the importance of communication and teamwork in patient care. All student groups perceived that the clarity of their own professional role had increased significantly. The conclusion of this study was that active patient learning by working together in a real ward context seems to be an effective means to increase collaborative and professional competence.

Debate has ensued about the proper timing of the introduction of IPE. Conventional wisdom has suggested that IPE is most effective in fostering teamwork when introduced to professionals who have a clear sense of their own professional identity and have experiences to share. The opposite viewpoint, however, is that IPE should be introduced at the very start of professional education to prevent the formation of negative interprofessional attitudes that will later be resistant to change.³⁶ Coster *et al.*³⁶ studied students in 8 healthcare groups from 3 higher education institutions in the United Kingdom at 4 time points. They found that the strength of professional identity in all professional groups was high on entry to university but declined significantly over time for some disciplines. Similarly, students' readiness for interprofessional learning was high at entry but declined significantly over time for all groups, except nursing students. They concluded that their findings provide support for introducing IPE at the start of the healthcare students' professional education in order to capitalize on their readiness for interprofessional learning and their well-formed professional identities. However, their study also suggested that students who enter with negative attitudes toward interprofessional learning may gain the least from IPE courses and that an unrewarding

experience in such courses may further reinforce their negative attitudes.

The evaluation of teamwork training is a challenging task for a number of reasons. First, to evaluate the effectiveness of teamwork skills training, it is necessary to measure both teamwork skills exhibited during patient care and team performance in terms of patient outcome. Then, to show that teamwork training improves patient safety, there must be an agreement that the performance measures used are valid proxies for patient safety. In addition, if assessment is done in a simulated environment, it is necessary to demonstrate that the training transfers to clinical situations. Finally, the evaluation must take into account individual and organizational factors that affect training effectiveness.³⁷

There are few validated tools to assess whether or not individuals possess team coordination skills. However, it is imperative to establish a relationship between ratings of team skills and clinical team performance for 2 reasons. First, it is important to empirically show that teamwork skills affect clinical performance and ultimately patient outcomes. Second, it is important to establish the validity of using behaviorally anchored team skill rating scales for assessing individual team skills and for assessing the effectiveness of training programs and interventions.³⁸ Wright *et al.*³⁸ chose to evaluate a rating scale that assessed general team coordination skills that could be applied in a wide variety of healthcare environments. The teamwork dimensions were assertiveness, decision making, situation assessment, leadership, and communication. They recruited 35 medical students to participate in 2 different types of educational tasks on 2 different occasions. Team assignments were random. Each team performed 2 patient assessment tasks in a classroom-based environment. The students used the problem-based teaching method. In the second part of the study, the teams were reassigned and performed 2 high-fidelity simulated patient assessment and care tasks. Two behavioral scientists used a behaviorally anchored team skill rating scale and rated each participant in all 4 cases. In general, individuals were rated higher in teamwork skills in the simulated care tasks than in the classroom tasks. For the classroom task, there was no evidence of a relationship between behaviorally anchored skill ratings and objective team performance measures. In the high-fidelity simulated tasks, there was evidence of a positive relationship between behaviorally anchored skill ratings and objective performance measures. These results may suggest that team skill development requires a dynamic interactive context. The results also provide some support for the validity and reliability of observer-based rating of teamwork skills

when a structured tool is provided for basing ratings on specific observable teamwork behaviors.

Faculty attitudes are believed to be a barrier to successful implementation of IPE initiatives within academic health settings. Curran *et al.*³⁹ studied these attitudes. They distributed a survey to all faculty members in the medicine, nursing, pharmacy, and social work programs in their institution. Respondents were asked to rate their attitudes toward interprofessional healthcare teams, IPE, and interprofessional learning in an academic setting using scales adopted from peer-reviewed literature. Medicine faculty members reported significantly lower scores than nursing faculty in all aspects of the survey. Female faculty and faculty who reported previous experience in IPE reported significantly higher scores. Age, years of practice, and experience as a health professional educator were not related to the overall attitudinal responses. They concluded that faculty development efforts aimed at changing attitudes and increasing understanding of interprofessional collaboration are critical.

CONCLUSION

The practice of medicine is complex. No one individual can expect to care for a patient on his own, and he must be able to effectively interact with other disciplines and specialties to optimize care. Communication across multiple units, physicians, nurses, and others becomes vital to ensuring that accurate and complete information is available, properly exchanged, and regularly updated. Medical education has often emphasized autonomy, and until recently, education on teamwork has not been explicitly included in the medical curriculum. In addition, medicine has traditionally been very hierarchical, emphasizing a communication structure that follows a chain of command philosophy. The IOM explained in its 1999 report that healthcare providers tend to be trained as individuals yet also function exclusively as teams; this creates a gap between training and reality. Teamwork has been studied at length by organizational and human factors psychologists, and as Salas *et al.*¹² stated, "improved teamwork—the seamless integration of multiple knowledge, skill and affective competencies—is a mechanism to improve patient safety and avoid errors." A well-functioning team should be able to do things more effectively and safely than an individual or a group of individuals. A poorly functioning team, however, may be antagonistic and detrimental to productivity.

Teaching teamwork is increasingly relevant in medical education as many factors threaten the ability of trainees to coordinate their individual efforts to care for patients. Medical training places coworkers together for variable and short periods of time. Teams form and then disband. In addition, work-hour restrictions necessitate increasing emphasis on the coordination of roles, facilitation of transfers, and supervision.

There appears to be a consensus in the literature on the need for education about teams in the healthcare professional's education. It is imperative to continue to develop educational curricula and training models for teamwork and collaborative practice across the continuum of professional education and to implement educational initiatives about the new model of interprofessional healthcare delivery and teamwork. Certain nonclinical skills must be learned by team members: group skills, communication skills, and conflict resolution skills. It is also vital to develop leadership training opportunities and to foster a culture that supports teamwork and builds the capacity for team members to practice collaboratively. Faculty development must be provided to address motivations to participate. This includes opportunities for faculty to learn how to facilitate interdisciplinary education sessions and to learn skills from management and behavioral sciences. By drawing on the science of teams and the work on team training that has been done in other fields, we can focus our endeavors on applying these methods to a medical curriculum that will encompass undergraduate and graduate training and accomplish the charge delivered by Kirch and the IOM. As Salas⁴⁰ recently stated in his presentation at the 2008 AAMC meeting, "team training and teamwork must be part of the DNA of healthcare."⁴⁰

DISCLOSURES

Potential conflict of interest: Nothing to report.

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