# Developing Expert Medical Teams: Toward an Evidence-based Approach

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## Abstract

Current health care literature cites communication breakdown and teamwork failures as primary threats to patient safety. The unique, dynamic environment of the emergency department (ED) and the complexity of patient care necessitate the development of strong interdisciplinary team skills among emergency personnel. As part of the 2008 *Academic Emergency Medicine* Consensus Conference on ''The Science of Simulation in Healthcare,'' our workshop group identified key theory and evidence-based recommendations for the design and implementation of team training programs. The authors then conducted an extensive review of the team training literature within the domains of organizational psychology, aviation, military, management, and health care. This review, in combination with the workshop session, formed the basis for recommendations and need for further research in six key areas: 1) developing and refining core competencies for emergency medicine (EM) teams; 2) leadership training for emergency physicians (EPs); 3) conducting comprehensive needs analyses at the organizational, personnel, and task levels; 4) development of training platforms to maximize knowledge transfer; 5) debriefing and provision of feedback; and 6) proper implementation of simulation technology. The authors believe that these six areas should form an EM team training research platform to advance the EM literature, while leveraging the unique team structures present in EM to expand team training theory and research.

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The practice of emergency medicine (EM) involves the management of complex patients in a dynamic and often uncertain environment. Emergency teams perform multiple concurrent tasks during times of high workload. In addition, several areas of EM are recognized as extremely high risk with regard to patient safety and medical errors.[1,2] EM teams combine members with specialized skill sets that require coordinated response to unexpected events.[3] In such types of teams, it is clear that success depends not only on individual performance, but also on the ability of the team to function in a coordinated, effective manner.[4] While the importance of developing team skills is recognized, there are currently no clear guidelines for designing and implementing team training programs.

A significant component of military and aviation-based team training occurs in simulators. As a result, team training and simulation-based training (SBT) have become almost synonymous.[5] The health care literature reports several uses of simulation for team training.[6–9] In this article, we present several issues that are germane to the development and study of team training in EM. Our goal is to 1) present a focused review of the EM team training literature, as well as from the aviation and organizational psychology fields; 2) demonstrate how studies and theoretical models from other domains can advance EM-based team training; and 3) postulate how the unique teams that practice in emergency

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departments (EDs) can be leveraged to advance team training theory and practice.

## REVIEW OF TEAM TRAINING PROGRAMS IN HEALTH CARE

The recent emphasis on team training in health care has prompted the development of several medical team training programs. While each program is not specifically designed for EM, the components of each can be applied to almost any area of health care where interdisciplinary teams function. In Table 1, we briefly review the content and strategy of each program, as well as any empirical evidence of training effectiveness.[10–17] While a complete dissection of all team training programs reported in the literature is beyond the scope of this article, Table 1 highlights several key issues. First, it is clear that program evaluation is largely limited to trainee reactions rather than transfer of learned material to the clinical workplace. In addition, small intervention groups and limited literature support makes it difficult to draw significant conclusions from any one study. We recommend that adoption of any training program be done with an understanding of the inherent limitations present in each curriculum. In addition, we recommend that development or modification of a training program be done with a firm understanding of team training principles. In the next sections, we outline important issues regarding curricular content and instructional strategies that should act as guides for future training and research.

Table 1
Summary of Team Training Programs

| Training Program | Description | Evaluation | Strengths | Limitations | Reference |
|---|---|---|---|---|---|
| Anesthesia Crisis Resource Management | SBT program designed by David Gaba and based on CRM principles developed in aviation | Trainee reactions | Use of simulation allows practice of teamwork principles<br>Emphasizes debriefing | Not multidisciplinary<br>No data supporting transfer of behavior to the clinical setting | Gaba et al.[10]<br>Howard et al.[11] |
| EM crisis resource management | Adapted CRM training for EM residents<br>Simulation-based program | Trainee reactions | Use of simulation allows practice of teamwork principles<br>Emphasizes debriefing | Not multidisciplinary<br>No data supporting transfer of behavior to the clinical setting<br>Limited report in the literature with small sample size | Reznek et al.[12] |
| Team-oriented medical simulation | SBT designed for multidisciplinary surgical teams | Trainee reactions | Use of simulation allows practice of teamwork principles | Limited literature support | Sexton et al.[13]<br>Baker et al.[14] |
| MedTeams | Classroom-based interdisciplinary team training utilizing aviation-based CRM principles | Trainee reactions<br>Links training to decrease in medical errors | Based on a thorough needs analysis<br>Offers refresher training | Study demonstrating reduction in medical errors has several large limitations | Morey et al.[15]<br>Risser et al.[16] |
| Medical Team Management Program | Developed by the Air Force and based on CRM principles<br>Classroom-based training<br>Goals:<br>1. Decrease medical errors<br>2. Change the military's medical culture | Trainee reactions | Contains post-training practice and a feedback phase that is conducted in the work environment | No data supporting transfer of behavior to the clinical setting<br>Limited literature support | Baker et al.[14] |
| Team Strategies and Tools to Enhance Performance and Patient Safety (Team STEPPS) | Developed by the Department of Defense and the Agency for Healthcare Research and Quality<br>Based on team training theory and research | New program, no available data | Based on team training theory and team research | Lack of information at this time<br>Broad-based training that likely requires adaptation to meet individual needs | Clancy et al.[17]<br>http://teamstepps.ahrq.gov/ |

CRM = crew resource management; EM = emergency medicine; SBT = simulation-based training.

## WHAT ARE THE COMPETENCIES WE SHOULD BE TRAINING IN EM?

Recent trends in medical education have shifted the focus of training toward demonstrating clinical competency. This shift, combined with the recognition of the importance of teamwork, led the American Council for Graduate Medical Education (ACGME) to include several teamwork-related skills in the core competencies that guide physician graduate education.[18] Competencies such as professionalism and interpersonal communication skills focus on interdisciplinary teamwork proficiency; however, development of team training curricula is hampered by the vague and inconsistent nature of competency definitions and an absence of linked observable behaviors that can be easily assessed and remediated. In a separate article in this issue, several of the authors outline a taxonomy of teamwork competencies and processes that are comprehensive yet focused on EM teams.[19] Here, we provide a brief description of the competencies (Table 2).[20–42]

Table 2
A Standard Taxonomy of Core Teamwork Competencies

| Competency | Description | Reference |
|---|---|---|
| Planning or preparation | | |
| Mission analysis | Identification and interpretation of the team's tasks as well as environmental conditions, available resources, and potential challenges. | Fleishman et al.[20]<br>Marks et al.[21] |
| Goal specification | Identification and prioritization of team goals. | Dickinson and McIntyre[22]<br>O'Leary-Kelly et al.[23] |
| Strategy formulation | Developing a course of action as well as contingency plans. Involves adjusting strategies in response to environmental and task changes. | Cannon-Bowers et al.[24]<br>Stout et al.[25] |
| Action | | |
| Monitoring progress toward goals | Tracking and communicating information related to the team's progress toward goals. | Cannon-Bowers et al.[24]<br>Jentsch et al.[26] |
| Systems monitoring and adaptation | Tracking team resources and environmental conditions to ensure the team can accomplish its goals; monitoring environmental changes and adapting strategies as necessary. | Fleishman et al.[20] |
| Back-up behavior | Team members' assist other team members with their tasks, balance work loads, and compensate for areas of deficiencies. Also called cooperation, work-load sharing, and group level citizenship behavior. | Dickinson et al.[22]<br>LePine et al.[27] |
| Coordination | Organizing the sequencing and timing of team activities. | Marks et al.[21]<br>Zalesny et al.[28] |
| Reflection | | |
| Debriefing and process feedback | Process of having team members reflect on their performance to help identify positive and negative aspects of performance, analyze errors or near misses, and develop a plan for improvement. | Salas et al.[29]<br>Tompkins[30] |
| Interpersonal factors | | |
| Team cohesion | Desire of group members to remain united to reach a common goal. Defined as the commitment of members to the group's tasks. | Goodman et al.[31]<br>Gully et al.[32]<br>Beal et al.[33] |
| Team efficacy | A shared belief in a group's ability to organize and execute the tasks required to accomplish the team's goals. | Zaccaro et al.[34] |
| Conflict resolution | Team members' ability to proactively and reactively manage conflict. | Cannon-Bowers et al.[24]<br>Simons et al.[35]<br>Van de Vliert et al.[36] |
| Mechanisms | | |
| Leadership | Directs and coordinates activities, assesses overall team performance, assigns roles, monitors and develops team attitudes and behaviors, facilitates problem solving and error recognition, facilitates feedback. | Salas et al.[37]<br>Kozlowski et al.[38] |
| Team cognition | Shared understanding of team goals, individual team member tasks, individual team member expertise, and the coordination of the team to accomplish its goals. | Mathieu et al.[39]<br>Cannon-Bowers et al.[40]<br>Klimoski and Mohammed[41] |
| Closed-loop communication | Following-up with a team member to verify that a message was correctly received and clarifying with the sender of a message that the message was received as intended. | Seigel and Federman[42]<br>Salas et al.[37] |

### Position: EM Should Adopt a Single Taxonomy of Team Competencies That Are Rooted in Team Theory and Linked to Observable Behaviors

In the team performance literature, team competencies focus on the individual team member's knowledge, skills, and abilities (KSAs) that support effective teamwork. These KSAs should serve to guide the development of team training objectives and thus form the framework for any SBT.[43] We propose that EM teamwork KSAs be divided into five categories: 1) planning and preparation, which includes mission analysis, goal specification, and strategy formulation; 2) action processes, which includes monitoring progress toward goals, systems monitoring and adaptation, back-up behavior, and coordination; 3) reflection (e.g., debriefing and process feedback); 4) interpersonal factors, which include team cohesion, team efficacy, and conflict resolution; and 5) supporting mechanisms, which include team cognition, closed-loop communication, and leadership. Successful implementation of these KSAs may lead to more effective team processes and improved performance. These KSAs are outlined in Table 1 and are described in detail elsewhere.[19,20,21] In the next section, we focus on leadership training and its potential impact on EM education. Additionally, we offer a Web-based discussion of situation awareness (SA), as SA is prominent in the literature and we felt it important to address issues regarding its implementation as a measure of team performance.

### Position: Strong Leadership Skills Are Crucial to the Practice of EM and Thus Should Be a Focus of EM Team Training

Individuals with strong leadership skills can enhance team performance and effectiveness in challenging circumstances.[44] Team leaders require competence in medical practice as well as proficiency in leadership and teamwork skills.[45] Specifically, feedback and monitoring roles have been shown to correlate with overall team performance outcomes.[46] While it has been shown that leadership training increases overall team performance, little headway has been made to develop or implement leadership training in EM programs. Below we outline some issues of importance with regard to leadership training in EM.

EM provides several leadership challenges due to the ad hoc nature of the teams and the volatile, uncertain nature of the environment. First, leaders must assign roles, coordinate activities, and clarify team goals with little or no time available for these activities.[47] Second, leaders must foster self-efficacy and skill proficiency, while keeping team goals a priority.[44] Third, EM leaders must promote cooperation within teams possessing little trust or cohesion. Finally, leaders must provide feedback and facilitate reflection on team performance.[22] The specifics of these leader responsibilities change depending on the skill level and experience of individual team members and the team as a whole.[48] There is theoretical support for a form of dynamic leadership in ad hoc teams with rotating members, but, to the best of our knowledge, a research-based model and framework to guide quantitative empirical research has not yet been developed.[22,48] We recommend that leadership training and assessment become a research priority in EM and that an initial step should be the validation of a model to explain the unique roles of EM team leaders. We feel that this is an area where EM can significantly advance team training theory and research.

## WHAT COMPONENTS ARE NECESSARY FOR AN EFFECTIVE TEAM TRAINING PROGRAM?

Development of any training program should be evidence-based, much like the practice of medicine. Baker and colleagues[14,49] recommend applying team training principles and theory developed in other domains to medicine. Incorporation of these principles would likely advance the current state of medical team research and enhance the effectiveness of team training programs. The large body of existing team training literature should be utilized and applied, with the understanding that not all research will translate completely to medical teams. It is therefore critical to have a thorough understanding of the training principles and team theory that drive research outcomes.

### Position: A Comprehensive Needs Analysis Is Essential before Implementing Any Team Training Program

A systematic needs assessment is a critical initial step to training design and can significantly impact training effectiveness.[50,51] Needs assessments incorporate three elements: 1) organizational analysis, 2) personnel analysis, and 3) task analysis. An *organizational analysis* specifically evaluates the goals of the organization and links these goals to the objectives of the training program. In addition, analysis at the organizational level can assess whether there is appropriate support for training (top management, sufficient resources) and identify particular groups within the organization that would benefit most from training. *Personnel analysis* involves identifying the workforce's KSA deficiencies, as well as any pretraining experiences that could be leveraged and used as motivators for training.[52] Finally, *task analysis* specifies the tasks to be trained and therefore helps define the learning objectives. Establishing clear linkages between the needs of the organization, the needs of the individuals, and the tasks to be trained increases overall program effectiveness.

It is necessary to stress the importance of conducting a multilevel needs analysis prior to implementing any team training program, especially when using and adapting training tools developed outside of the organization. What works in one institution may fail in another if the needs of the individuals and organization are not aligned with the program objectives. More importantly, an effective training program may be viewed as unsuccessful if the goals of the program do not link to the expectations of the organization. Needs assessment measures that have been developed in other industries must be identified and validated for use in EM.

### Position: Instructional Methodologies Should Be Chosen Based on Scientific Principles of Learning Theory

For a simulation-based team training program to be effective, it must incorporate principles of learning theory, present basic information about team training skills and behaviors, allow team members to practice their skills, provide remedial feedback, and reinforce behaviors after the initial training cycle is completed.[53] A typical training cycle is illustrated in Figure 1. Effective training programs target interventions and assessments to each phase of the training cycle. The interventions used should vary depending on the training objectives, learner characteristics, and available resources. In the next sections, we discuss training strategies that can be incorporated into SBT with the understanding that it is the strategy, and not the choice of technology, that is most crucial to training effectiveness.[54]

When designing a team training program, it is important to consider not only the training objectives (KSAs) and the instructional format (simulation), but also the strategy used to meet training goals (Figure 2). Team members can be trained as individuals or as a team unit depending on the goals of the training. If the purpose of training is to transfer teamwork behaviors to the clinical setting, then training is probably best conducted in a group setting.[55] If the goal is simply to make trainees aware of the role of team processes and behaviors, then this could likely occur using an individual or mass-distribution (lecture) format. We will focus on strategies that are applied to group training exercises as they are most likely to result in increased adaptability within teams.[55]

The team training literature supports several different instructional strategies (Table 3).[10,43,56–64] Many of these strategies can be combined within the same program. For instance, a SBT program might utilize guided error, self-correction, and scenario-based training to promote error mitigation, self-regulatory behaviors, and transfer of learning. It is important for instructors to be aware of these different methodologies so they can be combined to maximize the impact of training. Within the medical team training literature, there is little research that supports the adoption of any one strategy. Smith-Jentsch et al.[56] and Baker et al.[65] postulate that scenario-based training, team coordination training, self-correction training, and guided-error training will likely play significant roles in any comprehensive EM team-training program.[65] Likely, the ''best'' training strategy will depend on trainee characteristics, the level of task interdependence, and how knowledge and expertise is distributed among team members. Further study is required to determine exactly which KSAs are best trained using each strategy and which strategies maximize transfer of behaviors to the clinical setting.

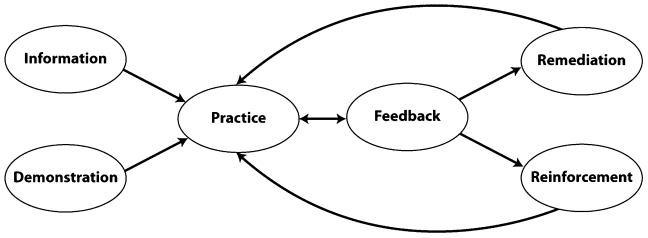


**Figure 1.** Phases of team training.[53]

### Position: There Are Several Principles That Should Guide the Development of Any Simulation-based Team Training Program

In a team setting, high-fidelity human patient simulators (HPSs) allow for the practice of team- and task-related skills in a clinical context. HPSs can be utilized in scenario-based training to replicate key aspects of a real work setting, thus precipitating critical task, psychological, and behavioral processes that can then be reviewed, assessed, and studied.[66] In addition, SBT is well-suited to provide an easily observable practice experience, which maximizes the opportunity for immediate feedback and reflection. While medical simulation

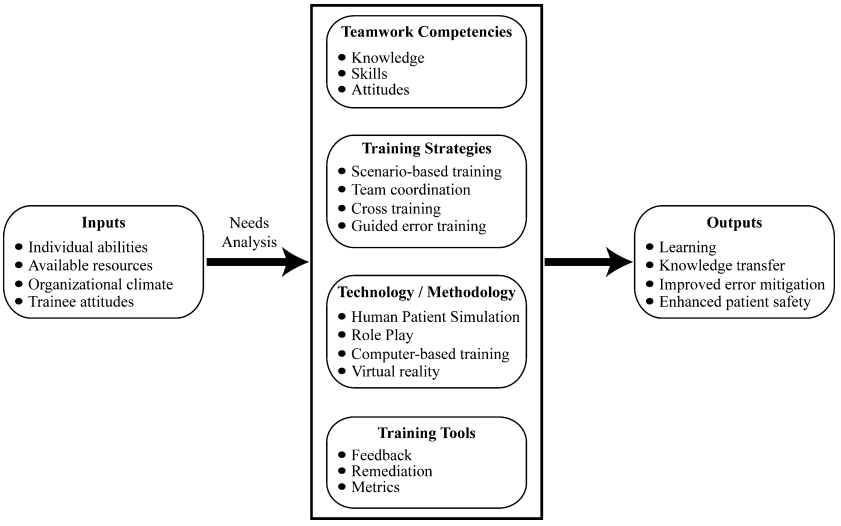


**Figure 2.** Team Training Model.

Table 3
Team Training Strategies

| Training Strategy | Definition | Reference |
|---|---|---|
| Assertiveness training | Models assertive and nonassertive techniques during role-plays and other demonstrations. | Smith-Jentsch et al.[56] |
| Meta-cognitive training | Teaching people to ''think about thinking'' and modify their decision-making processes rather than the decisions themselves. | Smith et al.[57] |
| Team coordination training | Teaches team coordination, communication, and back-up behavior; the basis of CRM-based training. | Entin and Serfaty[58]<br>Gaba et al.[10] |
| Cross-training | Team members practice performing each other's tasks to gain a shared understanding of coworker's roles and responsibilities. | Volpe et al.[59] |
| Perceptual contrast training | Improves knowledge and awareness by having trainees observe the same scenarios performed several ways to contrast positive and negative behaviors. | Wilson et al.[60] |
| Self-correction training | Teaches individuals and teams to assess and correct their own behavior; teaches feedback processes and offers ways to resolve deficiencies. | Blickensderfer et al.[61] |
| Guided error training | Errors are built into the training system to build problem-solving and cognitive skills; requires good facilitator to provide appropriate and immediate feedback. | Ivancic et al.[62]<br>Kozlowski et al.[63] |
| Scenario-based training | Training utilizes events embedded within a scripted scenario to trigger behaviors and guide learning. Simulation-based team training utilizes a scenario-based training design. | Fowlkes et al.[43]<br>Hamman[64] |

is now a well-established instructional tool, there are no clear recommendations for the design of HPS-based team training.

To be effective, team-oriented simulation exercises need to follow a set of design principles. Fowlkes et al.[43] outline a methodology for the development of simulation-based team experiences that is generalizable and produces context-specific experiences. This methodology is based on the placement of discreet event sets within the simulation-based exercise. It is crucial that each event be tightly linked to the assessment goals of the scenario.[67] Each event set is designed and positioned to provoke behaviors and team interactions that are of interest to the evaluators. This allows researchers the ability to create assessment tools around anticipated behaviors. The result is a series of highly specific, observable actions that can reliably be evaluated by trained observers. Studies have demonstrated that this approach yields results with excellent interrater reliability[68] and good internal consistency and interexercise correlations in event-based simulation systems.[43]

Simulation-based training does not rely on chance encounters, but rather creates a need for team interaction.[69] Events begin with a ''trigger'' that requires some team interaction and activates the team. Well-designed event sequences minimize the interdependence of performance quality.[43] How one event is experienced should be independent of how the team responded to a previous event. Each event should create independent measures of process and performance. Taken together, the components of event-based simulation design offer realistic training exercises that can be linked to observable team process and performance metrics. Such a design is likely to enhance transfer of learned behaviors to the clinical workplace. Further work is necessary to elucidate design factors that enhance sustainability and adaptability in medical teams.

**Position: The Provision of Feedback and Allowance for Reflection Is Critical for Effective Simulation-based Team Training. As Such, Feedback and Debriefing Techniques Should Be Evidence-based and Grounded in Team Training Theory**

Providing diagnostic feedback is a cornerstone of effective team training and is recognized by learners as one of the most valuable components of SBT.[70] Providing feedback helps learners identify KSA deficiencies that contribute to the gap between the team's observed performance and their target goals. This can occur during a simulation by ''freezing'' the action and allowing for discussion or in more formalized posttraining debriefing sessions. Debriefing allows individual team members to reflect on their performance and identify errors and successes. In addition, debriefing sessions allow for discussion of team processes and interactions at the team level, thus allowing team members to better understand team process issues and to further develop a shared mental model of the team's performance. Teams can therefore come to a consensus of what techniques did or did not work and decide on strategies to improve future performance. This constructive approach to debriefing is in contrast to the ''shame and blame'' culture that has defined medical education. By focusing on *what* is right rather than *who* is right, teams can begin to identify and mitigate causes of error much more effectively.[67]

Feedback is a powerful tool, and whether it is accepted as a positive motivator of change, or discounted as an undeserved criticism, depends largely on the properties of the information given, the manner in which it is delivered, and the way it is interpreted.[57] In addition, credibility is a key factor in determining how feedback impacts trainee behavior.[71,72] Feedback that is supported by some evidence of authenticity, such as a video recording, will have a greater impact. Objective indicators of performance increases the likelihood that feedback is accepted,[73] which supports the use of visual

Table 4
Guidelines for Debriefing Health Care Teams

| | |
|---|---|
| 1. | Debriefings should be diagnostic, to identify strengths and weaknesses and expose latent errors. |
| 2. | Debriefings should be used to facilitate the development of strategies to mitigate future errors. |
| 3. | Training programs should be designed to allow for the provision of *immediate* feedback. |
| 4. | Debriefings should occur in a supportive environment focused on process improvement. |
| 5. | Debriefing facilitators should be appropriately trained and utilize evidence-based methodology. |
| 6. | Team leaders should become proficient in debriefing to facilitate the transfer of reflection to the clinical setting. |
| 7. | The content, timing, and frequency of debriefing should directly relate to the learning objectives and level of the learner. |
| 8. | Credibility of feedback is crucial and can be enhanced with the use of video recordings or objective checklists. |

recordings of simulations to demonstrate critical events during team debriefing sessions. Additionally, the need for perceived credibility by trainees supports the recommendation that debriefing facilitators demonstrate expertise in both teamwork skills and debriefing strategies. The role of the facilitator is to guide the team past a focus on the results and products (team outputs), to a discussion on the interactions, coordination, and communication (team processes) that led to the specific outcome.[65] Although certain aspects of feedback and debriefing may be intuitive, the debriefing facilitator is crucial to assuring that a safe environment is created and that the training goals and objectives are met. Current standards for medical team training instructors are not well developed and vary widely between institutions and training protocols.

In summary, there are several studies and principles that should guide the use of feedback in debriefing situations. Some of these principles likely apply to postclinical event debriefs as well as training debriefs. Team leaders should be taught how to debrief to help transfer this behavior to the clinical setting and to continue the evaluation and learning process beyond the SBT session. Ideally, teams are taught to self-correct, monitor, and adapt their decision-making processes and interactions.[23] In Table 4, we list several recommendations for debriefing based on evidence in the team training literature. Further research is needed to determine exactly what constitutes ''best practices'' for team debriefing.

### Position: Team Training Programs Should Be Designed to Foster the Transfer of Teamwork Behaviors to the Clinical Environment

Transfer is strictly defined as the application of knowledge, skills, or attitudes learned in one context to another context. For our purposes, transfer refers to the ability to apply behaviors learned in the classroom or simulator to the work (clinical) environment. Without transfer of learned behavior, team training holds little value. The team training literature demonstrates the need to incorporate procedures and techniques specifically designed to increase transfer of behavior to clinical practice.[74] Kozlowski and Salas[75] outline the characteristics of trainee, training design, and organizational environment that can impact team training transfer. We summarize their findings and highlight areas where efforts can be focused to facilitate transfer of team behaviors.

Multiple studies demonstrate that trainee characteristics influence the extent that team training transfers to the work environment.[75] Specifically, self-expectancy, motivation, self-efficacy, and positive past training experiences can all influence transfer of behavior.[74,76,77] Maximizing transfer of knowledge requires analyzing these factors prior to designing and implementing a team training program, which underscores the importance of conducting a personnel analysis prior to designing a team training program. Further research is needed to understand how the characteristics of health care professionals should be leveraged to maximize learning transfer.

When training individuals in a team context, it is important to take into account several factors that impact knowledge transfer. First and foremost, individual trainees must possess some level of knowledge and proficiency in the tasks required to accomplish the team's goal. If individuals do not possess the basic skills to perform a task (i.e., intubation), they cannot give proper attention to the team process skills needed for team success.[55] It is therefore critical that novice's initial exposure to teamwork occur within a familiar domain, perhaps outside of health care. After trainees gain experience in medical knowledge and procedures, the context of training can be transferred to a simulated clinical setting where the focus can then shift from task work to teamwork. This issue has become more important as experts are recommending the implementation of teamwork training into undergraduate medical education.[77]

The effectiveness of any team training program is based not only on the content and design of the program, but also on the characteristics and climate of the organization.[74,75,77] Climate describes the shared perceptions of employees concerning which practices, procedures, and behaviors get rewarded and supported and which are expected within their organization.[78] The presence of a climate of safety within an organization suggests a level of organizational commitment to, and prioritization of, safety initiatives. Research demonstrates that when training objectives are in line with the organization's safety climate, there is increased transfer of knowledge.[14] In addition, organizations that support innovation and change will likely see higher levels of skill transfer.[79,80]

Given the importance of organizational climate on team training effectiveness, it follows that an assessment of the organization's safety climate should be conducted prior to implementing a training program. Instruments designed to measure the safety climate of organizations exist; however, most well-described health care team training programs were employed without conducting a pretraining safety culture assessment.[14] We recommend that health care adapt and validate a measurement tool to assess organizational safety

culture and that such a tool be used prior to developing and employing any team training program.

**Position: The Level of Fidelity in the Simulation System Should Be Matched to the Level of the Learner and the Objectives of the Training**

Advances in simulation technology have led to the general assumption that simulators with higher levels of fidelity, that is, those that best create a realistic environment, are superior to lower-fidelity models. This assumption leads one to believe that it is the machine, and not the training program, that defines an effective team training program. Focusing on just the technology can result in costly, unproductive training. As we illustrate in Figure 2, simulator equipment is only one part of a team training platform.

High-fidelity medical simulation attempts to recreate the clinical work environment. This can be done by maximizing technology to produce the most realistic, lifelike simulation system possible. In this case, the *physical fidelity* of the simulation would be high. In aviation and in medicine, assumptions are often made that the physical fidelity of the system leads to transfer of learning.[5,81] In fact, maximizing physical fidelity is not required for effective training and transfer. What may be a more important factor is the *psychological fidelity* of the system.[82] Psychological fidelity describes the extent to which the simulated experience evokes the same psychological processes (cognitive, motivational, affective, and behavioral) as in the clinical environment that is being emulated. This has more to do with the design of the overall simulation system than the technology of the simulator. Maximizing psychological fidelity may allow more cost-effective training with lower-fidelity simulators, while still ensuring transfer of behavior and skill retention.[83]

The optimal choice of simulation technology for learning depends on the level of the trainee and the objectives of the training program. In early ''awareness'' stages of team training, case studies and role plays are effective, inexpensive ways to actively engage learners, provide basic knowledge, and develop an appreciation for the importance of teamwork skills.[84] Part trainers can also be used as a means of developing teamwork competence while performing a set of clinical tasks without the distraction of irrelevant stimuli. Part trainers are generally cheaper than full-body simulators and have the advantage of being more portable. The application of lower-fidelity training modalities to EM team training has yet to be extensively studied. If team training is to be implemented throughout medical education, it is imperative that training programs be tailored to suit the needs of learners at every stage. In addition, rising costs of simulation make it necessary to use this technology judiciously.

**Position: Detailed Training Evaluations Should Occur to Ensure That Training Is Effective and Goals Are Being Met**

There exist several recommendations regarding evaluation of team training programs.[14,74,85] Most are based on Kirkpatrick's model of *training evaluation*, which categorizes four levels of outcome measures (Table 5). This model is useful in that it provides a framework for measuring whether training objectives are accomplished. Most studies in medical team training and in simulation training in general conduct evaluations that target trainees' self-reported reactions and opinions. This information is the easiest to capture, although it is often discounted due to the lack of correlation between positive reactions and learning.[86] Recent efforts have moved toward developing tools to measure outcomes demonstrating a clear benefit from team training. We feel that this is necessary, but also caution that evaluating a training program based solely on outcome measures answers the question ''did the training meet the objectives,'' and therefore may satisfy stakeholders, but does not explain *why* objectives were or were not met.

A more contemporary view of training program assessment distinguishes between *training evaluation* models that focus on measuring outcomes and *training effectiveness* models that explain why expected outcomes did or did not occur.[87] If we are to advance the science of team training, and tailor currently existing training models to EM, it is imperative that we

Table 5
Kirkpatrick's Model of Training Evaluation

| Level | Description | Outcome | Comments |
|---|---|---|---|
| 1 | Reactions | Assesses participant's self-reported opinions regarding their enjoyment and perception of value of the training. | Most common evaluation done in medical team literature; important because they tap into trainees' attitudes and motivations, however, do not provide strong evidence for effectiveness on their own. |
| 2 | Learning | Assesses the extent of trainee improvement in KSAs. | Often uses pre- and posttest evaluations. |
| 3 | Transfer | Assesses the application of learned behaviors to the real-work environment. | Measurement at this level is difficult in EM due to the unpredictable nature of the ED environment; development of assessment tools is needed. |
| 4 | Results | Assesses the impact of training at an organizational level. | For EM teams this means improved patient outcomes and a decrease in medical errors. For health care executives this is likely the most meaningful measure of effectiveness. |

ED = emergency department; EM = emergency medicine; KSA = knowledge, skills, and abilities.

Table 6
Areas of Focus for an EM-based Team Training Research Platform

| Recommendation | Brief Rationale |
|---|---|
| 1. Application of core competencies in teamwork to a broadly applied EM team training program. | 1. Will allow for standardization of taxonomy and facilitate generalizability of training programs and research results. |
| 2. Development of a leadership training program that is level-specific and designed to promote a dynamic model of leadership. | 2. Will help to define and establish the roles and competencies specific for EM team leaders. Can have significant impact on team literature. |
| 3. Develop and test a debriefing model that can be widely utilized. | 3. Will help set standards for debriefing techniques to maximize program effectiveness. |
| 4. Develop and test a train-the-trainer program to ensure quality team training and maximize transfer to the clinical environment. | 4. Will offer programs a ''best practices'' approach to team training instruction. |
| 5. Develop and test a comprehensive needs analysis tool for use in health care organizations. | 5. Will support the implementation of team training programs within EM departments and health care organizations. |
| 6. Develop and set guidelines for the use of high and low-fidelity simulations for team training. | 6. Will assist medical clerkship directors and residency leadership in designing team training programs. |
| 7. Develop and evaluate metrics to assess team training effectiveness in multiple areas. | 7. Will help provide valid data to support the need for team training programs in EM. |
| 8. Establish a multicenter, multidisciplinary research network to facilitate state-of-the-art research in health care team training. | 8. Will be required to obtain significant research subjects and advance current theory and research. |

EM = emergency medicine.

understand how individual, training, and organizational factors influence training outcomes. Assessment methodologies should be sensitive to the difference between training evaluation and effectiveness. It is our recommendation that both types of assessment occur and that measurement tools be applied appropriately and with caution to avoid overstating or understating the value of various training interventions.

## WHAT ARE THE BIGGEST CHALLENGES TO IMPLEMENTING TEAM TRAINING PROGRAMS IN EM?

### Position: The Primary Barriers to Effective Team Training Are Rooted in the Nature and Culture of the Health Care Organization in Which They Are Implemented

We feel that the greatest challenge emergency physicians (EPs) face when trying to implement a team training program is the organization in which they practice. Management and the organizational leadership must not only state its support of training initiatives, but must also have in place policies and reward systems that communicate this support to all employees. Katz-Navon et al.[88] report that health care organizations that emphasize patient safety, but reward behaviors that increase productivity and economic efficiency, will be unsuccessful in transferring effective team behaviors to the work environment. In addition, organizations that foster an environment in which errors are the ''fault'' of an employee will lack the open and honest climate needed to identify error sources and implement corrective action.[89] True organizational buy-in is required for effective team training, but significant barriers still exist.[58] While data demonstrating the effectiveness of team training will go a long way, these data are likely several years away, and the mandate to train is immediate. We as educators must foster a supportive environment within our clinical units so that we create a model of true interdisciplinary cooperation founded on basic principles of team effectiveness and patient safety.

## SUMMARY

The medical community has recognized the importance of interdisciplinary team training and is now calling on physician scientists to develop and validate team training programs. In this article, we outline several areas of importance to team training in EM. As with any area of clinical practice, the presentation of existing data leads to the generation of more robust research questions. While certain principles of aviation-based team training can be applied to EM, it is clear that the high level of uncertainty and unique nature of each patient encounter will require that EM-specific team skill sets be identified, developed, and studied. In Table 6 we present what we feel should be the core target areas of research in team training and EM. We recognize the expertise of individuals in organizational psychology and human factors research and feel that collaboration with team experts will afford EM researchers the best opportunity for success in training program and research study design. The creation of strong collaborations between team experts and EPs from multiple centers will increase the likelihood of conducting psychometrically sound studies that will advance team training research within EM, health care, and other domains.

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