TeamSTEPPS™: Team Strategies and Tools to Enhance Performance and Patient Safety

Heidi B. King, MS, CHE; James Battles, PhD; David P. Baker, PhD; Alexander Alonso, PhD; Eduardo Salas, PhD; John Webster, MD, MBA; Lauren Toomey, RN, BSBA, MIS; Mary Salisbury, RN, MSN

Abstract

Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS™) is a systematic approach developed by the Department of Defense (DoD) and the Agency for Healthcare Research and Quality (AHRQ) to integrate teamwork into practice. It is designed to improve the quality, safety, and the efficiency of health care. TeamSTEPPS is based on 25 years of research related to teamwork, team training, and culture change. As a direct outcome of the 1999 Institute of Medicine (IOM) report, *To Err is Human*, TeamSTEPPS introduces tools and strategies to improve team performance in health care. This article describes the evolution of the TeamSTEPPS program and its research foundation, development, and implementation. To date, the DoD has taught TeamSTEPPS at over 68 facilities, creating approximately 1,500 trainers/coaches, who have trained over 5,000 staff members. Beginning with the public release of TeamSTEPPS resources in November 2006, AHRQ began its effort to disseminate TeamSTEPPS nationwide. To support this plan, a national infrastructure is being established for long-term sustainment through collaborative efforts of several Federal agencies, academic centers, and health care networks, aiming for wide-scale dissemination.

Introduction

Public reaction to problems associated with patient safety reached a critical mass with the 1999 publication of *To Err is Human*, which concluded that medical errors cause up to 98,000 deaths annually.[1] Since the release of this Institute of Medicine (IOM) report, the Agency for Healthcare Research and Quality (AHRQ) and the Department of Defense (DoD) have been Federal leaders in the patient safety movement. A major focus of these agencies has been supporting research and development activities centered on improving team performance in the delivery of care. Many organizations—such as the Joint Commission, Institute for Healthcare Improvement (IHI), the National Quality Forum (NQF), and the Accreditation Council for Graduate Medical Education (ACGME)—have cited the importance of teamwork in patient safety. Through the Floyd D. Spence National Defense Authorization Act (NDAA) of 2001,[2] Congress mandated DoD's Military Health System (MHS) to implement a Patient Safety Program (PSP); thus establishing the Healthcare Team Coordination Program (HCTCP). This mandate requires implementation of a team training initiative within Military Treatment Facilities (MTFs) and Combat Casualty Care arenas.

In November 2006, AHRQ, in collaboration with the DoD, released Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS™) as the national standard for team training in health care. TeamSTEPPS is the result of a multiyear research and development project jointly funded by AHRQ and DoD.[3, 4] Since 2005, numerous organizations and individuals have contributed to the refinement of the TeamSTEPPS curriculum. (For a complete list of contributors consult the TeamSTEPPS™ Instructor Guide which can be ordered from http://www.ahrq.gov/qual/teamstepps/.) Within the DoD, TeamSTEPPS has been introduced (and is in various phases of implementation) at over 68 MTFs. Within these facilities, approximately 1,500 trainers and coaches have been fully trained to deliver TeamSTEPPS and implement teamwork principles into practice.

The purpose of this paper is to describe the TeamSTEPPS initiative, including its history, present status and update, and future direction. An earlier paper appeared in the *Human Resources Management Review* in 2006 and provides a similar review.[5] With the release over the past year of TeamSTEPPS as a public domain resource, AHRQ and the DoD anticipate that much will be accomplished over the next several years as "early adopters" create an "early majority" of health care institutions that have implemented this initiative.[6]

Teamwork and Health Care

Physicians, nurses, pharmacists, technicians, and other health care professionals must coordinate their activities to make patient care safe and efficient. Health care workers perform interdependent tasks while functioning in specific roles and sharing the common goals of quality and safety in care. However, even though the delivery of care requires teamwork, members of these teams are rarely trained together; they often come from separate disciplines and diverse educational programs.

Given the interdisciplinary nature of the work and the necessity for cooperation amongst those who perform it, teamwork is critical to ensure patient safety. Teams make fewer mistakes than individuals, especially when each team member knows his or her responsibilities, as well as the responsibilities of other team members.[7, 8, 9] However, simply conducting training or installing a team structure does not ensure the team will operate effectively. Teamwork is not solely a consequence of co-locating individuals together. Rather, it depends on a willingness to cooperate, coordinate, and communicate while remaining focused on a shared goal of achieving optimal outcomes for all patients. Teamwork does not require that team members work together on a permanent basis, yet it is sustained by a commitment to a shared set of team knowledge, skills, and attitudes (KSAs), rather than permanent assignments that carry over from day to day.[10]

Team Knowledge, Skill, and Attitude Competencies

The importance of teamwork in health care emerged in anesthesiology over a decade ago with the work of David Gaba and colleagues who developed Anesthesia Crisis Resource Management (ACRM).[11, 12, 13] ACRM was designed to help anesthesiologists effectively manage crises by working in multidisciplinary teams that include physicians, nurses, technicians, and other medical professionals. ACRM provides training in specific technical skills and in generic

teamwork skills using patient simulators. The team skills were adopted from research on aviation teams and include developing a thorough case orientation, making inquiries and assertions, communicating, giving and receiving feedback, exerting leadership, maintaining a positive group climate, anticipating and planning, managing workload distribution, maintaining vigilance, and re-evaluating actions.

In the late 1990s, Dynamics Research Corporation (DRC) conducted a DoD-sponsored randomized controlled trial to study team training in emergency departments as an error-reduction strategy.[10] More recently, research on teamwork in health care and its requirements has spread to other disciplines. For example, Healey, Undre, and Vincet developed Observational Teamwork Assessment for Surgery (OTAS), a behavioral rating scale that can be used to assess cooperation, leadership, coordination, awareness, and communication in surgical teams.[14] Thomas, Sexton, and Helmreich have developed 10 behavioral markers for teamwork in neonatal resuscitation teams,[15] and Flin and Maran have identified nontechnical skill requirements for teams in acute medicine.[16]

In 2005, Baker and colleagues reviewed the above literature and other relevant information in an attempt to define important elements of teamwork in the professional education of physicians.[17] Baker argues that the KSAs advocated by Salas and colleagues were directly relevant to health care.[9] These competencies must be possessed by individual health care providers to perform on a variety of teams with which they interact on a daily basis, as well as the numerous tasks that require coordination by health care workers. As discussed below, these competencies served as the foundation for the TeamSTEPPS Initiative. Table 1 presents each KSA, its definition, behavioral examples, and the supporting evidence references.

Table 1. Team KSAs and the coordinating mechanisms of teamwork

Teamwork	Definition	Behavioral Examples	Selected Citations
Team leadership	Ability to direct and coordinate the activities of other team members, assess team performance, assign tasks, develop team KSAs, motivate team members, plan and organize, and establish a positive atmosphere.	• Facilitate team problem solving • Provide performance expectations and acceptable interaction patterns • Synchronize and combine individual team member contributions • Seek and evaluate information that impacts team functioning • Clarify team member roles • Engage in preparatory meetings and feedback sessions with the team	• Cannon-Bowers, et al.[18] • Salas, et al.[19] • Barach, et al.[20] • Healey, et al.[14] • Thomas et al.[15] • Flin & Maran[16]
Mutual performance monitoring	The ability to develop common understandings of the team environment and apply appropriate task strategies in order to accurately monitor teammate performance.	• Identify mistakes and lapses in other team members' actions • Provide feedback regarding team member actions in order to facilitate self-correction	• McIntyre & Salas, 1995[20]

Table 1. Team KSAs and the coordinating mechanisms of teamwork (continued)

Teamwork	Definition	Behavioral Examples	Selected Citations
Backup behavior	Ability to anticipate other team members' needs through accurate knowledge about their responsibilities. The ability to shift workload among members to achieve balance during periods of high workload or pressure.	• Recognition by potential back-up providers that there is a workload distribution problem in their team • Shifting of work responsibilities to under-utilized team members • Completion of the whole task or parts of tasks by other team members	• McIntyre & Salas[21] • Porter, et al.[22]
Adaptability	Ability to adjust strategies based on information gathered from the environment through the use of compensatory behavior and reallocation of intra-team resources. Altering a course of action or team repertoire in response to changing conditions (internal or external)	• Identify cues that a change has occurred, assign meaning to that change, and develop a new plan to deal with the changes • Identify opportunities for improvement and innovation for habitual or routine practices • Remain vigilant to changes in the internal and external environment of the team	• Cannon-Bowers, et al.[18] • Kozlowski, et al.[23] • Klein & Pierce[24]
Team/collective orientation	Propensity to take other's behavior into account during group interaction and belief in the importance of the team's goals over individual member's goals	• Taking into account alternative solutions provided by teammates and appraising that input to determine what is most correct • Increased task involvement, information sharing, strategizing, and participatory goal setting	• Driskell & Salas[25] • Shamir[26] • Wagner[27]
Shared mental models	An organizing knowledge structure of the relationships between the task the team is engaged in and how the team members will interact	• Anticipating and predicting each other's needs • Identifying changes in the team, task, or teammates and implicitly adjusting strategies as needed	• Cannon-Bowers, et al.[18] • Klimoski & Mohammed[28] • Mathieu, et al.[29] • Stout, et al.[30]
Mutual trust	The shared belief that team members will perform their roles and protect the interests of their teammates	• Information sharing • Willingness to admit mistakes and accept feedback	• Bandow[31] • Webber[32]
Closed-loop communication	The exchange of information between a sender and a receiver, regardless of the medium	• Following up with team members to ensure message was received • Acknowledging that a message was received • Clarifying with the sender of the message that the message received is the same as the intended message sent	• McIntyre & Salas[21]

KSAs = knowledge, skills, and attitudes

TeamSTEPPS™: A 3-Year R&D Project

TeamSTEPPS is the result of a 3-year research program funded by the DoD Patient Safety Program (PSP) within the TRICARE Management Activity (TMA) and AHRQ. Using a collaborative model, AHRQ and DoD brought together experts in team training, health care, aviation human factors, and change management, all of which contributed critical expertise. Most noteworthy was the DoD Healthcare Team Coordination Program (HCTCP) cadre of Master Trainers who have been involved in the instruction of TeamSTEPPS since its onset in early 2005. Each session results in new insights into the curriculum and effective implementation strategies that enable the resource materials to be current and appropriately focused. The DoD and AHRQ continue to assess and evaluate effectiveness and potential correlations to clinical process and outcome measures.

TeamSTEPPS was initiated in January 2003, when AHRQ and DoD convened a national panel of experts on human factors, human error, and medical team training. At this meeting, approximately 30 of the Nation's leading experts discussed the needs, requirements, and strategies for effective teamwork in health care. Topics included competency requirements for medical teams, appropriate training strategies for teams, how to reliably measure teamwork, and what health care could learn from aviation and other disciplines. The result was a roadmap that helped guide the research that followed.

A comprehensive review of the literature on the evidence-based relationship between teamwork and patient safety was conducted. An earlier review by Pizzi and colleagues[33] had been published in an AHRQ report,[34] which identified patient safety practices in other fields that should be tested in health care. Pizzi and colleagues argued that crew resource management training (CRM) has a great deal of promise for addressing teamwork in health care. Because this review focused only on CRM, a broader review was needed. Therefore, Baker and colleagues[4] reviewed the larger discipline of teamwork and team training. Because much of this work had been accomplished in the military, AHRQ and DoD felt this research could be directly extended to health care.

In addition to the literature review, DoD sought to examine their existing medical team training programs to identify any changes or updates that might be required. The DoD HCTCP has been conducting medical team training since 2001. By 2003, a number of different medical team training programs existed within the DoD. To assess the strengths and weaknesses of these programs, Baker and colleagues[3] conducted a case-study analysis of three existing DoD medical team training programs: MedTeams®, Medical Team Management, and Dynamic Outcomes Management© (Note: Dynamic Outcomes Management has since been renamed *Lifewings*).

Although the results revealed that each program possessed strengths, the issued report called for the development of a medical team training specification that was evidence-based and would guide developers of medical team training programs. Baker and colleagues[3] recommended that this document be constructed like a Federal Aviation Administration (FAA) Advisory Circular. Such FAA documents specify the requirements carriers must meet when implementing certain programs, such as CRM training (e.g., refer to FAA AC120-51E). In the end, AHRQ and DoD decided that a new, updated, evidence-based program wholly owned by the Federal Government was warranted to enable wide-scale dissemination.

The Evidence-Base for TeamSTEPPS™

The teamwork competencies presented in Table 1 and their research basis served as the foundation for TeamSTEPPS. With that information as a starting point, the goal of AHRQ and DoD was to take this academically oriented information and convert it to a framework that was meaningful from an instructional standpoint. As an example, theories of teamwork point to the importance of adaptability/flexibility as a central skill.[35, 36, 37] Yet, it is difficult to directly train the skill of adaptability/flexibility, which is required when responding to unpredictable situations teams may encounter. Therefore, TeamSTEPPS instructs team members to monitor the performance of others and provide assistance, plan and organize team roles, and communicate with one another efficiently and effectively. Combined, these skills yield a highly adaptable and flexible team.

To develop the TeamSTEPPS instructional model, teamwork competencies from the literature were classified as trainable or as competencies that are the result of employing these trainable skills (i.e., outcomes). For example, shared mental models were viewed as an outcome of using monitoring and back-up behaviors. The resulting TeamSTEPPS instructional framework is presented in Figure 1, where the core competencies include the trainable skills of leadership, situation monitoring (mutual performance monitoring), mutual support (backup behavior), and communication. These core competencies are encircled by the patient care team, which encompasses the patient. Performance, knowledge, and attitudinal outcomes are then depicted in the corners, resulting from proficiency on the central skills or core competencies.

Course Description

The TeamSTEPPS curriculum (Figure 2) contains an introductory module relating to the history of team training, a testimonial from Sue Sheridan, and the structure of teams. The introduction provides participants with insight into the importance of teamwork in health care. Formation and formal definition of different team types are discussed. Four didactic-based modules discuss the core competencies/skills (Figure 1):

1. Leadership.
2. Situation monitoring.
3. Mutual support.
4. Communication.

Emphasis is placed on defining team skills, demonstrating the tools and strategies team members can use to gain proficiency in the competencies/skills, and identification of tools and strategies that can be used to overcome common barriers to achieve desired outcomes. Specialty case scenarios and video vignettes are used to further reinforce the learning. Figure 2 summarizes the entire curriculum with respect to the barriers discussed, tools and strategies taught, and outcomes that can be achieved.

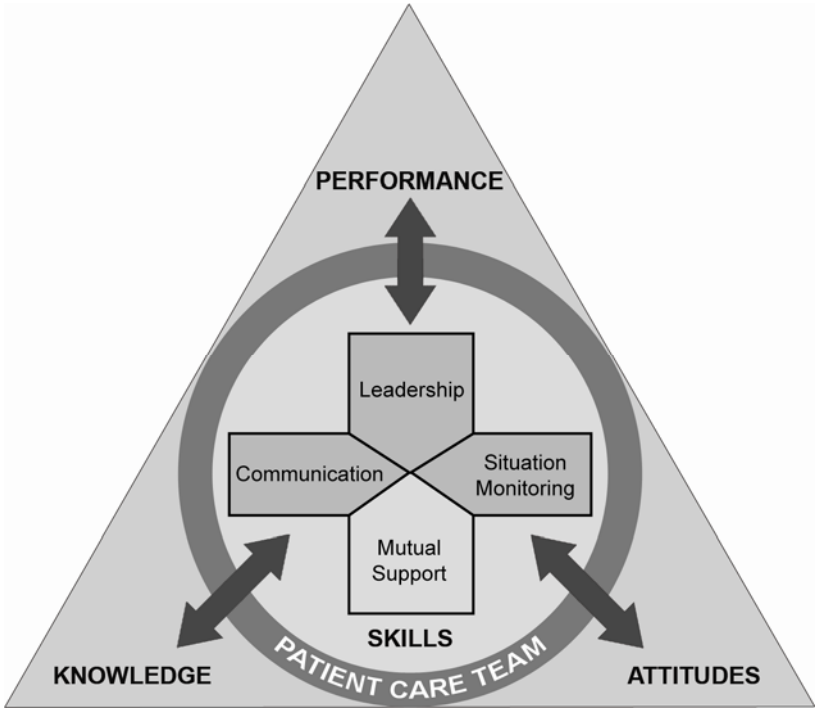

Figure 1. The resulting TeamSTEPPS instructional framework.

Figure 2. TeamSTEPPS™ Curriculum

The Delivery System

The TeamSTEPPS initiative also includes several sessions devoted to Implementation, a multiphase process based on John Kotter's model of organizational change.[38] The process is carried out by a cadre of trainer/coaches who champion the effort within their unit, department, or institution. A successful TeamSTEPPS Initiative requires a carefully developed implementation and sustainment plan that is captured in Figure 3. It is based on lessons learned, DoD experience, the literature of quality and patient safety, and culture change.

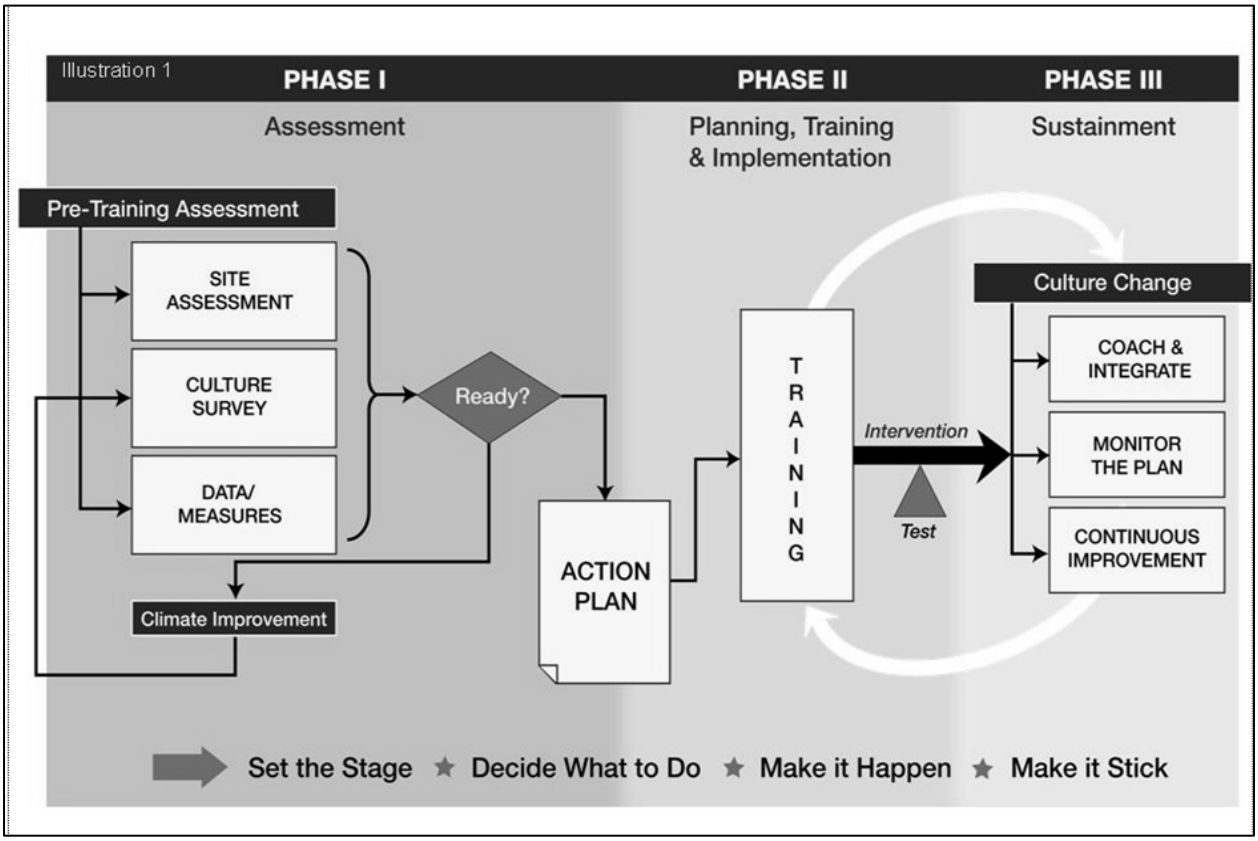

Figure 3. A shift toward a culture of safety

Phase I: Assessment – set the stage. The goal of Phase I is to determine organizational readiness for undertaking a TeamSTEPPS initiative. During the pretraining assessment of Phase I, the organization or work unit identifies leaders and key champions that will make up the organization-level change team. The role of this organization-level change team is to identify specific opportunities for improvement that can be realized by employing a teamwork initiative. A site assessment is conducted to determine the readiness of the institution to include vital support of leadership, potential barriers to implementing change, and whether resources are in place to successfully support the initiative. Such practice is typically referred to as a training needs analysis; it is a necessary first step to implementing a teamwork initiative.[39]

The AHRQ Hospital Survey on Patient Safety Culture[40] is a tool that is available to the public to conduct a site assessment. This survey can assist health care organizations and systems in evaluating employees' perceptions and attitudes about the existing culture and issues related to patient safety. Information gathered from this assessment enables leaders to evaluate a variety of organizational factors that have an impact on patient safety to include:

- Assessing awareness about safety issues.
- Evaluating specific patient safety interventions.
- Tracking of change in patient safety over time.
- Setting internal and external benchmarks.
- Fulfilling regulatory requirements or directives.

To further demonstrate the need for improved teamwork and the importance of acting now, facility-specific data (e.g., root cause analyses, occurrence reporting, and patient and staff satisfaction questionnaires) can be used to further support the cause.

A final determination is based on whether improved team performance—to include employing a TeamSTEPPS initiative—is the appropriate intervention necessary to impact change. A thorough needs analysis may uncover many underlying issues within the institution (e.g., systems problems, equipment problems, staffing shortages). The role of leadership is to assess the overall needs of the organization based on the analysis and determine the appropriate interventions.

Once organizational readiness is determined and a decision to proceed with a TeamSTEPPS Initiative is made, the role of the organizational level change team is enhanced. Usually appointed by facility leadership, the change team will:

- Determine the unit or departments in which the initiative should be deployed.
- Develop an implementation and action plan for the organization.
- Train the staff or other trainers.
- Serve as the champions responsible for ongoing coaching and reinforcement of the team behaviors and skills on the unit or department.
- Include feedback on successful use of the tools and strategies, and how best to improve.

Phase II: Planning, training, and implementation – Decide what to do and make it happen. Phase II is the planning and execution segment of the TeamSTEPPS Initiative. Typically, the change team (or specific designees) complete a 2½-day intensive TeamSTEPPS train-the-trainer session (as described later, AHRQ is developing an infrastructure to support such training). Provided in this session is the core TeamSTEPPS curriculum to include scenarios, case studies, multimedia, and simulation. Culture change and coaching workshops that entail the provision of skills and strategies necessary for implementation, sustainment, and spread of the initiative are introduced. A 4-hour block of time is devoted to participant development of a customized TeamSTEPPS Implementation and Action Plan. Each unit or department produces a tangible report detailing exactly how the initiative will be executed to best meet their unique circumstances. At the end of the session, participants are provided an opportunity to practice teach a module of the core curriculum using specialty-specific scenarios

appropriate to their units or departments. Peer and instructor feedback serves to reinforce understanding of the content, along with refinement of presentation skills.

TeamSTEPPS was designed to be tailored to the organization in which it is being implemented. Options include implementation of all tools and strategies throughout the entire organization, a phased-in approach that targets specific units or departments, or selection of individual tools introduced at specific intervals (a dosing strategy). As long as the primary learning objectives are maintained, the TeamSTEPPS materials are extremely adaptable. Two different versions of the materials are available from AHRQ (i.e., the full course TeamSTEPPS Fundamentals and a shorter Essentials course).

Phase III: Sustainment—Make it stick. The goal of Phase III is to sustain and spread improvements in teamwork performance, clinical processes, and outcomes resulting from the TeamSTEPPS Initiative. During this phase, users will:

- Integrate teamwork skills and tools into daily practice.
- Monitor and measure the on-going effectiveness of the TeamSTEPPS intervention.
- Develop an approach for continuous improvement and spread of the intervention throughout the organization or work unit.

Sustainment is managed by the designated change team through coaching and active observation of team performance. It involves continuing training of the core curriculum through refresher courses and newcomers' orientation, conducting continual evaluations of teams throughout the organization, and providing meaningful, ongoing feedback to staff members in the workplace, where day-to-day health care is provided.

The key objective is to ensure that there are opportunities to implement the tools and strategies taught, practice and receive feedback on the trained skills, and continually reinforce the TeamSTEPPS principles in the unit or within the department.

DoD Initiatives

Numerous Military Treatment Facilities (MTFs) throughout the Military Health System (MHS) are in various phases of the TeamSTEPPS initiative. The HCTCP continues to assess readiness of facilities interested in undertaking a TeamSTEPPS initiative, provides ongoing followup through coaching and consultation, and holds bimonthly Learning Action Network (LAN) teleconferences. Training and implementation have been provided as a whole-hospital approach, within specific specialty units and departments and in ambulatory clinics. Approaches to implementation have included selection of the entire suite of TeamSTEPPS tools and strategies, as well as a phased-in approach of specific tools. The spread of TeamSTEPPS has been evident with the migration of the initiative to additional specialty units and departments within several facilities.

TeamSTEPPS has been incorporated into several other curriculum milieus within DoD to include training at simulation centers, education courses at the Uniformed Services University of the Health Sciences (USUHS), and military operational units. Overall reaction to the TeamSTEPPS initiative has been favorable. Participants in the sessions have provided comments that the

specific teamwork behaviors and skills are pertinent, useful, and applicable to their setting. Many of the tools and strategies (e.g., DESC [Describe, Express, Specify, and Consequences] script for conflict resolution) have been immediately transferable and applicable to situations encountered within participants' work settings. The biggest challenges within the DoD relate to deployments and staff turnover.

AHRQ Initiatives

AHRQ held a 3-day train-the-trainer workshop in spring 2007 with representatives from over a dozen health care systems and hospitals within the High-Reliability Organization (HRO) network. Focus was on development of customized TeamSTEPPS Implementation and Action Plans to support the particular needs of the organizations. Further support is provided by AHRQ through a bimonthly teleconference. A sharing of success stories and lessons learned related to implementation strategies occurs during these calls.

A TeamSTEPPS Collaborative in May 2007 brought together approximately 30 health professionals and researchers. Further clarification regarding requirements for implementation and dissemination of TeamSTEPPS was presented. Participants were in various phases of implementation and shared numerous challenges and experiences. Participants agreed to regular sharing of information, constructing a research agenda for the future, and conducting an annual meeting. Each participating institution will report their progress and findings related to the TeamSTEPPS initiative.

Establishing a National Support Network

Since the release of TeamSTEPPS in late 2006, AHRQ has received numerous requests for the materials and guidance on implementation strategies. To address this need, AHRQ and DoD are establishing a national support network for TeamSTEPPS through the Centers for Medicare & Medicaid Services (CMS) Quality Improvement Organizations (QIOs). Following an agricultural extension model, the intent is for QIOs to serve as partners in the diffusion and adoption of TeamSTEPPS, further aiding health care entities in improving patient outcomes through the tracking of multiple performance metrics. QIOs will be trained and supported via an AHRQ grant through the American Institutes for Research (AIR), which has teamed with Booz Allen Hamilton, Delmarva Foundation for Medical Care, Lumetra, Carilion Clinic, Creighton University Medical Center, Duke University Health Systems, and the University of Minnesota Medical Center – Fairview.

At the core of the AHRQ/DoD national implementation plan are Duke, Carilion, University of Minnesota, and Creighton. These medical centers, which are in various phases of implementation and sustainment, will act as Team Resource Center training sites for the national implementation project. QIO staff and representatives from other health care organizations will be able to enroll in regularly scheduled TeamSTEPPS Master Training Programs. The week-long sessions will provide not only training but also demonstrations as to how TeamSTEPPS was effectively implemented at the host training center. Because each center is different in terms of capabilities, resources, size, and location, the four organizations will provide a variety of training settings for addressing different needs, yielding a greater degree of flexibility in providing training and support to other organizations. A dynamic learning opportunity exists for participants attending a

TeamSTEPPS Master Trainer program, exposing participants to both a classroom learning environment and actual observation of the TeamSTEPPS behaviors and skills applied within a health care setting.

Future Directions

TeamSTEPPS represents a significant advancement in addressing team performance issues in health care. Nonetheless, a critical question remains: Does TeamSTEPPS produce the outcomes hypothesized in Figure 1? Does training in the core curriculum of leadership, communication, back-up behavior, and cross-monitoring lead to more adaptable, safer health care teams? Alternatively, do the tools and strategies presented in TeamSTEPPS lead to enhanced team performance and desirable outcomes?

Similar debate has raged over the impact of team-training programs of all kinds in all industries.[4, 8, 41] Our goal here in raising these issues is not to question the efficacy of TeamSTEPPS or team training in health care – it works – but to continue to stimulate research. Such research and innovation is the basis of TeamSTEPPS itself. The progress that has been made since the IOM report is tremendous, but there is still much to learn, particularly in health care.

Outside of health care, Salas, Burke, Bowers, and Wilson[42] have investigated the impact of Crew Resource Management (CRM) training in the aviation community. These researchers compiled information from 58 published accounts of CRM training to determine its effectiveness within aviation. Emphasis was placed on evaluation of CRM training using Kirkpatrick's hierarchy of training evaluation. Results indicated that trainees had positive reactions and enhanced learning that resulted in behavioral change on the whole.

However, establishing a link between CRM and safety was not possible due to limitations in the number of incidents reported. It is very difficult to link interventions to low base rate events, such as incidents and accidents, because of their infrequency. Nonetheless, as Salas and colleagues point out, aviation has accepted the efficacy of CRM training despite being unable to show a direct effect on the ultimate criterion: a reduction in aircraft accidents.[42] CRM makes sense, and there is little debate that process and performance are improved.

Within health care, Salas and colleagues (2004) updated the 2001 meta-analysis by conducting a systematic review of CRM in the health care industry, which yielded similar results. Twenty-eight accounts (11 within the medical community) of the implementation of CRM training in hospitals and clinics were systematically reviewed. Just as in previous work, links between CRM training and reactions and declarative and procedural knowledge were established. However, like in the aviation industry, a limited number of organizational safety outcomes could be established, preventing researchers from identifying an impact of CRM on safety.

Based on the above results, the evidence supports the efficacy of TeamSTEPPS. However, direct empirical evidence for the TeamSTEPPS initiative's impact on safety outcomes has yet to be presented. Both AHRQ and DoD are actively pursuing this question, and we believe the evidence will emerge in the near future. As part of the national implementation, AHRQ and DoD have requested such studies, and the participating institutions are working on this challenge. For

example, Duke University Medical Center, in partnership with the University of North Carolina, administered a variant of TeamSTEPPS to over 400 graduating medical and nursing students, collecting data on the performance of four-member physician/nurse teams interacting with standardized patients. Carilion Clinic is planning to examine the relation between TeamSTEPPS and hospital-acquired infection rates and patient satisfaction, while Creighton and Minnesota are testing specific tools in the curriculum and studying how to embed TeamSTEPPS principles into medical education.

Another area we believe has a great deal of potential for future research is the sustainment phase of TeamSTEPPS training. Presently, too little is known about the best strategies for sustaining teamwork principles in the workplace. To date, the approach has been to provide coaching and feedback related to specific cases observed by champions. Nonetheless, research suggests that distributed practice may very well be the best strategy for sustainment.[43]

However, practice in this setting is most effective when a realistic treatment situation is reenacted that provides opportunities for learning and skills reinforcement. This suggests the need to involve simulation in the sustainment phase to guarantee realism without jeopardizing the safety and security of actual patients. Still, the impact of simulators for sustainment needs to be assessed carefully in order to offset the cost of such systems. As such, research evaluating the impact of simulators on team training sustainment would go a long way towards providing insight into the importance of practice.

A second issue associated with sustainment of team training is the cycle with which practice and/or skills reinforcement should take place. Given organizational demands associated with hospitals, it is crucial to find the appropriate interval for providing skills reinforcement in order to optimize the utility of such programs.

Finally, the differential impact of TeamSTEPPS tools and strategies, or any team training program, should be continually investigated. In order to identify and further develop the most crucial tools and strategies for reducing medical error, researchers should embark on the evaluation of individual strategies and tools in the workplace. This might entail looking into the impact of such strategies and/or tools by skill (e.g., assessing the impact of only communication-related strategies on reduction of medical error).

Summary

In summary, TeamSTEPPS is the outcome of a multi-year research and development program led by DoD and AHRQ. DoD has used the curriculum successfully throughout military health care and shown that it works. Now AHRQ is developing an infrastructure to support the implementation of the TeamSTEPPS program nationally. This effort is, in part, the result of the overwhelming response of the health care community to the TeamSTEPPS initiative. Health care institutions see its utility, value the TeamSTEPPS principles, and want to use them. As these early adaptors implement, test, and refine the program, there is anticipation that much will be learned to advance to field of teamwork and its relation to patient safety. Achievement since 2003 has been notable, and we hope that these accomplishments stimulate future research and development innovations. It is only through such work that programs like TeamSTEPPS emerge.

Acknowledgments

The views herein are those of the authors and do not reflect the positions of the organizations with which they are affiliated. David P. Baker is now at the Carilion Clinic. We would like to thank all who have contributed to the development to TeamSTEPPS™. Unfortunately, they are too numerous to list here.

Author Affiliations

Department of Defense TRICARE Management Activity (Ms. King, Ms. Toomey); Agency for Healthcare Research and Quality (Dr. Battles); American Institutes for Research (Dr. Baker, Dr. Alonso); The University of Central Florida (Dr. Salas); Webster Consulting (Dr. Webster); The Cedar Institute (Ms. Salisbury).

Address correspondence to: Heidi B. King, Deputy Director, Patient Safety Division, TRICARE Management Activity, Skyline 5, Suite 810, 5111 Leesburg Pike, Falls Church, VA 22041; e-mail: heidi.king@tma.osd.mil or James Battles, Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD 20850; e-mail: james.battles@ahrq.hhs.gov.

References

1. Kohn LT, Corrigan JM, Donaldson MS. To err is human. Washington, DC: National Academies Press; 1999.
2. Floyd D .Spence National Defense Authorization Act for Fiscal Year 2001. Available at: http://www.house.gov/hasc/comdocs/billsandreports/106thcongress/hr5408law.pdf. Accessed April 7, 2008.
3. Baker DP, Beaubien JM, Holtzman AK. DoD medical team training programs: An independent case study analysis. Washington, DC: American Institutes for Research; 2003.
4. Baker DP, Gustafson S, Beaubien JM, et al. Medical teamwork and patient safety: The evidence-based relation. Washington, DC: American Institutes for Research; 2003.
5. Alonso A, Baker D, Day R, et al. Reducing medical error in the military health system: How can team training help? Hum Resour Manage Rev 2006; 16: 396-415.
6. Rogers EM. Diffusion of innovations (5th edition). New York: Free Press; 2003.
7. Volpe CE, Cannon-Bowers JA, Salas E, et al. The impact of cross training on team functioning: An empirical investigation. Hum Factors 1996; 38: 87-100.
8. Smith-Jentsch KA, Salas E, Baker DP. Training team performance-related assertiveness. Pers Psychol 1996; 49: 909-936.
9. Sims DE, Salas E, Burke SC. Is there a “big five” in teamwork? 19th Annual Meeting of the Society for Industrial and Organizational Psychology. Chicago, IL; 2004.
10. Morey JC, Simon R, Jay GD, et al. Error reduction and performance improvement in the emergency department through formal teamwork training: Evaluation results of the MedTeams project. Health Serv Res 2002; 37: 1553-1581.
11. Gaba DM. Research techniques in human performance using realistic simulation. In: Henson LC, Lee AH, editors. Simulators in anesthesiology education. New York: Plenum; 1998. p 93-101.
12. Gaba DM, Howard SK, Fish KJ, et al. Simulation-based training in anesthesia crisis resource management (ACRM): A decade of experience. Simulat Gaming 2001; 32: 175-193.
13. Howard SK, Gaba DM, Fish KJ, et al. Anesthesia crisis resource management training: Teaching anesthesiologists to handle critical incidents. Aviation Space Environ Med 1992; 63: 763-770.
14. Healey AN, Undre S, Vincent CA. Developing observational measures of performance in surgical teams. Qual Saf Health Care 2004; 13 Suppl 1: i33-i40.

15. Thomas EJ, Sexton JB, Helmreich RL. Translating teamwork behaviors from aviation to healthcare: Development of behavioural markers for neonatal resuscitation. Qual Saf Health Care 2004; 13 Suppl 1: i57-i64.

16. Flin R, Maron N. Identifying and training non-technical skills for teams in acute medicine. Qual Saf Health Care 2004; 13 Suppl 1: i80-i84.

17. Baker D, Salas E, King H, et al. The role of teamwork in the professional education of physicians: Current status and assessment recommendations. Jt Comm J Qual Patient Saf 2005; 31: 185-202.

18. Cannon-Bowers JA, Tannenbaum SI, Salas E, et al. Defining competencies and establishing team training requirements. In: Guzzo RA, Salas E, eds. Team effectiveness and decision-making in organizations. San Francisco: Jossey-Bass, 1995. p. 333-380.

19. Salas E, Burke CS, Stagl, KC. Developing teams and team leaders: Strategies and principles. In: Demaree RG, Zaccaro SJ, Halpin SM, editors. Leader development for transforming organizations. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.; 2004, p. 325-358.

20. Barach P, Weingart M. Trauma team performance. In: Wilson WC, Grande CM, Hoyt DB, eds. Trauma: Resuscitation, anesthesia, surgery, and critical care. New York: Marcel Dekker, Inc.; 2003. p. 96-150.

21. McIntyre RM, Salas E. Measuring and managing for team performance: Emerging principles from complex environments. In: Guzzo RA, Salas E, editors. Team effectiveness and decision making in organizations. Mahwah, NJ: Lawrence Erlbaum Associates, 1995, p. 194-203.

22. Porter COLH, Hollenbeck JR, Ilgen DR et al. Backup behavior in teams: The role of personality and legitimacy of need. J Appl Psychol 2003; 88: 391-403.

23. Kozlowski SWJ, Gully SM, Nason ER, et al. Developing adaptive teams: A theory of compilation and performance across levels and time. In: Ilgen DR, Pulakos ED, eds. The changing nature of performance: Implications for staffing, motivation, and development. San Francisco: Jossey-Bass, 1999. p. 240-292.

24. Klein G, Pierce LG. Adaptive teams. Proceedings of the 6th ICCRTS Collaboration in the Information Age, Track 4: C2 Decision Making and Cognitive Analysis, 2001.

25. Driskell JE, Salas E. Collective behavior and team performance. Hum Factors 1992; 34: 277-288.

26. Shamir B. Calculations, values, and entities: The sources of collective motivation. Hum Relations 1990; 43: 313-332.

27. Wagner JA. Studies of individualism-collectivism: Effects on cooperation in groups. Acad Manage J 1995; 38: 152-172.

28. Klimoski R, Mohammed S. Team mental model: Construct or metaphor? J Manage 1994; 20: 403-437.

29. Mathieu JE, Heffner TS, Goodwin GF, et al. The influence of shared mental models on team process and performance. J Appl Psychol 2000; 85: 273-283.

30. Stout RJ, Cannon-Bowers JA, Salas E. The role of shared mental models in developing team situational awareness: Implications for team training. Training Res J 1996; 2: 85-116.

31. Bandow D. Time to create sound teamwork. J Qual Participat 2001; 24: 41-47.

32. Webber SS. Leadership and trust facilitating cross-functional team success. J Manage Develop 2002; 21: 201-214.

33. Pizzi L, Goldfarb NI, Nash DB. Crew resource management and its applications in medicine. In: Shojana KG, Duncan BW, McDonald KM, et al, eds. Making health care safer: A critical analysis of patient safety practices. Rockville, MD: Agency for Healthcare Research and Quality; 2001. p. 501-510.

34. Shojania KG, Duncan BW, McDonald KM, Wachter RM, eds. Making health care safer: A critical analysis of patient safety practices. Evidence Report/Technology Assessment 43; AHRQ Pub. No. 01-E058. Rockville, MD: Agency for Healthcare Research and Quality; July 2001. Available at: http://www.ahrq.gov/clinic/ptsafety/pdf/ptsafety.pdf. Accessed April 7, 2008.

35. Cannon-Bowers JA, Salas E. Teamwork competencies: The interaction of team member knowledge, skills, and attitudes. In: O'Neil HF Jr, ed. Workforce readiness: Competencies and assessment. Mahwah, NJ: Lawrence Erlbaum Associates; 1997. p. 151-174.

36. Seamster TL, Kaempf GL. Identifying resource management skills for airline pilots. In: Salas E, Bowers C, Edens E, eds. Improving teamwork in organizations: Applications of resource management training. Mahwah, NJ: Lawrence Erlbaum Associates; 2001. p. 9-30.

37. Smith-Jentsch KA, Baker DP, Salas E, et al. Uncovering differences in team competency requirements: The case of air traffic control teams. In: Salas E, Bowers C, Edens E, eds. Improving teamwork in organizations: applications of resource management training. Mahwah, NJ: Lawrence Erlbaum Associates; 2001. p. 31-54.

38. Kotter J, Rathgeber H. Our iceberg is melting: Changing and succeeding under any conditions. New York: St. Martin's Press; 2006.

39. Salas E, Cannon-Bowers JA. The science of training: A decade of progress. Ann Rev Psychol 2000; 52: 471-491.

40. Patient safety culture surveys. Rockville, MD: Agency for Healthcare Research and Quality; March 2008. Available at: http://www.ahrq.gov/qual/hospculture/. Accessed April 7, 2008.

41. Jentsch F, Smith-Jentsch KA. Assertiveness and team performance: More than "just say no." In: Salas E, Bowers C, Edens E, eds. Improving teamwork in organizations: Applications of resource management training. Mahwah, NJ: Lawrence Erlbaum Associates; 2001. p. 73-94.

42. Salas E, Burke CS, Bowers CA, et al. Team training in the skies: Does crew resource management (CRM) training work? Hum Factors 2001; 43: 641-674.

43. Kraiger K, Ford JK, Salas E. Application of cognitive, skill-based, and affective theories of learning to new methods of training evaluation. J Applied Psychol 1993; 78: 311-328.