Toward the Development of the Perfect Medical Team: Critical Components for Adaptation

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Objective: Medical teams play a vital role in the delivery of safe and effective patient care. Toward the goal of becoming a high-reliability health system, the authors posit that the "perfect" medical team is one that develops their attitudes, behaviors, and cognitions (ABCs) to facilitate adaptation.

Methods: The authors synthesized the literature (frameworks, measures, and conceptual models) on teamwork in healthcare ($k = 161$) to develop an evidence-based model of ABCs, which current evidence suggests, are requisite for medical team adaptation. Clinical vignettes were garnered from the media and other sources to illustrate how these ABCs—or failure in using these ABCs—can lead to positive or negative events in healthcare.

Results: The resulting model contains the most frequently included ABCs in healthcare teamwork models, measures, and frameworks: psychological safety (41, 25.5%), situation assessment (66, 41.0%), shared mental models (56, 34.8%), team leadership behaviors (78, 48.4%), role awareness (64, 39.7%), team decision-making (61, 37.9%) and planning (41, 25.5%), conflict management (51, 31.7%), task coordination (71, 44.1%), adaptation (46, 28.6%), and backup behavior (54, 33.5%). The authors posit that communication and organizational conditions—other highly cited components—(141, 87.6%, and 90, 55.9%, respectively) serve as moderators of these relationships.

Conclusions: The authors argue that each of these ABCs is critical for enhancing team adaptation and subsequently increasing patient safety. A list of practical tools and educational strategies that teams and organizations can use to improve their performance on each of these ABCs is provided.

Key Words: teams, adaptation, teamwork, framework

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"No other industry tolerates a one-in-four failure rate."[1]

Healthcare has yet to become a high-reliability industry, defined as those that operate in complex environments yet are exceptionally safe, with extremely low error rates.[2] To demonstrate, a recent article shows that 29.6% of nurses rate patient safety in their institution as unfavorable.[3] Furthermore, as many as 440,000 preventable hospital deaths occur annually,[4] costing one trillion dollars.[5] Although the causes of medical error are multifaceted, poor teamwork is often a major contributing factor to such sentinel events.[6,7] Thus, medical teams (defined as "a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life-span of membership")[8] must become high-reliability teams (HRTs).[9] That is, medical teams must be armed with the requisite attitudes, behaviors, and cognitions (ABCs) that comprise effective teamwork[10] to deliver safe, high-quality care.[11]

Processes and Emergent States: The ABCs of Teamwork

Effective patient safety research and application require an examination of the context in which work is performed.[12] As such, several human factors engineering frameworks and strategies aim to understand and mitigate threats to patient harm.[13] The Systems Engineering Initiative for Patient Safety is a widely accepted patient safety model, which postulates the influential role(s) of work system inputs (i.e., organizational culture, person[s], tools and technologies, and tasks), care processes (e.g., teamwork), and their influence(s) on outcomes related to patient (e.g., patient outcomes, patient satisfaction) and provider well-being (e.g., burnout).[14,15]

Along these lines, teamwork ABCs are composed of team processes (interdependent cognitive, verbal, and behavioral teamwork *activities* engaged in for the purpose of achieving the team's goal; e.g., coordination)[16] and emergent states (cognitive, motivational, and affective *products* of team experiences that serve as both proximal outcomes, as well as inputs to subsequent team processes and outcomes; e.g., trust).[16] This is rooted in more general, widely cited teamwork frameworks and models.[16,17] For example, Salas et al (2015)[17] focus on six core processes and emergent states (cooperation, coordination, cognition, conflict, coaching, and communication) and three influencing conditions (context, composition, and culture) of teamwork. While informative and foundational theories, these frameworks and models were developed to describe teamwork broadly and thus fail to consider the distinctive characteristics of healthcare that influence how teamwork unfolds. As such, these frameworks lack prescriptive teamwork improvement strategies that are readily applicable to unique challenges experienced by healthcare teams.

Barriers to Teamwork in Healthcare: Challenging Conditions and the Need for Adaptation

Conditions are factors external to the team that impact teamwork and/or goal accomplishment. Examples include organizational

culture, resource availability, and performance context[17] (e.g., inpatient versus outpatient settings; geographical location [rural versus urban]). Many aspects of the healthcare setting pose barriers to effective teamwork including heterogeneous (e.g., interprofessional) and fluid (e.g., shift changes) team composition,[18,19] dynamic and ill-defined patient problems,[20,21] frequent delays and interruptions (e.g., patients not having medical records; language barrier[s]; overbooked clinicians, team members lacking specialized expertise),[22] high stakes,[23] time constraints,[24] competing demands,[25] long hours,[26] often low resources,[27] fragmentation and siloed care processes,[28] a culture of autonomy and individual responsibility,[28] and hierarchical organizational/professional cultures.[28] To overcome these barriers and become an HRT, the perfect medical team must be able to adapt, defined as readjusting strategies when conditions or situations change.[29] *The perfect medical team is adaptive and resilient:* it has the necessary teamwork ABCs to anticipate and respond to these challenges, allowing them to adapt and continue to provide high-quality care.

Purpose

High-reliability teams are committed to being mindfully attentive and actionable toward preventing errors and increasing safety. As a result, an HRT is able to successfully adapt to frequently fluctuating demands, priorities, unexpected delays, changing patient statuses, and interruptions, thus improving safety. Despite the barriers to effective performance, evidence suggests that healthcare teamwork can be improved.[30] However, little guidance exists about specific strategies that healthcare teams can use to improve adaptation, safety, and ultimately achieve HRT status.

Given the centrality of teams to HROs[31] and healthcare systems (e.g., delivering patient care),[32] we advance an evidence-based framework informed by team science. Understanding the mechanics, which underpin ideal HRT function in healthcare, contributes a critical component to patient safety and healthcare's journey to becoming a high reliability industry. We therefore seek to provide prescriptive strategies for the development and maintenance of effective, adaptable medical teams in light of the challenges that such teams encounter. First, we conduct a review of the literature to develop a conceptual model of the inputs, processes and emergent states (i.e., the ABCs), and moderators of adaptation in healthcare teams. We then walk through the ABCs by succinctly summarizing evidence-based guidance and using vignettes to bring the ABCs to life and provide prescriptive strategies for both frontline team members and organizational leadership. In doing so, we unpack the teamwork components of a "perfect" medical team.

Although a truly "perfect" medical team may be unattainable, the components described herein will help arm medical teams with some of the key ABCs necessary to adapt, leading to better and safer patient outcomes. We do not intend to convey the message that this is an exhaustive, all-encompassing list of ABCs important to healthcare teams; rather, based on our review of the literature, the ABCs discussed in this article are covered frequently in healthcare. There is evidence that they matter, and we offer these as a solid point of departure to have targets of opportunities for improving teamwork in healthcare.

METHODS

Search Strategy

To inform model development, we reviewed healthcare teamwork models, frameworks, taxonomies, and measures (e.g., surveys, observational tools). Our search method involved (*a*) searching PubMed for relevant systematic reviews; (*b*) identifying additional articles fitting our inclusion criteria from the reference lists of these reviews; and (*c*) referring back to more general (i.e., nonhealthcare specific), seminal models of teamwork and team adaptation to ensure our model would be grounded in the broader teamwork theory. See Appendix A for full list of articles coded ($k = 169$, including 161 healthcare and 8 nonhealthcare).

Data Abstraction

The authors examined the models, measures, frameworks, and taxonomies, with a goal of identifying the most commonly included teamwork dimensions. Coding was framed using Salas et al.'s (2015) *critical considerations for teamwork*[17] framework as a guiding framework. Salas et al. (2015)[17] was chosen because it is comprehensive and we felt that it provided an overarching structure at an appropriate level of specificity; however, we allowed additional dimensions and constructs not included in this framework to emerge. We coded the dimensions of teamwork that were represented, based on standardized definitions (Table 1). That is, we did not rely upon the dimension name provided by the authors of the original articles; rather, we reviewed the constructs and items and assigned them to dimensions based on the definitions in Table 1. When possible, we coded at the most granular level possible (i.e., subdimension level; e.g., the specific construct of "trust," instead of just coding for its broader dimension of "cooperation"). If the article did not provide enough detail to code at this granular subdimension/construct level, only the broader dimension was coded. Each dimension and/or subdimension was coded "1" if the model/framework/measure contained it, and a sum and percentage were computed for each construct and dimension to determine frequency. The general teamwork models ($k = 8$) were not included in sums and percentages, but rather just served as a guidepost to ensure that our model was grounded in the broader teamwork science. Thus, percentages are computed of 161 healthcare teamwork articles (15 healthcare teamwork models and 146 healthcare teamwork measures).

Inclusion and Exclusion Criteria

When measures/models/frameworks had dimensions that were outside the scope of teamwork (e.g., technical skills), those dimensions were ignored. Measures had to cover multiple dimensions (e.g., a measure of just team cohesion was not included) and had to be developed for healthcare teams (e.g., manufacturing team measures were not included) whose purpose was providing patient care (e.g., measures of quality improvement teamwork were excluded).

RESULTS

The most commonly included dimensions and subdimensions were general communication (87.6%), conditions (55.9%), general coaching/team leadership (48.4%), general coordination (44.1%), situation assessment (41.0%), general team cognition/shared mental models (SMMs, 34.8%), role awareness (39.7%), team decision-making (37.9%), backup behavior (33.5%), conflict management (31.7%), adaptation (28.6%), psychological safety (25.5%), and planning (25.5%). See Table 1 for definitions, *n*s, and percentages of all dimensions and subdimensions coded.

We chose to include in our model those subdimensions that were included in at least 25% of the models, frameworks, and measures coded (i.e., those listed in the previous paragraph). Thus, we propose the model displayed in Figure 1. Following an input mediator/moderator outcome input (IMOI) path,[41] our model maps the most commonly identified processes and emergent states onto the following three key team inputs[8]: (*a*) a common goal (for the healthcare setting, we have adapted this to a common patient-centered goal); (*b*) specific team roles; and (*c*) the existence of tasks that require interdependence to complete the goal. We then include the mediators

TABLE 1. Definitions and Frequency of Dimensions Examined

Dimensions From Salas et al.,[17] Subdimensions, and Definitions Used in Coding	No. Articles That Included	Percentage of Articles That Included	Included in Current Model?
• COACHING: Behaviors including goal setting, task delegation, and provision of feedback to guide the team to successful task accomplishment.	86	53.4%	NA
◦ Coaching/team leadership (general): Establishing goals and setting direction to achieve the team's goal.[17] Can be designated or shared, formal or informal.	78	48.4%	Yes
◦ Debriefing: Reviewing prior events and team performance, providing feedback, discussing lessons learned[33]	18	11.2%	No
• COGNITION: Knowledge and expertise developed, used, and shared within the team.	125	77.6%	NA
◦ Cognition/SMM (general): A shared understanding among team members of team mission objectives, task, and progress.[17] Includes development of SMMs.	56	34.8%	Yes (with situation assessment)
◦ Planning: Developing courses of action, interpreting and evaluating mission, tasks, conditions, and resources available[16]	41	25.5%	Yes (with team decision-making)
◦ Briefs/time outs: Short discussion periods to establish or update team roles, expectations, coordinate tasks, and other plans[33]	11	6.8%	No
◦ Team decision-making: Making decisions about task work as a team; includes multiple, interprofessional, and/or interdisciplinary team member perspectives and participation.	61	37.9%	Yes (with planning)
◦ Shared goal: A specific objective that members are all aware of, that is, the purpose for team performance	40	24.8%	Yes (as input)
◦ Situation assessment/monitoring: Tracking or monitoring progress towards the goal, and/or changes in conditions (environmental, patient), and/or team members, (often termed "situation awareness")[16]	66	41.0%	Yes (with SMMs)
◦ Role awareness: Team members' understanding of team members' roles and responsibilities	64	39.7%	Yes (as SMMs)
• COMMUNICATION: "A reciprocal process of team members' sending and receiving information that forms and reforms a team's attitudes, behaviors, and cognitions."[17]	141	87.6%	NA
◦ Communication (general): Quality, quantity, mode of communication, use of communication strategies and tools	141	87.6%	Yes
• CONDITIONS: "Factors affecting how teams operate and how variability within those factors can both directly and indirectly… influence team outcomes."[17]	90	55.9%	NA
◦ Context: Evaluation of organizational and/or environmental resources, equipment, and structures to carry out teamwork	33	20.5%	Yes (as conditions)
▪ Responsibility: The responsibility, autonomy, accountability a team has	17	10.6%	Yes (as conditions)
◦ Climate and/or culture: Consideration of the culture and/or climate (i.e., "Assumptions about humans' relationships with each other and their environment that are shared among an [organization] and manifest in individuals' values, beliefs, norms for social behavior, and artifacts"[17]) for teamwork within the organization	15	9.3%	Yes (as conditions)
◦ Composition: Structure of and/or familiarity with teammate KSAs and consideration of KSAs in workload distribution	65	40.3%	Yes (as conditions)
• CONFLICT: Preventing, controlling, or guiding team conflict before it occurs, as well as working through task and interpersonal disagreements among the team[16]	51	31.7%	NA
◦ Conflict management (general): Effectively preventing and/or resolving task, and/or relationship, and/or process conflict	51	31.7%	Yes
• COOPERATION: Motivational and affective components of teamwork	91	56.5%	NA
◦ Cooperation (general): "the attitudes, beliefs, and feelings of the team that drive behavioral action."[17]	24	14.9%	No
◦ Cohesion/team climate/team efficacy: "the tendency of a group to stick together and remain united"[34], positive feelings, and group culture, the belief that the team will be effective.	28	17.4%	No

(Continued next page)

TABLE 1. *(Continued)*

Dimensions From Salas et al.,[17] Subdimensions, and Definitions Used in Coding	No. Articles That Included	Percentage of Articles That Included	Included in Current Model?
◦ Psychological safety: "a shared belief that the team is safe for interpersonal risk taking,"[35] including willingness to report safety concerns and errors.	41	25.5%	Yes
◦ Respect and professionalism: Team members interacting competently and respectfully toward one another	35	21.7%	No
◦ Social support: "team members' efforts to provide emotional and psychological strength to one another"[36]	8	5.0%	No
◦ Team orientation: the extent to which members prefer to work on a team (as opposed to individually)[37]	20	12.4%	No
◦ Trust: "the intention to accept vulnerability based on positive expectations of the intentions or behavior of another"[38]	19	11.8%	No
• COORDINATION: "The enactment of behavioral and cognitive mechanisms necessary to perform a task and transform team resources into outcomes"[17]	134	83.2%	NA
◦ Coordination (general): "Orchestrating the sequencing and timing of interdependent actions"[16]	71	44.1%	Yes
◦ Adaptation: "a change in team performance, in response to a salient cue or cue stream, that leads to a functional outcome for the entire team. Team adaptation is manifested in the innovation of new or modification of existing structures, capacities, and/or behavioral or cognitive goal-directed actions,"[39] or the capability of the team to adapt (adaptability).	46	28.6%	Yes (as outcome)
◦ Backup behavior: Assisting team members with tasks, balancing workload among team members[16] (aka mutual support)	54	33.5%	Yes
◦ Collaboration: "Assuming complementary roles and cooperatively working together, sharing responsibility"[40]	33	20.5%	No
◦ Effort: Physical and/or mental exertion to complete a task	5	3.1%	No
◦ Multiteam systems: Coordination (e.g., including communication, collaboration) with other teams in the organization who affect the team's task	13	8.1%	No
◦ Task management: The process of tracking and progressing a task to achieve the team's goal	14	8.7%	No
• TEAMWORK (GENERAL): team attitudes, behaviors, and cognitions, described only generally	14	8.7%	No

KSA, knowledge, skills, and abilities.

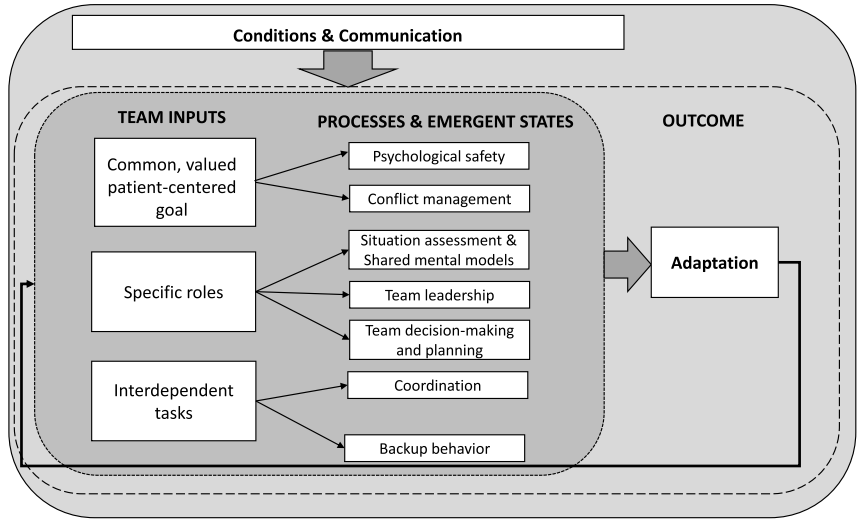

FIGURE 1. The IMOI model: toward a perfect medical team. This figure is a conceptual model of the "perfect medical team" ABCs described in the article. The model follows the IMOI path,[41] with three team inputs (common patient-centered goal, specific roles, and interdependent tasks), seven mediators (i.e., behavioral processes and cognitive and affective emergent states, including psychological safety, conflict management, situation assessment and SMMs, team leadership, team decision-making and planning, coordination, and backup behavior) and one outcome (adaptation). We posit that these ABCs facilitate adaptation, which is necessary for patient safety; however, this can only occur when conditions are supportive and effective communication occurs, as shown by the arrow at the top. The arrow pointing from adaptation back to the figure indicates the recursive nature of the relationship, that is, adaptation feeds back into improved teamwork in subsequent performance episodes.

(processes and emergent states) from our review. Specifically, we advocate that, to be adaptive, a perfect medical team must do the following: (*a*) foster psychological safety at multiple levels; (*b*) manage conflict effectively and efficiently; (*c*) engage in situation awareness and develop SMMs around the team, task, and environment; (*d*) use effective leadership models and behaviors; (*e*) facilitate team decision-making and planning; (*f*) coordinate tasks within and between teams; and (*g*) overcome barriers to requesting and receiving backup. As can be seen, we chose to combine SMMs, role awareness, and situation assessment, as well as team decision-making and planning, because these constructs tend to be highly interrelated in the medical context. We also include communication and conditions as moderators of all of these relationships, because these drive the successful enactment of these processes and emergent states. We included communication and conditions at the dimension levels, rather than subdimension levels, because theory[17,42] suggests that these two constructs broadly serve as facilitators and barriers to other teamwork processes and states. As such, we present these as moderators in the model. Together, the selected ABCs drive medical team adaptation. Because the field of medical teamwork continues to proliferate, we expect that this framework will be updated to reflect new knowledge. For now, this framework offers guidance in terms of improving medical team adaptation based on current understanding.

Next, we define each ABC and briefly describe the science underpinning it, expanding upon its relevance to effective medical teamwork and adaptation. To allow for a more grounded understanding of the ABCs in practice, Table 2 contains real critical incidents derived from patient safety organizations and media that illustrate the presence or absence of each ABC. We also provide practical recommendations that medical teams can use to improve the ABCs in Table 3.

The Perfect Medical Team Fosters Psychological Safety at Multiple Levels

Psychological safety is the shared feeling within the team that it is safe to speak up, seek advice, and ask questions.[79] Psychological safety is associated with higher rates of reporting adverse events,[80] more participation from team members,[79] and reduced failure to rescue rates,[81] suggesting that it is essential for adaptation. When a team experiences psychological safety, members are more likely to engage in open and honest communication (facilitating SMM development), admit when they need help (facilitating backup behavior), voice concerns (facilitating conflict management), and offer feedback (facilitating team leadership).

The Perfect Medical Team Manages Conflict Effectively and Efficiently

Conflict occurs when team member interests, beliefs, views, or preferences are incompatible[82] and is frequent in healthcare; e.g., between one and four "highly tense" communications occur between team members during each surgical procedure.[51] When appropriately managed, conflict provides a healthy outlet for managing team member attitudes and emotions.[83] However, mismanaged conflict and power struggles yield a potential threat to patient safety.[84,85]

The Perfect Medical Team Engages in Situation Awareness and Develops SMMs Around the Team, Task, and Environment

An SMM is "an individually held, organized, cognitive representation of task-related knowledge and/or team-related knowledge that is held in common among health care providers who must interact as a team in pursuit of common objectives for patient care."[86] Adaptive medical teams develop and maintain accurate SMMs[87] around all elements relevant to their work, including goals, priorities, roles and responsibilities, team member expertise, patient desires and concerns, and the care plan (Table 4). Triangulating these unique pieces of information can facilitate adaptation, even in the presence of imperfect technical skills.[88] Shared metal models are gained by team members paying attention to the situation/team members/environment, obtaining situation awareness regarding what is occurring, and communicating this information.

TABLE 2. Vignettes Associated with ABCs in Model

ABC	Vignette	Comments
Psychological safety	An hour and a half into a surgery for a recurrent ventral hernia, a patient began experiencing classic symptoms of an allergic reaction: her blood pressure dropped, her face turned red, and she began wheezing. The anesthesiologist reviewed her medications and concluded the symptoms were most likely caused by a latex allergy. He immediately asked the surgeon to change his gloves to a nonlatex variety. "You're wrong. This can't be a latex allergy," the surgeon argued. The anesthesiologist firmly restated, "I am certain it is." The surgeon refused to change his gloves, insisting against a latex allergy, even after the anesthesiologist asked him what else could be causing the symptoms and whether it was worth endangering the patient. Only after the anesthesiologist instructed a nurse to call the Dean of Surgery and hospital president did the surgeon unwillingly change his gloves. After surgery, tests confirmed the patient had developed a latex allergy and could have died without a glove change.[43]	❖ Team had psychological safety, allowing anesthesiologist to speak up and be assertive to surgeon
Conflict management	Seventeen-year-old Daniel Miller was admitted to the ICU with a fast heart rate, vomiting, unusual breathing, chest pain, and inability to void urine. He had abnormal lab values and was showing variable – and at some points, undetectable - blood pressure. A medical resident ordered him to be sedated to insert an arterial line; however, due to Daniel's undetectable blood pressure, the use of the sedative – known to reduce heart rate – worried the ICU nurse. The nurse questioned the resident about this twice; yet, the attending was not contacted and Daniel was sedated. Shortly after the administration of the sedative, Daniel went into cardiac arrest and passed away. Daniel's family reports that it seemed as if the nurses' concerns were not being listened to. The official report of the incident called into question the support that was given to residents and nurses.[44]	❖ Failure of effective conflict management – nurse attempted to state concerns, but resident seemingly ignored
Situation assessment and SMMs	In 2007, nineteen-year-old Blake Fought had a central line in his neck improperly removed by a nurse who had not had training on this type of line removal. Shortly after the line removal, Blake gasped for air. Other nurses on the unit—who did not have a shared understanding that the nurse who had removed the line was not experienced, and, consequently, that the line had been incorrectly removed—told Blake that he was just anxious. In reality, an air bubble had entered into Blake's blood vessels and traveled to his heart. Subsequently, Blake asphyxiated and died as a result of this incident.[45]	❖ Team did not have a SMM of nurse's experience and expertise around this procedure; thus no one offered backup behavior
Team leadership	Mrs. Bridle, an elderly former nurse, was admitted to the hospital after a fall that caused a stroke that resulted in limited mobility of her right arm. Mrs. Bridle, described as someone who could "command a room," was put on a medication that had side effects causing cognitive dulling resulting in an inability to speak or feed herself. Her son Peter reported that the staff did not bathe her for 11 weeks. "I pleaded with them every time I went in to give her a bath," Peter said. Nurses, according to Peter, responded that they were "too busy" to do so. "My mother stopped wanting us to come to the hospital, not because she didn't want to see us but because she was embarrassed, humiliated that she was lying in her own filth. She was a proud woman who didn't want us to see her like that." Additionally, staff did not help Mrs. Bridle put in her hearing aid, rendering her almost deaf. After 12 weeks, she was transferred to a different hospital but died one week later.[46]	❖ Failure of the leader to delegate task of bathing ❖ Failure of the leader to balance workload (also backup behavior)

Team decision-making and planning	A 23-year-old patient presented to the emergency department with a red, swollen foot, which physicians presumed was cellulitis, a simple skin infection. However, because the case looked quite serious, one of the ER physicians flagged down a senior surgical resident to see the patient and verify that no surgical intervention was needed. Upon examining the patient, the surgical resident was suspicious that symptoms were not due to cellulitis but may actually have been caused by necrotizing fasciitis- a potentially fatal flesh-eating bacteria. The resident called the surgeon on-duty and a plastic surgeon. They huddled to discuss the patient's symptoms. After discussing, they spoke with the patient and her family to encourage a biopsy to confirm the results. As a result of the revised diagnosis, the young patient received aggressive treatments and survived. Moreover, because the team worked together to catch the disease at an early stage, the young patient's leg was saved and her prognosis was positive.[47]	❖ The ER physician and surgical resident pulled in the surgeon and plastic surgeon to obtain additional perspectives and make decisions as a team
Coordination	Sherman Sizemore, a 73-year-old Baptist minister, underwent exploratory surgery to diagnose abdominal pain. The anesthesiologist and nurse anesthetist reportedly gave him paralytic agents, but did not give him general anesthesia until 16 minutes after the first abdominal cut. This caused Sherman to be conscious with awareness and complete sensation, but unable to speak or move, during a large portion of the surgical procedure which caused excruciating pain. With no prior history of psychological distress, Sherman had nightmares, fears of being buried alive, refused to be left alone, and ultimately committed suicide two weeks after the surgery.[48]	❖ Nurse anesthetist, anesthesiologist, and surgeon failed to appropriately coordinate sequence and timing of drugs and commencement of procedure
Backup behavior	Jeff, a typically high performing resident physician at a medical center, was losing sleep and under significant stress outside of work. One afternoon, Jeff was on duty in the ICU, and a colleague noticed that he seemed lost, tired, and disengaged as he reviewed a patient. "She doesn't look that bad" he mumbled. "I think she's O.K." Jeff, seemingly in a hurry to get home, suggested to his colleague that the patient be given IV fluids. That night, the patient's fever increased, and her blood pressure and urine output decreased, indicating an overwhelming infection which Jeff had missed. The patient eventually recovered, but Jeff's colleague considered that the patient's clinical deterioration may have been prevented had someone stepped in to assist Jeff upon noticing he was distracted, stressed, and exhausted.[49]	❖ Jeff's colleague failed to offer task assistance when it was clear Jeff needed it

TABLE 3. Towards a Perfect Medical Team: Strategies for Adaptation

ABC	Example Strategies Team Members and Team Leaders Can Enact	Organizational Conditions and Actions to Facilitate Strategies	Relevant Resources
1. Psychological safety	❖ Show that it is acceptable to make and admit mistakes or shortcomings by being open about your own mistakes or pitfalls, especially with team members of a lower status. This can be done in a debrief, for instance. ❖ Allow team members of any status, experience level, and profession to speak freely without being shut down. ❖ Actively solicit input, ideas, and advice from all team members, and communicate that everyone has important pieces to contribute. ❖ Empower nurses and allied health personnel to speak up by explicitly asking their opinion and being open to their input.	❖ Instill a just culture (i.e., blame for error is on organization, rather than individuals) ❖ Train staff that it is acceptable, and expected, that they be assertive and speak up when they have a concern, need help, or notice an error – regardless of any power differential between parties. ❖ Provide employees with means to submit formal complaints regarding particular employees' safety and/or interpersonal behaviors ❖ Openly share near-miss events in briefs, meetings, newsletters, e-mails, etc. Reward those who prevented the near-miss from becoming an actual event. This sends the message that mistakes happen, and reporting them is important, safe, and valued.	Edmondson (1999)[35]; Reader et al., (2007)[50]
2. Conflict management	❖ When a message is conveyed that feels hostile, try to avoid getting upset. Reorient your focus to the content of a message, not the delivery. ❖ Be solutions-oriented, rather than assigning blame. ❖ If time is not of the essence, take a moment to step out and breathe before responding to a hostile communication. ❖ Take a few minutes to debrief after the issue is resolved and the parties are calm to discuss what happened, emotions, and what should be done in the future. ❖ Consider implementing use of a cue (e.g., red card, raised hand, buzzword) to indicate when a team member has a major safety concern. At the introduction of this cue, all action should stop until the concern is addressed.	❖ Provide conflict management training, teamwork training, and assertiveness training to improve conflict communication skills. ❖ Provide clear chains or command for escalation of issues that cannot be resolved within a team. Ensure these chains of command are viewed as welcoming and nonthreatening and that team members will not be punished formally or informally for using them.	Lingard et al. (2002);[51] Eichbaum (2018)[52]; Behfar et al. (2008)[53]; Druskat and Wolff (2001)[54]; Rogers et al. (2013)[55]
3. Situation assessment and SMMs	❖ Communicate effectively and frequently – especially if a team member is new, be explicit about everyone's expertise and experience levels ❖ Conduct daily briefs with entire interprofessional team before beginning a shift or performance episode. Discuss goals, roles and responsibilities, expectations, contingency plans, patient needs/wants/concerns, team member concerns, and other issues of importance. ❖ Build in patient-centered questions into an interprofessional daily brief; e.g., What is patient's overall goal? What does patient need or want? Unique patient/family preferences or concerns that we need to be aware of? ❖ Conduct huddles as needed to quickly problem-solve when events or patient status changes, voice concerns, anticipate changes, etc. Facilitate a culture of participation in huddles – team members should stop what they are doing (if possible) to join.	❖ Have units, departments, or whole organization engage in teamwork training ❖ Provide continuous updates (via staff meetings, fliers, and e-mail) about organizational/environmental issues and changes ❖ Gain awareness of who knows what by conducting meetings, using newsletters, posting pictures and snippets about team members on bulletin boards, hosting brown bags or social events where team members can learn more about one another	Gaba et al. (1995)[56]; Michinov et al. (2008)[57]; Tschan et al. (2009)[58]; Westli et al. (2010)[59]; Deering et al. (2011)[60]

4. Team leadership	❖ Remind the team of the goal and why it matters. Remind team members how their efforts each contribute to goal accomplishment, patient safety, and patient satisfaction. ❖ Use shared and informal leadership models, when appropriate, by allowing team members to lead different parts of a task based on who has the most appropriate expertise. ❖ Delegate tasks based on expertise, role, experience, and workload. Use situation assessment, SMMs, and backup behavior principles when considering task delegation. ❖ When giving feedback, follow feedback best practices: (1) Discuss behaviors, not personal characteristics; (2) Talk about positives *and* negatives; (3) Encourage everyone to speak up by calling on people, looking them in the eye, and allowing for some silence ❖ Conduct debriefs at the end of each shift or performance episode. Discuss what was done well, and what could be improved, both in terms of task/technical work and teamwork.	❖ Make the goal and mission of the organization known and salient through visual signs and messages. ❖ Improve task delegation by ensuring employees are able to work at the top of their license. ❖ Empower nurses and allied health professionals to engage in shared and informal leadership roles when appropriate. ❖ Send messages that feedback and debriefs matter. Educate employees on giving effective feedback.	Carson et al. (2007)[36]; Salas et al. (2008)[61] Papaspyros et al, (2010)[62]; Paull et al., (2009)[63]; Schmutz and Eppich (2017)[64]; Schramm et al., (2011)[65]; Tannenbaum and Cerasoli (2013)[66]; Lacerenza et al. (2018)[67]
5. Team decision-making and planning	❖ Explicitly ask each team member to contribute to the plan or decision. ❖ Show that you value team members' contributions to encourage further participation. ❖ Ask for feedback on your ideas and be open to receiving it. ❖ To ensure plans and decisions are patient-centered, get in the habit of asking "is this aligned with what the patient wants? Is it in his/her best interest?" ❖ Include patient/family in the care plan. Help them see how the care plan fits in with the big picture.	❖ Facilitate and encourage regular interprofessional, interdisciplinary team meetings ❖ Provide training on empathetic communication and listening to improve patient-centered and interprofessional communication skills ❖ Provide education and signs to patients (e.g., brochures, posters, etc.) reminding them to speak up about their wishes and concerns.	Baghbanian et al. (2012)[68]; Legare et al. (2013)[69]
6. Coordination	❖ Write patient preferences, needs, wishes, and updates on white-board in patient's room (inpatient) and in encounter notes to revisit at subsequent appointments (outpatient) ❖ Use standardized communication protocols (e.g., SBAR) and handoff mnemonics (e.g., I-PASS, I-SWITCH) and encourage others to do the same. ❖ Close the loop: It should not be assumed that a message (e.g., a test result) was sent, or that not hearing anything is meaningful (e.g., not hearing back about a test result should not be indicative that the test was negative). Rather, follow up on all messages to ensure nothing was missed. ❖ Use check-backs: when a message is communicated, the receiver should acknowledge that it was heard and repeat it back. The sender should confirm that the message was heard correctly or correct it if it was not.	❖ Train employees on structured protocols (e.g., SBAR- situation, background, assessment, recommendation) for communicating complex and multifaceted information. Similarly, train employees on handoff pneumonics (I-PASS, I-SWITCH, etc.) to structure handoffs and transitions of care. ❖ Implement occasional unit, department, or organizational meetings where team members discuss what processes or policies facilitate coordination, what processes or policies are hindering coordination, and what new processes or policies could improve coordination. ❖ Host interdepartmental meetings to get employees of different work areas familiar with one another, and to provide a shared forum to discuss upcoming cases that will require interdepartmental coordination. ❖ Consider staffing a role who is responsible for facilitating care coordination with external hospitals, practices, and other healthcare systems for patients who have recently received care elsewhere.	Gittell et al., (2000)[70]; Keebler et al. (2016)[71]; Okhuysen and Bechky (2009)[72]; Petrovic et al. (2012)[73]; Vardaman et al. (2012)[74]

(Continued next page)

TABLE 3. (Continued)

ABC	Example Strategies Team Members and Team Leaders Can Enact	Organizational Conditions and Actions to Facilitate Strategies	Relevant Resources
7. Backup behavior	❖ Consider using friendly buzz-phrases such as "I've got an extra hand" (to offer help) and "Have a free hand?" (to ask for help) to make it easier and less threatening to ask for help/suggest assistance may be needed. ❖ Foster a culture of continuous learning within the team. For example, when conducting a complex or uncommon procedure, bring in available interprofessional team members who are inexperienced in the procedure, regardless if they are a student/trainee or not.	❖ Foster a culture of helping – communicate that it is both ok and expected to ask for and provide backup when needed. ❖ Conduct regular education and in-services and allow team members to communicate what they wish to learn. Include opportunities for clinicians to earn educational credits to further incentivize participation (e.g., Continuing Medical Education credits). ❖ Conduct observations and task analyses to examine workload and determine need for task reallocation between professions (when appropriate).	Kalisch et al. (2009)[75]; Zeller et al. (2011)[76]; Marks, et al. (2002)[77]; Amabile et al. (2014)[78]

The Perfect Medical Team Uses Effective Leadership Models and Behaviors

Team leaders must set goals, delegate tasks, and provide feedback to guide the team toward task accomplishment. Leaders should engage in behaviors such as searching for information, solving problems and balancing workload, and managing personnel and material resources.[89] As previously stated, healthcare teams often have fluid membership, with members joining, leaving, and changing within and between shifts. As such, rather than having a single formal leader, it is useful to train all team members to share the role of leader, where it can be rotated based on task expertise, when appropriate.[90]

The Perfect Medical Team Engages in Team Decision-Making and Planning

Team decision-making and planning entail the intentional inclusion of multiple, interprofessional team members in making decisions about patient care and planning the team's strategy.[91] This includes anticipating the need for change and adjusting team and task work when necessary. This can occur in planned meetings, or within the context of a self-correction method, such as an interprofessional brief or a huddle. Teams that engage in such self-correction behaviors better identify hazards,[92,93] reduce surgical delays,[94] improve team communication,[92] avoid error,[95] and improve subsequent task performance by as much as 25%.[96]

The Perfect Medical Team Coordinates Tasks Within and Between Teams

Coordination is defined as "orchestrating the sequencing and timing of interdependent actions."[16] Meta-analytic evidence suggests that coordination is positively related to team performance.[97] Coordination must occur both within teams (e.g., in a surgical team, an anesthesiologist must confirm the patient is numb before the obstetrician begins a cesarean section), as well as between teams (e.g., the laboratory must test a patient sample and communicate results before a provider can start a patient on an antibiotic).

The Perfect Medical Team Overcomes Barriers to Requesting and Receiving Backup Behavior

Backup behavior involves anticipating team members' needs, balancing workload among team members, providing assistance to team members, or completing tasks for a teammate.[98,99] Backup behavior improves team performance and satisfaction.[97] Backup behavior is essential to facilitate adaptation when team members are lacking experience or are overloaded with responsibilities. In healthcare, there can be a number of barriers to backup behavior, including time constraints, differences in roles and expertise, and team culture.

Table 3 provides strategies to enhance each of the previously mentioned ABCs.

Communication as a Moderator

Communication enables a team to adjust strategies, plans, or actions during rapid, evolving situations with fluctuating demands.[100] Effective communication is the linchpin of teamwork[100]; the need for communication (or lack thereof) exists to successfully enact all of the preceding ABCs. Importantly, team communication *quality,* rather than *frequency*, determines team performance.[101] Standardized communication techniques, such as information exchange protocols (e.g., situation, background, assessment, recommendation, etc.), can improve communication quality by streamlining clear, brief, and complete information exchange(s).[102] Structured protocols are also useful during care transitions[103] (facilitating SMMs and coordination), resulting in fewer errors.[104]

TABLE 4. Types of SMMs with Medical Examples

SMM Type	Subtype	Example
Environment	Physical environment	Is the operating room available if needed? Are there any physical factors (e.g., broken air conditioner, fire alarm testing, etc.) of note and how will they impact our work and patient care?
	Organizational	What is the culture of this organization and of this unit? What are the policies and procedures we follow?
	Equipment	What equipment is available to us? Who knows how to use it? Is there any equipment we will need that is unavailable or out of use?
Task	Task load	What will we be working on today? What does each patient need?
	Patients	Who are we taking care of? What is their condition? Do they have any special considerations? What is the plan for this patient?
	Strategy	In what order will we complete our tasks? Which patient should be seen first? How will we divide up the workload?
Team	Team member expertise	Who is on this team? Do members have the background and experience to complete the necessary tasks?
	Roles	What is everyone's role on this team? How might roles shift within or between performance episodes? Who will lead?
	Staffing	Do we have sufficient staffing to cover our needs? Will we need back up?

Conditions as a Moderator

For adaptation to occur, supportive conditions must promote and value teamwork.[105] Behaviors that are reinforced and rewarded, however subtly, become engrained in day-to-day occurrences within the organization.[106] Conversely, employees will not engage in behaviors that are not reinforced, modeled, or rewarded,[107] especially when and/or if those behaviors are penalized. Thus, although medical team members can strive to optimize the ABCs outlined in the current framework, these efforts will not last unless supportive conditions are present.

DISCUSSION

Our model (Fig. 1) and recommended strategies (Table 3) serve to translate the science of effective teams to enhance medical team adaptation and ultimately patient care. We posited that adaptive medical teams use all of the ABCs described in our model: fostering psychological safety at multiple levels; managing conflict effectively and efficiently; engaging in situation awareness and developing SMMs around the team, task, and environment; using effective leadership models and behaviors; facilitating team decision-making and planning; coordinating tasks within and between teams; and overcoming barriers to requesting and receiving backup. Although other ABCs not of focus in the article may also help move the needle toward team perfection, we posit that effective adaptation is not possible without the elements highlighted in the current model. Thus, we evoke the ABCs in Figure 1 as an essential starting point for improving medical team adaptation.

Our model was derived from (*a*) classic theoretical models of general teamwork, (*b*) models of general team adaptation, (*c*) models of teamwork in healthcare, and (*d*) tools developed to measure healthcare teamwork. As such, our model contains similar elements to many of these, (e.g., *Critical considerations of teamwork*,[17] *Big five of teamwork*,[98] *TeamSTEPPS* framework,[33] *Teamwork in Emergency Medicine* framework[108]). However, our model differs from these and other healthcare teamwork models by developing an IMOI model of *team adaptation specific to medical teams*. Our model delves deeper to describe specific mechanisms and characteristics through which the ideal medical team can adapt to improve patient safety in the context of large and complex healthcare systems. Furthermore, our model deviates from other published models of team adaptation in terms of our lack of inclusion of team member traits. Christian et al. (2017)[109] posits and finds meta-analytic support for personality, cognitive ability, and goal orientation as team inputs. Similarly, Burke et al. (2006)[39] proposes openness to experience (a personality trait) and cognitive ability as inputs to adaptive team performance. We did not include such traits in our model for two reasons: (*a*) they were not typically present in the healthcare-specific models of teamwork we reviewed, and (*b*) team member traits are not under the control of the team (e.g., a team member cannot change his teammates' cognitive ability); thus, they do not lend themselves to actionable strategies in healthcare. In addition, unlike these models, our model largely ignores the relationships between the various processes and emergent states. We have chosen to do this for simplicity, although we acknowledge that there is evidence that there are such interrelationships (e.g., SMMs facilitate coordination, etc.).

Our model aligns with related theories such as collective mindfulness, which states that teams can regulate behavior by being (*a*) preoccupied with failure (notice when things go wrong), (*b*) reluctant to simplify (avoid quick fixes and workarounds), (*c*) be sensitive to operations (avoid automated processes when undesirable), (*d*) commit to bounce back from failure, and (*e*) defer to expertise (give tasks to the right person).[110] These characteristics are similar to some elements in our model (e.g., situation awareness, team leadership, adaptation), although our model takes a broader view of the process of adaptation.

Practical Implications

The model described herein advances knowledge of a specific area of human factors literature, which can and should be considered within the context of patient safety initiatives at large.[15,111] Specifically, this article synthesizes numerous teamwork frameworks, models, and scales and delineates the teamwork components most salient for medical teams to be adaptive. The current model can be used for isolating areas of strength and weakness of medical teams; in this way, teamwork can be improved so that the needle approaches perfection. To assist teams in their development, we present a suite of specific strategies that can be used by frontline healthcare teams and by organizational leadership (Table 3). Any or all of these strategies can help teams improve adaptation. Furthermore, the real-life clinical vignettes in this article can be used to illustrate the principles, motivate team members, and facilitate case-based learning.

One strategy that merits additional attention is teamwork training, because the use of this strategy can simultaneously impact multiple ABCs in our model. Teamwork training is a learning strategy for systematically acquiring teamwork competencies requisite to effective team performance that has been found to be positively associated with improved team performance, task performance, and reduced medical errors.[30] It is essential not to consider team training as a one-stop effort; rather, periodic retraining and refresher training should be provided.[112] Furthermore, organizational and frontline leaders should continuously reinforce use of the trained behaviors on the job.[112]

CONCLUSIONS

In the face of conditions innate to healthcare, no medical team can truly achieve "perfection"; however, medical teams can optimize teamwork ABCs to increase adaptation. We posit that teamwork can be substantially enhanced through the previously mentioned ABCs and the strategies delineated in this article. We conclude by reminding the reader that effective teamwork is a systems issue; that is, teams can only be highly effective and adaptive when in an organization with supportive conditions.

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REFERENCES

1. Binder L. Ignored as an election issue, deaths from medical errors have researchers alarmed. *Forbes*. https://www.forbes.com/sites/leahbinder/2018/11/09/ignored-as-an-election-issue-deaths-from-medical-errors-have-researchers-alarmed/#3210da81653d. Published 2018. Accessed January 15, 2019.
2. Sutcliffe KM. High reliability organizations (HROs). *Best Pract Res Clin Anaesthesiol*. 2011;25:133–144.
3. Aiken LH, Sloane DM, Barnes H, et al. Nurses' and patients' appraisals show patient safety in hospitals remains a concern. *Health Aff*. 2018;37:1744–1751.
4. James J. A new, evidence-based estimate of patient harms associated with hospital care. *J Patient Saf*. 2013;9:122–128.
5. Andel C, Davidow S, Hollander M, et al. The economics of health care quality and medical errors. *J Health Care Finance*. 2012;39:39–50.
6. The Joint Commission. *Sentinel event statistics released for 2014*. 2015. Available at: http://www.jointcommission.org/assets/1/23/jconline_April_29_15.pdf. Accessed January 15, 2019.
7. Rosen MA, DiazGranados D, Dietz AS, et al. Teamwork in healthcare: key discoveries enabling safer, high-quality care. *Am Psychol*. 2018;73:433–450.
8. Salas E, Dickinson T, Converse S, et al Toward an understanding of team performance and training. In: Swezey R, Salas E, eds. *Teams: Their Training and Performance*. Westport, CT: Ablex Publishing; 1992:3–29.
9. Wilson K, Burke C, Priest H, et al. Promoting health care safety through training high reliability teams. *Qual Saf Health Care*. 2005;14:303–309.
10. Salas E, Burke C, Cannon-Bowers J. Teamwork: emerging principles. *Int J Manag Rev*. 2000;2:339–356.
11. Schmutz J, Manser T. Do team processes really have an effect on clinical performance? A systematic literature review. *Br J Anaesth*. 2013;110:529–544.
12. Pronovost PJ, Goeschel CA, Marsteller JA, et al. Framework for patient safety research and improvement. *Circulation*. 2009;119:330–337.
13. Carayon P, Xie A, Kianfar S. Human factors and ergonomics as a patient safety practice. *BMJ Qual Saf*. 2014;23:196–205.
14. Carayon P, Hundt A, Karsh B, et al. Work system design for patient safety: the SEIPS model. *BMJ Qual Saf*. 2006;15(suppl 1):i50–i58.
15. Holden R, Carayon P, Gurses A, et al. SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*. 2013;56:1669–1686.
16. Marks M, Mathieu J, Zaccaro S. A temporally based framework and taxonomy of team processes. *Acad Manag Rev*. 2001;26:356–376.
17. Salas E, Shuffler ML, Thayer AL, et al. Understanding and improving teamwork in organizations: a scientifically based practical guide. *Hum Resour Manag*. 2015;54:599–622.
18. Salas E, Reyes DL, McDaniel SH. The science of teamwork: progress, reflections, and the road ahead. *Am Psychol*. 2018;73:93–600.
19. Andreatta P. A typology for health care teams. *Health Care Manage Rev*. 2010;58:345–354.
20. Zajac S, Gregory ME, Bedwell WL, et al. The cognitive underpinnings of adaptive team performance in ill-defined task situations. *Organ Psychol Rev*. 2013;4:49–73.
21. Fiscella K, Mcdaniel SH. The complexity, diversity, and science of primary care teams. *Am Psychol*. 2018;73:451–467.
22. Ren Y, Kiesler S, Fussell SR. Multiple group coordination in complex and dynamic task environments: interruptions, coping mechanisms, and technology recommendations. *J Manag Inf Syst*. 2008;25:105–130.
23. Kriewaldt J, Davies LM, Rice S, et al Clinical practice in education: towards a conceptual framework. In: *A Companion to Research in Teacher Education*. Singapore: Springer; 2017:153–166.
24. Shapiro SL, Shapiro DE, Schwartz GE. Stress management in medical education: a review of the literature. *Acad Med*. 2000;75:748–759.
25. Konrad TR, Link CL, Shackelton RJ, et al. It's about time: physicians' perceptions of time constraints in primary care medical practice in three national healthcare systems. *Med Care*. 2010;48:95–100.
26. Gopal R, Glasheen JJ, Miyoshi TJ, et al. Burnout and internal medicine resident work-hour restrictions. *Arch Intern Med*. 2005;165:2595–2600.
27. Chou LP, Li CY, Hu SC. Job stress and burnout in hospital employees: comparisons of different medical professions in a regional hospital in Taiwan. *BMJ Open*. 2014;4:e004185.
28. Carayon P, Wooldridge A, Hose B-Z, et al. Challenges and opportunities for improving patient safety through human factors and systems engineering. *Health Aff*. 2018;37:1862–1869.
29. Priest H, Burke C, Munim D, et al. Understanding team adaptability: initial theoretical and practical considerations. *Proc Hum Factors Ergon Soc Annu Meet*. 2002;46:561–565.
30. Hughes AM, Gregory ME, Joseph DL, et al. Saving lives: a meta-analysis of team training in healthcare. *J Appl Psychol*. 2016;101:1266–1304.
31. Baker DP, Day R, Salas E. Teamwork as an essential component of high-reliability organizations. *Health Serv Res*. 2006;41(Pt 2):1576–1598.
32. Gawande A. Big Med. *The New Yorker*. Available at: https://www.newyorker.com/magazine/2012/08/13/big-med. Published 2012. Accessed January 12, 2019.
33. Agency for Healthcare Research and Quality. TeamSTEPPS 2.0. Available at: http://www.ahrq.gov/professionals/education/curriculum-tools/teamstepps/instructor/fundamentals/index.html. Published 2015. Accessed July 5, 2017.
34. Carron A, Brawley L, Widmeyer W. The measurement of cohesiveness in sport groups. *Adv Sport Exerc Psychol Meas*. 1998;23:213–226.
35. Edmondson A. Psychological safety and learning behavior in work teams. *Adm Sci Q*. 1999;44:350–383.
36. Carson JB, Tesluk PE, Marrone JA. Shared leadership in teams: An investigation of antecedent conditions and performance. *Acad Manag J*. 2007;50:1217–1234.

37. Driskell JE, Salas E. Collective behavior and team performance. *Hum Factors*. 1992;34:277–288.
38. Rousseau D, Sitkin S, Burt R, et al. Not so different after all: A cross-discipline view of trust. *Acad Manag Rev.* 1998;23:393–404.
39. Burke CS, Stagl KC, Salas E, et al. Understanding team adaptation: a conceptual analysis and model. *J Appl Psychol*. 2006;91:1189–1207.
40. O'Daniel M, Rosenstein A. Professional communication and team collaboration. In: Hughes R, ed. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville, MD: Agency for Healthcare Research and Quality; 2008:271–284.
41. Ilgen DR, Hollenbeck JR, Johnson M, et al. Teams in organizations: from input-process-output models to IMOI models. *Annu Rev Psychol*. 2005; 56:517–543.
42. Lingard L, Whyte S, Espin S, et al. Towards safer interprofessional communication: constructing a model of "utility" from preoperative team briefings. *J Interprof Care*. 2006;20:471–483.
43. Pronovost PJ, Vohr E. Safe Patients, Smart Hospitals: How One Doctor's Checklist Can Help Us Change Health Care from the inside out. *New York: Plume*. 2011.
44. Canadian Patient Safety Institute. Hospital administration changes and an apology brought meaning to Daniel's life. Available at: http://www.patientsafetyinstitute.ca/english/news/patientsafetynews/pages/hospital-administration-changes-and-an-apology-brought-meaning-to-daniel's-life.aspx. Published 2013. Accessed June 29, 2017.
45. Center for Justice. Stories of malpractice: Virginia's survivors of medical negligence. Available at: http://centerjd.org/system/files/VAmalpracticestoriesF.pdf. Accessed July 5, 2017.
46. Donnelley L. Victims of neglect at the Alexandra Hospital. The Telegraph. Available at: http://www.telegraph.co.uk/news/health/heal-our-hospitals/9763018/Victims-of-neglect-at-the-Alexandra-Hospital.html. Published 2012. Accessed March 26, 2019.
47. Gawande A. *Complications: A Surgeon's Notes on an Imperfect Science*. New York: Picador; 2003.
48. Family sues after man gets wide-awake surgery. NBC News. Available at: http://www.nbcnews.com/id/18040894/ns/health-health_care/t/family-sues-after-man-gets-wide-awake-surgery/#.XFJjWlxKg2y. Published 2007. Accessed March 26, 2019.
49. Chen P. When the doctor is distressed. *The New York Times*. Available at: http://www.nytimes.com/2009/10/01/health/01chen.html. Published 2009. Accessed March 26, 2019.
50. Reader TW, Flin R, Mearns K, et al. Interdisciplinary communication in the intensive care unit. *Br J Anaesth*. 2007;98:347–352.
51. Lingard L, Reznick R, Espin S, et al. Team communications in the operating room: talk patterns, sites of tension, and implications for novices. *Acad Med*. 2002;77:232–237.
52. Eichbaum Q. Collaboration and teamwork in the health professions: Rethinking the role of conflict. *Acad Med*. 2018;93:574–580.
53. Behfar KJ, Peterson RS, Mannix EA, et al. The critical role of conflict resolution in teams: A close look at the links between conflict type, conflict management strategies, and team outcomes. *J Appl Psychol*. 2008;93:170–188.
54. Druskat V, Wolff S. Building the emotional intelligence of groups. *Harv Bus Rev*. 2001;79:80–91.
55. Rogers DA, Lingard L, Boehler ML, et al. Surgeons managing conflict in the operating room: Defining the educational need and identifying effective behaviors. *Am J Surg*. 2013;205:125–130.
56. Gaba DM, Howard SK, Small SD. Situation awareness in anesthesiology. *Hum Factors*. 1995;37:20–31.
57. Michinov E, Olivier-Chiron E, Rusch E, et al. Influence of transactive memory on perceived performance, job satisfaction and identification in anaesthesia teams. *Br J Anaesth*. 2008;100:327–332.
58. Tschan F, Semmer NK, Gurtner A, et al. Explicit reasoning, confirmation bias, and illusory transactive memory. *Small Gr Res*. 2009;40:271–300.
59. Westli HK, Johnsen BH, Eid J, et al. Teamwork skills, shared mental models, and performance in simulated trauma teams: An independent group design. *Scand J Trauma Resusc Emerg Med*. 2010;18:47.
60. Deering S, Rosen MA, Ludi V, et al. On the front lines of patient safety: Implementation and evaluation of team training in Iraq. *Jt Comm J Qual Patient Saf*. 2011;37:350–356.
61. Salas E, Klein C, King H, et al. Debriefing medical teams: 12 evidence-based best practices and tips. *Jt Comm J Qual Patient Saf*. 2008;34: 518–527.
62. Papaspyros SC, Javangula KC, Adluri RKP, et al. Briefing and debriefing in the cardiac operating room. Analysis of impact on theatre team attitude and patient safety. *Interact Cardiovasc Thorac Surg*. 2010;10:43–47.
63. Paull DE, Mazzia LM, Izu BS, et al. Predictors of successful implementation of preoperative briefings and postoperative debriefings after medical team training. *Am J Surg*. 2009;198:675–678.
64. Schmutz JB, Eppich WJ. Promoting learning and patient care through shared reflection: A conceptual framework for team reflexivity in health care. *Acad Med*. 2017;92:1555–1563.
65. Schramm GE, Kashyap R, Mullon JJ, et al. Septic shock: A multidisciplinary response team and weekly feedback to clinicians improve the process of care and mortality. *Crit Care Med*. 2011;39: 252–258.
66. Tannenbaum SI, Cerasoli CP. Do team and individual debriefs enhance performance? A meta-analysis. *Hum Factors*. 2013;55:231–245.
67. Lacerenza CN, Marlow SL, Tannenbaum SI, et al. Team development interventions: Evidence-based approaches for improving teamwork. *Am Psychol*. 2018;73:517–531.
68. Baghbanian A, Hughes I, Kebriaei A, et al. Adaptive decision-making: how Australian healthcare managers decide. *Aust Heal Rev*. 2012;36: 49–56.
69. Legare F, Stacey D, Briere N, et al. Healthcare providers' intentions to engage in an interprofessional approach to shared decision-making in home care programs: a mixed methods study. *J Interprof Care*. 2013;27: 214–222.
70. Gittell JH, Fairfield KM, Bierbaum B, et al. Impact of relational coordination on quality of care, postoperative pain and functioning, and length of stay: A nine-hospital study of surgical patients. *Med Care*. 2000; 38:807–819.
71. Keebler JR, Lazzara EH, Patzer BS, et al. Meta-analyses of the effects of standardized handoff protocols on patient, provider, and organizational outcomes. *Hum Factors*. 2016;58:1187–1205.
72. Okhuysen G, Bechky B. Coordination in organizations: an integrative perspective. *Acad Manag Ann*. 2009;3:463–502.
73. Petrovic MA, Aboumatar H, Baumgartner WA, et al. Pilot implementation of a perioperative protocol to guide operating room-to-intensive care unit patient handoffs. *J Cardiothorac Vasc Anesth*. 2012;26:11–16.
74. Vardaman JM, Cornell P, Gondo MB, et al. Beyond communication: The role of standardized protocols in a changing health care environment. *Health Care Manage Rev*. 2012;37:88–97.
75. Kalisch B, Weaver S, Salas E. What does nursing teamwork look like? A qualitative study. *J Nurs Care Qual*. 2009;24:298–307.
76. Zeller EL, Doutrich D, Guido GW, et al. A culture of mutual support: Discovering why new nurses stay in nursing. *J Contin Educ Nurs*. 2011; 42:409–414.
77. Marks MA, Sabella MJ, Burke CS, et al. The impact of cross-training on team effectiveness. *J Appl Psychol*. 2002;87:3–13.
78. Amabile T, Fisher CM, Pillemer J. IDEO's culture of helping. *Harv Bus Rev*. 2014;92:54–61.

79. Nembhard IM, Edmondson A. Making it safe: the effects of leaders inclusiveness and professional status on psychological safety and improvement efforts in health care teams. *J Organ Behav*. 2006;27: 941–966.
80. Appelbaum NP, Dow A, Mazmanian PE, et al. The effects of power, leadership and psychological safety on resident event reporting. *Med Educ*. 2016;50:343–350.
81. Smith ME, Wells EE, Friese CR, et al. Interpersonal and organizational dynamics are key drivers of failure to rescue. *Health Aff*. 2018;37: 1870–1876.
82. Jehn KA. A multimethod examination of the benefits and detriments of intragroup conflict. *Adm Sci Q*. 1995;40:256–282.
83. Langford CP, Bowsher J, Maloney JP, et al. Social support: a conceptual analysis. *J Adv Nurs*. 1997;25:95–100.
84. Rogers DA, Lingard L, Boehler ML, et al. Surgeons managing conflict in the operating room: defining the educational need and identifying effective behaviors. *Am J Surg*. 2013;205:125–130.
85. Lyndon A, Zlatnik MG, Maxfield DG, et al. Contributions of clinical disconnections and unresolved conflict to failures in intrapartum safety. *J Obstet Gynecol Neonatal Nurs*. 2014;43:2–12.
86. Floren LC, Donesky D, Whitaker E, et al. Are we on the same page? Shared mental models to support clinical teamwork among health professions learners: a scoping review. *Acad Med*. 2018;93:498–509.
87. Converse S, Kahler S. *Knowledge Acquisition and the Measurement of Shared Mental Models*. Orlando, FL: Naval Training Systems Center; 1992.
88. Gaba DM, Howard SK, Small SD. Situation awareness in anesthesiology. *Hum Factors*. 1995;37:20–31.
89. Fleishman E, Zaccaro S, Mumford M. Individual differences and leadership: an overview. *Leadersh Q*. 1991;2:237–243.
90. Salas E, Zajac S, Marlow SL. Transforming health care one team at a time: ten observations and the trail ahead. *Gr Organ Manag*. 2018;43:357–381.
91. Legare F, Stacey D, Briere N, et al. Healthcare providers' intentions to engage in an interprofessional approach to shared decision-making in home care programs: a mixed methods study. *J Interprof Care*. 2013;27:214–222.
92. Hicks CW, Rosen M, Hobson DB, et al. Improving safety and quality of care with enhanced teamwork through operating room briefings. *JAMA Surg*. 2014;149:863–868.
93. Shunk R, Dulay M, Chou CL, et al. Huddle-coaching: a dynamic intervention for trainees and staff to support team-based care. *Acad Med*. 2014;89:244–250.
94. Nundy S, Mukherjee A, Sexton JB, et al. Impact of preoperative briefings on operating room delays: a preliminary report. *Arch Surg*. 2008;143: 1068–1072.
95. Deering S, Rosen MA, Ludi V, et al. On the front lines of patient safety: implementation and evaluation of team training in Iraq. *Jt Comm J Qual Patient Saf*. 2011;37:350–356.
96. Tannenbaum SI, Cerasoli CP. Do team and individual debriefs enhance performance? A meta-analysis. *Hum Factors*. 2013;55:231–245.
97. LePine J, Piccolo R, Jackson C, et al. A meta-analysis of teamwork processes: tests of a multidimensional model and relationships with team effectiveness criteria. *Pers Psychol*. 2008;61:273–307.
98. Salas E, Sims D, Burke C. Is there a "big five" in teamwork? *Small Gr Res*. 2005;36:555–599.
99. 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.
100. Salas E, Wilson K, Murphy C, et al. Communicating, coordinating, and cooperating when lives depend on it: tips for teamwork. *Jt Comm J Qual Patient Saf*. 2008;34:333–341.
101. Marlow S, Lacerenza C, Paoletti J, et al. Does team communication represent a one-size-fits-all approach?: a meta-analysis of team communication and performance. *Organ Behav Hum Decis Process*. 2017;144:145–170.
102. Vardaman JM, Cornell P, Gondo MB, et al. Beyond communication: the role of standardized protocols in a changing health care environment. *Health Care Manage Rev*. 2012;37:88–97.
103. Keebler JR, Lazzara EH, Patzer BS, et al. Meta-analyses of the effects of standardized handoff protocols on patient, provider, and organizational outcomes. *Hum Factors*. 2016;58:1187–1205.
104. Petrovic MA, Aboumatar H, Baumgartner WA, et al. Pilot implementation of a perioperative protocol to guide operating room-to-intensive care unit patient handoffs. *J Cardiothorac Vasc Anesth*. 2012;26:11–16.
105. Hackman J. *Groups That Work (and Those That Don't): Creating Conditions for Effective Teamwork*. San Francisco, CA: Jossey-Bass; 1990.
106. Tracey J, Tannenbaum SI, Kavanagh M. Applying trained skills on the job: the importance of the work environment. *J Appl Psychol*. 1995;80: 239–252.
107. King H, Harden S. Sustainment of teamwork. In: Salas E, Frush K, Baker DP, et al, eds. *Improving Patient Safety Through Teamwork and Team Training*. New York: Oxford; 2013:188–200.
108. Fernandez R, Kozlowski S, Shapiro M, et al. Toward a definition of teamwork in emergency medicine. *Acad Emerg Med*. 2008;15: 1104–1112.
109. Christian J, Christian M, Pearsall M, et al. Team adaptation in context: an integrated conceptual model and meta-analytic review. *Organ Behav Hum Decis Process*. 2017;140(suppl C):62–89.
110. Weick K, Sutcliffe K, Obstfeld D. Organizing for high reliability: processes of collective mindfulness. *Cris Manag*. 2008;3:81–123.
111. Shekelle PG, Pronovost PJ, Wachter RM, et al. The top patient safety strategies that can be encouraged for adoption now. *Ann Intern Med*. 2013;158(Pt 2):365–368.
112. Gregory M, Feitosa J, Driskell T, et al Designing, delivering, and evaluating team training in organizations: principles that work. In: Salas E, Tannenbaum S, Cohen D, et al, eds. *Developing and Enhancing Teamwork in Organizations*. San Francisco, CA: Jossey-Bass; 2013: 441–487.

Appendix A: List of Models, Frameworks, and Measures Used in Development of Model

Models/Frameworks Coded

General: Teamwork

1. Input–throughput–output model of team adaptation[1]
2. Work group effectiveness model[2]
3. Model of the team adaptive process in context[3]
4. Taxonomy of team processes[4]
5. Model of team/group effectiveness[5]
6. Big five of teamwork[6]
7. Critical considerations of teamwork[7]
8. Cognitive framework of adaptive team performance in ill-defined task situations[8]

Healthcare-Specific

9. TeamSTEPPS framework[9]
10. The InQuIRe framework in primary care[10]
11. Teamwork effectiveness assessment model (TEAM)[11]
12. List of healthcare team training competencies[12]
13. Framework of ICU team performance[13]
14. Teamwork in Emergency Medicine framework[14]
15. Labor and delivery unit team skills[15]
16. Framework of collaboration between healthcare teams and community health workers[16]
17. Unnamed framework of teamwork and team interventions in chronic care[17]
18. List from systematic review of teamwork and patient safety in healthcare[18]
19. Themes from review of facilitators and barriers influencing collaboration and teamwork between general practice practitioners and nurses[19]
20. Framework of team collaboration in pediatric rehabilitation[20]
21. Integrated model of team effectiveness for patient safety in healthcare[21]
22. Integrative framework of teamwork, clinician occupational well-being and patient safety in hospital settings[22]
23. Framework of workplace safety structure/high reliability organizations/high reliability teams[23]

Measures Coded

24. Scales to measure organisational features of acute hospital wards[24]
25. Unnamed[25]
26. Unnamed[26]
27. CARDIOTEAM checklist[27]
28. Nurse/physician interaction survey[28]
29. The Interprofessional Collaborative Competency Attainment Survey (ICCAS)[29]
30. Collaboration and satisfaction about care decisions[30]
31. Unnamed[31]
32. Unnamed[32]
33. Team Decision Making Questionnaire (TMDQ)[33]
34. Unnamed[34]
35. Unnamed[35]
36. Unnamed[36]
37. Team performance during simulated crisis incident (TPDSCI) and CRM checklist[37]
38. Kalamazoo essential elements communication skills[38]
39. Leadership and Team Behavior Management Tool[39]
40. Unnamed[40]
41. Teamwork effectiveness assessment model (TEAM)[11]
42. Unnamed[41]
43. Team emergency assessment measure (TEAM)[42]
44. Communication Competency Questionnaire[43]
45. Emergency Team Dynamics (ETD) scale[43]
46. Adapted Leadership Behaviour Description Questionnaire (Initiating Structure)[44]
47. Unnamed[45]

48. Unnamed[46]
49. Checklist of Expected Actions[47]
50. Safety climate measure[48]
51. Team effectiveness scale[49]
52. Unnamed[50]
53. Team Member Verbalization[51]
54. Teamwork and patient care measure[52]
55. Unnamed[53]
56. Anesthetists' Non-Technical Skills (ANTS) behavioral marker system[54]
57. Assessment of emergency physicians' non-technical skills[55]
58. Communication and teamwork skills assessment (CATS)[56]
59. Unnamed[57]
60. Relational Coordination Scale[58]
61. Resuscitation Team Leader Evaluation[59]
62. Unnamed[60]
63. Clinical teamwork scale (CTS)[61]
64. Team behavior during trauma resuscitation[62]
65. The Observational Teamwork Assessment for Surgery (OTAS)[63]
66. Attitude Toward Health Care Teams[64]
67. Patients' Insights and Views Observing Teams (PIVOT) Questionnaire[65]
68. Jefferson Scale of Attitudes Toward Nurse-Physician Collaboration[66]
69. Scale of Attitudes Towards Physician– Pharmacist Collaboration (SATP2C)[67]
70. Trauma team evaluation tool[68]
71. Collaborative Healthcare Interdisciplinary Relationship Planning (CHIRP) Scale[69]
72. Unnamed[70]
73. Unnamed[71]
74. Trainee test of team dynamics[72]
75. Nursing Teamwork Survey (NTS)[73]
76. Adapted version of Nurses' Opinion Questionnaire (NOQ) of the Ward Organisational Features Scales[74]
77. Clinical emergency preparedness team evaluation (CEPTE)[75]
78. The Teamwork Assessment Scale (TAS)[76]
79. Ottawa CRM global rating scale[77]
80. The Interprofessional Socialization and Valuing Scale (ISVS)[78]
81. Multidisciplinary Team Performance Tool[79]
82. The Imperial Paediatric Emergency Training Toolkit (IPETT)[80]
83. Unnamed team processes for multidisciplinary teams[81]
84. Value of teams survey[82]
85. Unnamed[83]
86. Unnamed[84]
87. Unnamed[85]
88. Working as a Team section of the VA All Staff Survey[86]
89. Nurse Anesthetists' Non-Technical Skills (N-ANTS)[87]
90. Unnamed[88]
91. Unnamed[89]
92. Mayo high performance teamwork scale[90]
93. Unnamed[91]
94. Unnamed[92]
95. Unnamed[93]
96. The Team Survey[94]
97. Unnamed[95]
98. The Oxford Non-Technical Skills (NOTECHS)[96]
99. Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS)[97]
100. Situation awareness global assessment technique (SAGAT)[98]
101. Global Rating Scale[99]

102. Assessment of Obstetric Team Performance (AOTP) and Global AOTP (GAOTP)[100]
103. Unnamed[101]
104. Template Analysis Approach[102]
105. Unnamed[103]
106. The Team Climate Assessment Measurement (TCAM)[104]
107. Unnamed (self-efficacy for interprofessional collaboration)[105]
108. Interprofessional Attitudes Scale (IPAS)[106]
109. Unnamed[107]
110. Perception of Interprofessional Collaboration Questionnaire (PINCOM-Q)[108]
111. Teamwork Mini-Clinical Evaluation Exercise (T-MEX)[109]
112. Assessment of Interprofessional Team Collaboration Scale (AITCS)[110]
113. Technical and non-technical rating scale for septic shock[111]
114. Operating room teamwork assessment scale (ORTAS)[112]
115. Self-efficacy for targeted team-based competencies in an actual OR environment[113]
116. Edinburgh Basic Surgical Training Assessment Form (EBSTAF)[114]
117. Assessment of Pediatric Resuscitation Communication Leader Assessment (APRC-LA)/Trauma team communication assessment (TTCA)[115]
118. Readiness of Health Care Students for Interprofessional Learning (RIPLS)[116]
119. Unnamed[117]
120. Unnamed[118]
121. Teamwork leadership interpersonal skills (TLIS) and Emergency clinical care skills (ECCS)[119]
122. Emergency medical technician personnel teamwork scale[120]
123. UWE Entry Level Interprofessional Questionnaire, ELIQ[121]
124. Unnamed[122]
125. Simulation Team Assessment Tool (STAT)[123]
126. Unnamed[124]
127. The Oxford Non-Technical Skills (NOTECHS) II[125]
128. Unnamed[126]
129. Collaborative Practice Assessment Tool (CPAT)[127]
130. Unnamed[128]
131. Unnamed[129]
132. Teamwork climate scale of Safety Attitudes Questionnaire (SAQ) and behavioral observations[130]
133. ICU nurse-physician questionnaire[131]
134. Unnamed[132]
135. KidSIM Team Performance Scale[133]
136. KidSIM Attitude Toward Teamwork in Training Undergoing Designed Education Simulation (ATTITUDES) Questionnaire[134]
137. Primary Care Team Dynamics Survey[135]
138. Hospital survey on patient safety culture[136]
139. Modified NOTECHS for trauma: T-NOTECHS[137]
140. Unnamed[138]
141. Team Development Measure (TDM)[139]
142. Team functioning survey[140]
143. Unnamed[141]
144. Multidisciplinary team observational assessment rating scale (MDT-OARS)[142]
145. Team Evaluation and Assessment Measure (TEAM) [143]
146. Interdisciplinary Team Performance Scale (ITPS)[144]
147. Team Performance Scale (TPS)[145]
148. Unnamed[146]
149. Unnamed[147]
150. Healthcare Team Vitality Instrument[148]
151. Nurse-Physician Collaboration Scale (NPCS)[149]
152. Unnamed[150]
153. Group effectiveness[151]
154. Multisource feedback[152]

155. Unnamed[153]
156. Unnamed[154]
157. Observational tool based on the ten key behavioral skills for teams developed by the Center for Advanced Pediatric and Perinatal Education (CAPE)[155]
158. Observational Skill-based Clinical Assessment tool for Resuscitation (OSCAR)[156]
159. Emergency medicine crisis resource management (EMCRM)[157]
160. Operating Team Resource Management Survey (OTRMS)[157]
161. Unnamed[158]
162. Unnamed[159]
163. Observational rating tool for multidisciplinary critical care teams/Team behavioral rater (TBR)[160]
164. SNAPPI pre-defined scoring rubric[161]
165. Group Development Questionnaire (GDQ)[162]
166. Unnamed[163]
167. Unnamed[164]
168. Behaviorally anchored Team Skill Rating Scale[165]
169. Non-technical Skills for Surgeons (NOTSS) Rating Scale[166]

REFERENCES

1. Burke CS, Stagl KC, Salas E, et al. Understanding team adaptation: a conceptual analysis and model. *J Appl Psychol.* 2006;91:1189.
2. Campion MA, Medsker GJ, Higgs AC. Relations between work group characteristics and effectiveness: implications for designing effective work groups. *Pers Psychol.* 1993;46:823–847.
3. Christian JS, Christian MS, Pearsall MJ, et al. Team adaptation in context: an integrated conceptual model and meta-analytic review. *Organ Behav Hum Decis Process.* 2017;140:62–89.
4. Marks MA, Mathieu JE, Zaccaro SJ. A temporally based framework and taxonomy of team processes. *Acad Manage Rev.* 2001;26:356–376.
5. Hackman JR. *A normative model of work team effectiveness.* Arlington, VA: Office of Naval Research; 1983.
6. Salas E, Sims DE, Burke CS. Is there a "big five" in teamwork? Small Group Res. 2005;36:555–599.
7. Salas E, Shuffler ML, Thayer AL, et al. Understanding and improving teamwork in organizations: a scientifically based practical guide. *Hum Resour Manag.* 2015;54:599–622.
8. Zajac S, Gregory ME, Bedwell WL, et al. The cognitive underpinnings of adaptive team performance in ill-defined task situations: a closer look at team cognition. *Organ Psychol Rev.* 2014;4:49–73.
9. Agency for Healthcare Research and Quality. TeamSTEPPS 2.0. Available at: http://www.ahrq.gov/professionals/education/curriculum-tools/teamstepps/instructor/fundamentals/index.html. Published 2015. Accessed July 5, 2017.
10. Brennan SE, Bosch M, Buchan H, et al. Measuring team factors thought to influence the success of quality improvement in primary care: a systematic review of instruments. *Implement Sci.* 2013;8:1.
11. Chesluk BJ, Bernabeo E, Hess B, et al. A new tool to give hospitalists feedback to improve interprofessional teamwork and advance patient care. *Health Aff.* 2012;31:2485–2492.
12. Clay-Williams R, Braithwaite J. Determination of health-care teamwork training competencies: a delphi study. *Int J Qual Health Care.* 2009;21:433–440.
13. Dietz AS, Pronovost PJ, Mendez-Tellez PA, et al. A systematic review of teamwork in the intensive care unit: what do we know about teamwork, team tasks, and improvement strategies? J Crit Care. 2014;29:908–914.
14. Fernandez R, Kozlowski SW, Shapiro MJ, et al. Toward a definition of teamwork in emergency medicine. *Acad Emerg Med.* 2008;15:1104–1112.
15. Fialkow MF, Adams CR, Carranza L, et al. An in situ standardized patient-based simulation to train postpartum hemorrhage and team skills on a labor and delivery unit. *Simul Healthc.* 2014;9:65–71.
16. Franklin CM, Bernhardt, J. M., Lopez, R. P., Long-Middleton, E. R., Davis, S. Interprofessional teamwork and collaboration between community health workers and healthcare teams: an integrative review. *Health Serv Res Manag Epidemiol.* 2015;2:1–9.
17. Körner M, Bütof S, Müller C, et al. Interprofessional teamwork and team interventions in chronic care: a systematic review. *J Interprof Care.* 2016;30:15–28.
18. Manser T. Teamwork and patient safety in dynamic domains of healthcare: a review of the literature. *Acta Anaesthesiol Scand.* 2009;53:143–151.
19. McInnes S, Peters K, Bonney A, et al. An integrative review of facilitators and barriers influencing collaboration and teamwork between general practitioners and nurses working in general practice. *J Adv Nurs.* 2015;71:1973–1985.
20. Nijhuis BJ, Reinders-Messelink HA, de Blécourt AC, et al. A review of salient elements defining team collaboration in paediatric

rehabilitation. *Clin Rehabil.* 2007;21:195–211.
21. Weaver SJ, Feitosa J, Salas E, et al. The theoretical drivers and models of team performance and effectiveness for patient safety. 2012.
22. Welp A, Manser T. Integrating teamwork, clinician occupational well-being and patient safety–development of a conceptual framework based on a systematic review. *BMC Health Serv Res.* 2016;16:281.
23. Wilson KA, Burke CS, Priest HA, et al. Promoting health care safety through training high reliability teams. *BMJ Qual Saf.* 2005;14:303-309.
24. Adams A, Bond S, Arber S. Development and validation of scales to measure organisational features of acute hospital wards. *Int J Nurs Stud.* 1995;32:612–627.
25. Al-Hakim L. The impact of preventable disruption on the operative time for minimally invasive surgery. *Surg Endosc.* 2011;25:3385.
26. Alken A, Tan E, Luursema JM, et al. Feedback activities of instructors during a trauma surgery course. *Am J Surg.* 2013;206: 599–604.
27. Andersen PO, Jensen MK, Lippert A, et al. Development of a formative assessment tool for measurement of performance in multiprofessional resuscitation teams. *Resuscitation.* 2010;81:703–711.
28. Anderson A. Nurse-physician interaction and job satisfaction. *J Nurs Manag.* 1996;27:33.
29. Archibald D, Trumpower D, MacDonald CJ. Validation of the Interprofessional Collaborative Competency Attainment Survey (ICCAS). *J Interprof Care.* 2014;28:553–558.
30. Gedney Baggs J. Development of an instrument to measure collaboration and satisfaction about care decisions. *J Adv Nurs.* 1994;20:176–182.
31. Barach P, Johnson JK, Ahmad A, et al. A prospective observational study of human factors, adverse events, and patient outcomes in surgery for pediatric cardiac disease. *J Thorac Cardiovasc Surg.* 2008;136:1422–1428.
32. Bateman B, Colin Wilson F, Bingham D. Team effectiveness–development of an audit questionnaire. *J Manag Dev.* 2002;21: 215–226.
33. Batorowicz B, Shepherd TA. Measuring the quality of transdisciplinary teams. *J Interprof Care.* 2008;22:612–620.
34. Berrisford RG, Wilson IH, Davidge M, et al. Surgical time out checklist with debriefing and multidisciplinary feedback improves venous thromboembolism prophylaxis in thoracic surgery: a prospective audit. *Eur J Cardiothorac Surg.* 2011;41:1326–1329.
35. Braaf S, Manias E, Riley R. The 'time-out'procedure: an institutional ethnography of how it is conducted in actual clinical practice. *BMJ Qual Saf.* 2013;22:647–655.
36. Burtscher MJ, Wacker J, Grote G, et al. Managing nonroutine events in anesthesia: the role of adaptive coordination. *Hum Factors.* 2010;52:282–294.
37. Calhoun AW, Boone M, Miller KH, et al. A multirater instrument for the assessment of simulated pediatric crises. *J Grad Med Educ.* 2011;3:88–94.
38. Calhoun AW, Rider EA, Meyer EC, et al. Assessment of communication skills and self-appraisal in the simulated environment: feasibility of multirater feedback with gap analysis. *Simul Healthc.* 2009;4:22–29.
39. Carlson J, Min E, Bridges D. The impact of leadership and team behavior on standard of care delivered during human patient simulation: a pilot study for undergraduate medical students. *Teach Learn Med.* 2009;21:24–32.
40. Catchpole KR, Giddings A, De Leval M, et al. Identification of systems failures in successful paediatric cardiac surgery. *Ergonomics.* 2006;49:567–588.
41. Christian CK, Gustafson ML, Roth EM, et al. A prospective study of patient safety in the operating room. *Surgery.* 2006;139: 159–173.
42. Cooper S, Cant R, Porter J, et al. Rating medical emergency teamwork performance: development of the Team Emergency Assessment Measure (TEAM). *Resuscitation.* 2010;81:446–452.
43. Cooper S, O'carroll J, Jenkin A, et al. Collaborative practices in unscheduled emergency care: role and impact of the emergency care practitioner—quantitative findings. *Emerg Med J.* 2007;24:630–633.
44. Cooper S, Wakelam A. Leadership of resuscitation teams: 'Lighthouse leadership.' Resuscitation. 1999;42:27–45.
45. Copnell B, Johnston L, Harrison D, et al. Doctors' and nurses' perceptions of interdisciplinary collaboration in the NICU, and the impact of a neonatal nurse practitioner model of practice. *J Clin Nurs.* 2004;13:105–113.
46. Cunningham S, Chellali A, Jaffre I, et al. Effects of experience and workplace culture in human-robot team interaction in robotic surgery: a case study. *Int J Soc Robot.* 2013;5:75–88.
47. Daniels K, Lipman S, Harney K, et al. Use of simulation based team training for obstetric crises in resident education. *Simul Healthc.* 2008;3:154–160.
48. De Wet C, Spence W, Mash R, et al. The development and psychometric evaluation of a safety climate measure for primary care. *Qual Saf Health Care.* 2010;19:578–584.
49. El Ansari W, Lyubovnikova J, Middleton H, et al. Development and psychometric evaluation of a new team effectiveness scale for all

types of community adult mental health teams: a mixed-methods approach. *Health Soc Care Community.* 2016;24:309–320.
50. ElBardissi AW, Wiegmann DA, Henrickson S, et al. Identifying methods to improve heart surgery: an operative approach and strategy for implementation on an organizational level. *Eur J Cardiothorac Surg.* 2008;34:1027–1033.
51. Fernandez Castelao E, Russo SG, Cremer S, et al. Positive impact of crisis resource management training on no-flow time and team member verbalisations during simulated cardiopulmonary resuscitation: a randomised controlled trial. *Resuscitation.* 2011;82: 1338–1343.
52. Fernandez R, Pearce M, Grand JA, et al. Evaluation of a computer-based educational intervention to improve medical teamwork and performance during simulated patient resuscitations. *Crit Care Med.* 2013;41:2551–2562.
53. Fisher J, Lotery H, Henderson C. Time in motion—testing efficiency in the dermatology procedure setting. *Dermatol Surg.* 2009; 35:437–445.
54. Fletcher G, Flin R, McGeorge P, et al. Anaesthetists' Non-Technical Skills (ANTS): evaluation of a behavioural marker system. *Br J Anaesth.* 2003;90:580–588.
55. Flowerdew L, Brown R, Vincent C, et al. Development and validation of a tool to assess emergency physicians' nontechnical skills. *Ann Emerg Med.* 2012;59:376–385. e374.
56. Frankel A, Gardner R, Maynard L, et al. Using the Communication and Teamwork Skills (CATS) assessment to measure health care team performance. *Jt Comm J Qual Patient Saf.* 2007;33:549–558.
57. Friesen LD, Vidyarthi AR, Baron RB, et al. Factors associated with intern fatigue. *J Gen Intern Med.* 2008;23:1981–1986.
58. Hoffer Gittell J. Coordinating mechanisms in care provider groups: relational coordination as a mediator and input uncertainty as a moderator of performance effects. *Manage Sci.* 2002;48:1408–1426.
59. Grant EC, Grant VJ, Bhanji F, et al. The development and assessment of an evaluation tool for pediatric resident competence in leading simulated pediatric resuscitations. *Resuscitation.* 2012;83:887–893.
60. Greenberg JA, Irani JL, Greenberg CC, et al. The ACGME competencies in the operating room. *Surgery.* 2007;142:180–184.
61. Guise J-M, Deering SH, Kanki BG, et al. Validation of a tool to measure and promote clinical teamwork. *Simul Healthc.* 2008;3:217–223.
62. Hamilton N, Freeman BD, Woodhouse J, et al. Team behavior during trauma resuscitation: a simulation-based performance assessment. *J Grad Med Educ.* 2009;1:253–259.
63. Healey A, Undre S, Vincent C. Developing observational measures of performance in surgical teams. *BMJ Qual Saf.* 2004;13: i33–i40.
64. Heinemann GD, Schmitt MH, Farrell MP, et al. Development of an attitudes toward health care teams scale. *Eval Health Prof.* 1999;22:123–142.
65. Henry B, Rooney D, Eller S, et al. What patients observe about teamwork in the emergency department: development of the pivot questionnaire. *J Participat Med.* 2013;5:e4.
66. Hojat M, Fields SK, Veloski JJ, et al. Psychometric properties of an attitude scale measuring physician-nurse collaboration. *Eval Health Prof.* 1999;22:208–220.
67. Hojat M, Gonnella JS. An instrument for measuring pharmacist and physician attitudes towards collaboration: preliminary psychometric data. *J Interprof Care.* 2011;25:66–72.
68. Holcomb JB, Dumire RD, Crommett JW, et al. Evaluation of trauma team performance using an advanced human patient simulator for resuscitation training. *J Trauma.* 2002;52:1078–1086.
69. Hollar D, Hobgood C, Foster B, et al. Concurrent validation of chirp, a new instrument for measuring healthcare student attitudes towards interdisciplinary teamwork. *J Appl Meas.* 2012;13:360–375.
70. Hope JM, Lugassy D, Meyer R, et al. Bringing interdisciplinary and multicultural team building to health care education: the downstate team-building initiative. *Acad Med.* 2005;80:74–83.
71. Hu YY, Arriaga AF, Roth EM, et al. Protecting patients from an unsafe system: the etiology & recovery of intra-operative deviations in care. *Ann Surg.* 2012;256:203.
72. Hyer K, Skinner JH, Kane RL, et al. Using scripted video to assess interdisciplinary team effectiveness training outcomes. *Gerontol Geriatr Educ.* 2004;24:75–91.
73. Kalisch BJ, Lee H, Salas E. The development and testing of the nursing teamwork survey. *Nurs Res.* 2010;59:42–50.
74. Kenaszchuk C, Reeves S, Nicholas D, et al. Validity and reliability of a multiple-group measurement scale for interprofessional collaboration. *BMC Health Serv Res.* 2010;10:83.
75. Kennedy JL, Jones SM, Porter N, et al. High-fidelity hybrid simulation of allergic emergencies demonstrates improved preparedness for office emergencies in pediatric allergy clinics. *J Allergy Clin Immunol Pract.* 2013;1:608–617. e614.
76. Kiesewetter J, Fischer MR. The teamwork assessment scale: a novel instrument to assess quality of undergraduate medical students' teamwork using the example of simulation-based ward-rounds. *GMS Z Med Ausbild.* 2015;32.

77. Kim J, Neilipovitz D, Cardinal P, et al. A pilot study using high-fidelity simulation to formally evaluate performance in the resuscitation of critically ill patients: the University of Ottawa Critical Care Medicine, High-Fidelity Simulation, and Crisis Resource Management I Study. *Crit Care Med.* 2006;34:2167–2174.
78. King G, Shaw L, Orchard CA, et al. The interprofessional socialization and valuing scale: a tool for evaluating the shift toward collaborative care approaches in health care settings. *Work.* 2010;35:77–85.
79. Lamb BW, Wong HW, Vincent C, et al. Teamwork and team performance in multidisciplinary cancer teams: development and evaluation of an observational assessment tool. *BMJ Qual Saf.* 2011;20:849–856.
80. Lambden S, DeMunter C, Dowson A, et al. The Imperial Paediatric Emergency Training Toolkit (IPETT) for use in paediatric emergency training: development and evaluation of feasibility and validity. *Resuscitation.* 2013;84:831–836.
81. Landry A, Erwin C. Perspectives on multidisciplinary team processes among healthcare executives: processes that facilitate team effectiveness. *J Health Hum Serv Adm.* 2015:350–380.
82. Levine RE, O'Boyle M, Haidet P, et al. Transforming a clinical clerkship with team learning. *Teach Learn Med.* 2004;16:270–275.
83. Lingard L, Espin S, Whyte S, et al. Communication failures in the operating room: an observational classification of recurrent types and effects. *BMJ Qual Saf.* 2004;13:330–334.
84. Lingard L, Regehr G, Orser B, et al. Evaluation of a preoperative checklist and team briefing among surgeons, nurses, and anesthesiologists to reduce failures in communication. *Arch Surg.* 2008;143:12–17.
85. Lingard L, Reznick R, Espin S, et al. Team communications in the operating room: talk patterns, sites of tension, and implications for novices. *Acad Med.* 2002;77:232–237.
86. Lukas CV, Mohr DC, Meterko M. Team effectiveness and organizational context in the implementation of a clinical innovation. *Qual Manag Health Care.* 2009;18:25–39.
87. Lyk-Jensen HT, Jepsen RMHG, Spanager L, et al. Assessing nurse anaesthetists' non-technical skills in the operating room. *Acta Anaesthesiol Scand.* 2014;58:794–801.
88. MacDonnell CP, Rege SV, Misto K, et al. An introductory interprofessional exercise for healthcare students. *Am J Pharm Educ.* 2012;76:154.
89. Mackenzie CF, Horst RL, Mahaffey DL, et al. Group decision-making during trauma patient resuscitation and anesthesia. Paper presented at: Proceedings of the Human Factors and Ergonomics Society Annual Meeting. Seattle, Washington; October 11–15, 1993.
90. Malec JF, Torsher LC, Dunn WF, et al. The mayo high performance teamwork scale: reliability and validity for evaluating key crew resource management skills. *Simul Healthc.* 2007;2:4–10.
91. Marshall NE, Vanderhoeven J, Eden KB, et al. Impact of simulation and team training on postpartum hemorrhage management in non-academic centers. *J Matern Fetal Neonatal Med.* 2015;28:495–499.
92. Mâsse LC, Moser RP, Stokols D, et al. Measuring collaboration and transdisciplinary integration in team science. *Am J Prev Med.* 2008;35:S151–S160.
93. Meurling L, Hedman L, Felländer-Tsai L, et al. Leaders' and followers' individual experiences during the early phase of simulation-based team training: an exploratory study. *BMJ Qual Saf.* 2013;22:459–467.
94. Millward LJ, Jeffries N. The team survey: a tool for health care team development. *J Adv Nurs.* 2001;35:276–287.
95. Minehart RD, Pian-Smith MC, Walzer TB, et al. Speaking across the drapes: communication strategies of anesthesiologists and obstetricians during a simulated maternal crisis. *Simul Healthc.* 2012;7:166–170.
96. Mishra A, Catchpole K, McCulloch P. The Oxford NOTECHS System: reliability and validity of a tool for measuring teamwork behaviour in the operating theatre. *BMJ Qual Saf.* 2009;18:104–108.
97. Mitchell L. Scrub practitioners' list of intra-operative non-technical skills–splints. In: Safer Surgery. Boca Raton, FL: CRC Press; 2017: 93–108.
98. Morgan P, Tregunno D, Brydges R, et al. Using a situational awareness global assessment technique for interprofessional obstetrical team training with high fidelity simulation. *J Interprof Care.* 2015;29:13–19.
99. Morgan PJ, Pittini R, Regehr G, et al. Evaluating teamwork in a simulated obstetric environment. *Anesthesiology.* 2007;106: 907–915.
100. Morgan PJ, Tregunno D, Pittini R, et al. Determination of the psychometric properties of a behavioural marking system for obstetrical team training using high-fidelity simulation. *BMJ Qual Saf.* 2012;21:78–82.
101. Morison S, Jenkins J. Sustained effects of interprofessional shared learning on student attitudes to communication and team working depend on shared learning opportunities on clinical placement as well as in the classroom. *Med Teach.* 2007;29:450–456.
102. Muller-Juge V, Cullati S, Blondon KS, et al. Interprofessional collaboration between residents and nurses in general internal medicine: a qualitative study on behaviours enhancing teamwork quality. *PLoS One.* 2014;9:e96160.
103. Nadolski GJ, Bell MA, Brewer BB, et al. Evaluating the quality of interaction between medical students and nurses in a large teaching hospital. *BMC Med Educ.* 2006;6:23.

104. Agency NPS. The Team Climate Assessment Measurement (TCAM) questionnaire. *Aston Organization Development LTD.* 2006. Available at: http://www.nrls.npsa.nhs.uk/resources/?entryid45=59884. Accessed January 12, 2019.
105. Nørgaard B, Draborg E, Vestergaard E, et al. Interprofessional clinical training improves self-efficacy of health care students. *Med Teach.* 2013;35:e1235–e1242.
106. Norris J, Carpenter MJG, Eaton MJ, et al. Development and construct validation of the interprofessional attitudes scale. *Acad Med.* 2015;90:1394.
107. Nyssen A-S, Blavier A. Integrating collective work aspects in the design process: an analysis case study of the robotic surgery using communication as a sign of fundamental change. In: Human Error, Safety and Systems Development. Berlin, Germany: Springer; 2010:18–27.
108. Ødegård A. Exploring perceptions of interprofessional collaboration in child mental health care. *Int J Integr Care.* 2006;6.
109. Olupeliyawa AM, O'sullivan AJ, Hughes C, et al. The Teamwork Mini-Clinical Evaluation Exercise (T-MEX): a workplace-based assessment focusing on collaborative competencies in health care. *Acad Med.* 2014;89:359–365.
110. Orchard CA, King GA, Khalili H, et al. Assessment of Interprofessional Team Collaboration Scale (AITCS): development and testing of the instrument. *J Contin Educ Health Prof.* 2012;32:58–67.
111. Ottestad E, Boulet JR, Lighthall GK. Evaluating the management of septic shock using patient simulation. *Crit Care Med.* 2007;35:769–775.
112. Paige JT, Aaron DL, Yang T, et al. Implementation of a preoperative briefing protocol improves accuracy of teamwork assessment in the operating room. *Am Surg.* 2008;74:817–823.
113. Paige JT, Garbee DD, Kozmenko V, et al. Getting a head start: high-fidelity, simulation-based operating room team training of interprofessional students. *J Am Coll Surg.* 2014;218:140–149.
114. Paisley AM, Baldwin P, Paterson-Brown S. Feasibility, reliability and validity of a new assessment form for use with basic surgical trainees. *Am J Surg.* 2001;182:24–29.
115. Parker-Raley J, Yanez K, Cerroni A, et al. Assessing trauma leader communication in an ED setting. *J Commun Healthc.* 2013;6:197–207.
116. Parsell G, Bligh J. The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). *Med Educ.* 1999;33:95–100.
117. Parush A, Kramer C, Foster-Hunt T, et al. Exploring similarities and differences in teamwork across diverse healthcare contexts using communication analysis. *Cogn Technol Work.* 2014;16:47–57.
118. Parush A, Momtahan K, Foster-Hunt T, et al. A communication analysis methodology for developing a cardiac operating room team-oriented display. Paper presented at: Proceedings of the Human Factors and Ergonomics Society Annual Meeting. San Antonio, Texas; October 19–23, 2009.
119. Pascual JL, Holena DN, Vella MA, et al. Short simulation training improves objective skills in established advanced practitioners managing emergencies on the ward and surgical intensive care unit. *J Trauma.* 2011;71:330–338.
120. Patterson PD, Weaver MD, Weaver SJ, et al. Measuring teamwork and conflict among emergency medical technician personnel. *Prehosp Emerg Care.* 2012;16:98–108.
121. Pollard KC, Miers ME, Gilchrist M. Collaborative learning for collaborative working? Initial findings from a longitudinal study of health and social care students. *Health Soc Care Community.* 2004;12:346–358.
122. Quinlan E, Robertson S. Mutual understanding in multi-disciplinary primary health care teams. *J Interprof Care.* 2010;24:565–578.
123. Reid J, Stone K, Brown J, et al. The Simulation Team Assessment Tool (STAT): development, reliability and validation. *Resuscitation.* 2012;83:879–886.
124. Reising DL, Carr DE, Shea RA, et al. Comparison of communication outcomes in traditional versus simulation strategies in nursing and medical students. *Nurs Educ Perspect.* 2011;32:323–327.
125. Robertson ER, Hadi M, Morgan LJ, et al. Oxford NOTECHS II: a modified theatre team non-technical skills scoring system. *PLoS One.* 2014;9:e90320.
126. Santos R, Bakero L, Franco P, et al. Characterization of nontechnical skills in paediatric cardiac surgery: communication patterns. *Eur J Cardiothorac Surg.* 2012;41:1005–1012.
127. Schroder C, Medves J, Paterson M, et al. Development and pilot testing of the collaborative practice assessment tool. *J Interprof Care.* 2011;25:189–195.
128. Sevdalis N, Wong HW, Arora S, et al. Quantitative analysis of intraoperative communication in open and laparoscopic surgery. *Surg Endosc.* 2012;26:2931–2938.
129. Sevdalis N, Healey AN, Vincent CA. Distracting communications in the operating theatre. *J Eval Clin Pract.* 2007;13(3):390–394.
130. Sexton JB, Makary MA, Tersigni AR, et al. Teamwork in the operating roomfrontline perspectives among hospitals and operating room personnel. *Anesthesiology.* 2006;105:877–884.

131. Shortell SM, Rousseau DM, Gillies RR, et al. Organizational assessment in intensive care units (ICUs): construct development, reliability, and validity of the ICU nurse-physician questionnaire. *Med Care.* 1991:709–726.
132. Siassakos D, Bristowe K, Draycott TJ, et al. Clinical efficiency in a simulated emergency and relationship to team behaviours: a multisite cross-sectional study. *BJOG.* 2011;118:596–607.
133. Sigalet E, Donnon T, Cheng A, et al. Development of a team performance scale to assess undergraduate health professionals. *Acad Med.* 2013;88:989–996.
134. Sigalet E, Donnon T, Grant V. Undergraduate students' perceptions of and attitudes toward a simulation-based interprofessional curriculum: the KidSIM ATTITUDES questionnaire. *Simul Healthc.* 2012;7:353–358.
135. Song H, Chien AT, Fisher J, et al. Development and validation of the primary care team dynamics survey. *Health Serv Res.* 2015;50:897–921.
136. Sorra J NV. Hospital survey on patient safety culture: agency for healthcare research and quality. 2004. Available at: http://www.ahrq.gov/qual/patientsafetyculture/hospsurvindex.htm. Accessed December 13, 2018.
137. Steinemann S, Berg B, DiTullio A, et al. Assessing teamwork in the trauma bay: introduction of a modified "NOTECHS" scale for trauma. *Am J Surg.* 2012;203:69–75.
138. Stewart M, Kennedy N, Cuene-Grandidier H. Undergraduate interprofessional education using high-fidelity paediatric simulation. *Clin Teach.* 2010;7:90–96.
139. Stock R, Mahoney E, Carney PA. Measuring team development in clinical care settings. *Fam Med.* 2013;45(10):691–700.
140. Strasser DC, Smits SJ, Falconer JA, et al. The influence of hospital culture on rehabilitation team functioning in VA hospitals. *J Rehabil Res Dev.* 2002;39:115–125.
141. Taneva S, Grote G, Easty A, et al. Decoding the perioperative process breakdowns: a theoretical model and implications for system design. *Int J Med Inform.* 2010;79:14–30.
142. Taylor C, Atkins L, Richardson A, et al. Measuring the quality of MDT working: an observational approach. *BMC Cancer.* 2012;12:202.
143. Taylor C, Brown K, Lamb B, et al. Developing and testing team (team evaluation and assessment measure), a self-assessment tool to improve cancer multidisciplinary teamwork. *Ann Surg Oncol.* 2012;19:4019–4027.
144. Temkin-Greener H, Gross D, Kunitz SJ, et al. Measuring interdisciplinary team performance in a long-term care setting. *Med Care.* 2004;42:472–481.
145. Thompson BM, Levine RE, Kennedy F, et al. Evaluating the quality of learning-team processes in medical education: development and validation of a new measure. *Acad Med.* 2009;84:S124–127.
146. Tofil NM, Morris JL, Peterson DT, et al. Interprofessional simulation training improves knowledge and teamwork in nursing and medical students during internal medicine clerkship. *J Hosp Med.* 2014;9:189–192.
147. Turrentine B, Calland JF, Adams R, et al. Studying communication patterns during surgery. Paper presented at: Proceedings of the Human Factors and Ergonomics Society Annual Meeting. Denver, Colorado; October 13–17, 2003.
148. Upenieks VV, Lee EA, Flanagan ME, et al. Healthcare Team Vitality Instrument (HTVI): developing a tool assessing healthcare team functioning. *J Adv Nurs.* 2010;66:168–176.
149. Ushiro R. Nurse-physician collaboration scale: development and psychometric testing. *J Adv Nurs.* 2009;65:1497–1508.
150. van Beuzekom M, Akerboom SP, Boer F. Assessing system failures in operating rooms and intensive care units. *Qual Saf Health Care.* 2007;16:45–50.
151. Vinokur-Kaplan D. Treatment teams that work (and those that don't): an application of Hackman's group effectiveness model to interdisciplinary teams in psychiatric hospitals. *J Appl Behav Sci.* 1995;31:303–327.
152. Violato C, Lockyer J, Fidler H. Multisource feedback: a method of assessing surgical practice. *BMJ.* 2003;326:546–548.
153. von Wyl T, Zuercher M, Amsler F, et al. Technical and non-technical skills can be reliably assessed during paramedic simulation training. *Acta Anaesthesiol Scand.* 2009;53:121–127.
154. Wadhera RK, Parker SH, Burkhart HM, et al. Is the "sterile cockpit" concept applicable to cardiovascular surgery critical intervals or critical events? The impact of protocol-driven communication during cardiopulmonary bypass. *J Thorac Cardiovasc Surg.* 2010;139:312–319.
155. Walker D, Fritz J, Olvera M, et al. Pronto low-tech obstetric simulation and team training in Mexico improves patient outcomes, and evidence-based care at birth. *Obstet Gynecol.* 2014;123:176S–177S.
156. Walker S, Brett S, McKay A, et al. Observational skill-based clinical assessment tool for resuscitation (OSCAR): development and validation. *Resuscitation.* 2011;82:835–844.
157. Wallin CJ, Meurling L, Hedman L, et al. Target-focused medical emergency team training using a human patient simulator: effects on behaviour and attitude. *Med Educ.* 2007;41:173–180.
158. Wauben LS, Dekker-van Doorn CM, van Wijngaarden JD, et al. Discrepant perceptions of communication, teamwork and situation awareness among surgical team members. *Int J Qual Health Care.* 2011;23:159–166.

159. Webster JL, Cao CG. Lowering communication barriers in operating room technology. *Hum Factors.* 2006;48(4):747–758.
160. Weller J, Frengley R, Torrie J, et al. Evaluation of an instrument to measure teamwork in multidisciplinary critical care teams. *BMJ Qual Saf.* 2011;20:216–222.
161. Weller JM, Torrie J, Boyd M, et al. Improving team information sharing with a structured call-out in anaesthetic emergencies: a randomized controlled trial. *Br J Anaesth.* 2014;112:1042–1049.
162. Wheelan SA, Hochberger JM. Validation studies of the group development questionnaire. *Small Group Res.* 1996;27:143–170.
163. Whelan JJ, Spencer JF, Rooney K. A 'ripper' project: advancing rural inter-professional health education at the university of tasmania. *Rural Remote Health.* 2008;8:1017.
164. Wiegmann DA, ElBardissi AW, Dearani JA, et al. An empirical investigation of surgical flow disruptions and their relationship to surgical errors. Paper presented at: Proceedings of the Human Factors and Ergonomics Society Annual Meeting: San Francisco, California; October 16–20, 2006.
165. Wright MC, Phillips-Bute BG, Petrusa ER, et al. Assessing teamwork in medical education and practice: relating behavioural teamwork ratings and clinical performance. *Med Teach.* 2009;31:30-38.
166. Yule S, Flin R, Paterson-Brown S, et al. Non-technical skills for surgeons in the operating room: a review of the literature. *Surgery.* 2006;139:140–149.