Leveraging Social Science-Healthcare Collaborations to Improve Teamwork and Patient Safety

Rosemarie Fernandez, MD
University of Washington
Division of Emergency Medicine
fernanre@uw.edu

James Grand, PhD
University of Maryland
Department of Psychology
grandjam@umd.edu

Word Count: 2910

Support: This project was funded by grants from the Agency for Healthcare Research and Quality (1R18HS020295 [RF] and 1R18HS022458 [RF]) and the Department of Defense US Army Medical Research and Materiel Command [W81XWH-10-2-0023 (RF)]. The funding sources had no role in the preparation, review, or approval of the manuscript.

Corresponding Author:
Rosemarie Fernandez, MD
University of Washington
Division of Emergency Medicine
Box 359702
325 Ninth Ave
Seattle, WA 98104
(206)744-8460
fernanre@uw.edu

Citation
Fernandez, R., & Grand, J.A. (2015). Leveraging social science-healthcare collaborations to improve teamwork and patient safety. *Current Problems in Pediatric and Adolescent Health Care, 45*, 370-377

Abstract

Effective teamwork is critical to the provision of safe, effective healthcare. High functioning teams adapt to rapidly changing patient- and environmental factors, preventing diagnostic and treatment errors. While the emphasis on teamwork and patient safety is relatively new, significant team-related foundational and implementation research exists in disciplines outside of healthcare. Social scientists, including, organizational psychologists, have expertise in the study of teams, multi-team units, and organizations. This article highlights guiding team science principles from the organizational psychology literature that can be applied to the study of teams in healthcare. The authors' goal is to provide some common language and understanding around teams and teamwork. Additionally, they hope to impart an appreciation for the potential synergy present within clinician-social scientist collaborations.

Teams and teamwork are ubiquitous in healthcare. Healthcare teams consist of two or more individuals with specialized skills who must improvise and coordinate their actions in high-pressured, unforgiving situations.[1] Such teams direct day-to-day patient care activities, respond to acute events (e.g., resuscitations), and manage institution-wide events (e.g., disaster response). Effective teams are capable of responding more quickly to changes in a patient's condition, noticing when "things aren't right" and adapting their plans and course of action accordingly.

High quality team leadership can further improve team performance by promoting clear goals, facilitating coordination and cooperation, and planning patient care-related tasks.[2-4] By maintaining a "big picture" overview, leaders can monitor multiple aspects of the patient's care, identify unexpected threats, and ensure the team adapts accordingly.[5] Notably, these functions take on even greater importance as task complexity and interdependency increase, and environmental stability and level of training become more variable[6]—conditions common in pediatric resuscitations and critical care settings.

It should come as no surprise then that teamwork and leadership have been identified as major influences on patient safety[7-10] and performance during acute pediatric emergencies.[11] This recognition has spurred an exponential increase in the number of empirical publications and reviews on teamwork and leadership in healthcare teams over the past decade. For example, within pediatric medicine, a sizeable body of work examining leadership performance and team effectiveness with graduate medical trainees during neonatal and pediatric resuscitation has begun to emerge.[12] We share in the promise this

direction holds for bettering patient safety and care, and encourage and welcome a continued focus on team performance and leadership in healthcare practice.

A Problem with a Solution

However, with new opportunities come new challenges. Although physicians are highly skilled at providing guidance on medical decision-making and treatment plans, they are less knowledgeable in how to train, participate in, and lead effective teams.[13] Teamwork, communication, and leadership—so-called "non-technical skills"—are rarely included in formal curricula, yet provide the backbone of patient care implementation. Consequently, and despite increased emphasis on the importance of teamwork and team leadership in recent years, many healthcare professionals and residents continue to feel underprepared to effectively work as part of or adopt leadership roles within the healthcare team.[14]

In any clinical area or specialty, there is a body of "basic science" that supports research and practice. Team and leadership science is no different. While healthcare has only recently recognized the importance of teamwork and leadership skills, fortunately there exists a significant body of theoretical and foundational work focused on understanding, improving, and measuring these capabilities outside of healthcare. Accessing and leveraging these resources represents a significant avenue for improving healthcare team performance and patient care during acute pediatric care events.

The significance of a well-developed and conceptually grounded understanding of teamwork and leadership models cannot be overstated. They provide healthcare

researchers, educators, and professionals with knowledge, skills, and developmental targets for developing and training critical non-technical skills. Likewise, they can inform the development of improved assessments that are better equipped to detect deficiencies in teamwork and leadership performance. Such measures can also serve as the basis for establishing competency norms to ensure that practitioners have the necessary skills to respond effectively as a resuscitation event leader. Unfortunately, healthcare providers tasked with improving team effectiveness and mitigating teamwork-related adverse events are often rarely trained in the scientific principles necessary to guide these efforts.[15]

Without the explicit use of sound evidence-based models of effective teamwork and leadership, it is not possible to systematically advance research or practice around team-related training and evaluation programs in healthcare.[15,16] We are already seeing this play out in the healthcare community today. Considerable resources and efforts are being dedicated to develop and implement teamwork and leadership training programs; however, their widespread impact has not been demonstrated.[17,18] The decisions regarding training content, application, and evaluation are complex. Without guiding principles and scientific support, it is difficult to determine cost effectiveness and potential success of such choices.

Significant gaps in the knowledge and methodologies employed in healthcare inhibit efforts to improve patient care through team and leadership training and assessment.[12,13,19] Fortunately, there is a wealth of research and best practices from the applied social sciences (e.g., industrial/organizational psychology, organizational behavior, human

factors, etc.) that can be drawn upon to inform the educational criteria, models, and frameworks needed to support healthcare teamwork and leadership training. Consequently, we believe that interdisciplinary collaborations between the applied social sciences and healthcare communities are critical to bridging this gap and improving team and leadership training in pediatric care.

The authors are part of a decade-long research collaboration between healthcare (RF) and organizational psychology (JAG) focused on developing, implementing, and evaluating team and leadership training in resuscitation teams. Industrial-organizational psychologists apply the rigor and methods of psychology to the scientific study of the workplace. That is, industrial-organizational psychologists study how the thoughts, behaviors, emotions, and relationships of people in organizations shape and are shaped by individual, group, unit, and organizational factors. In the remainder of this paper, we highlight some of the insights and lessons from our collaborative efforts as well as provide practical recommendations for forging meaningful partnerships between healthcare and social science researchers. Where appropriate, we also suggest sources for further information.

Lesson #1: Context Matters

Even amongst healthcare teams, not all teams are the same.[20] Clinic-based teams differ from inpatient care teams, which differ from resuscitation teams. Additionally, resuscitation teams in an ICU setting likely face different challenges than those within an emergency department or those that care for soldiers on a battlefield. Carefully defining the nature of the healthcare team is a critical step when translating team science into

healthcare. It is deceptively easy to define a team based solely on its physical location (e.g., operating room, emergency department, outpatient clinic). However, this approach oversimplifies important differences in the nature, needs, and characteristics of teamwork and leaders in these groups, and does not facilitate translating knowledge from other disciplines and team science.

Social scientists studying team performance have devised a variety of useful conceptual frameworks for understanding different types of teams.[21-24] These frameworks encourage defining teams by examining questions such as "Are the team members consistent from day to day? Does the team consist of all experts, or are there trainees? Does the team have consistent tasks or are they dynamic/changing frequently?" Answers to these questions provide insight into the team and leadership skills necessary to support this type of team effectively. For example, resuscitation teams have highly variable team members, frequently changing or poorly defined tasks, and, in academic settings, often include trainee (novice) members.[25] An effective team leader in this context thus requires strong coaching skills, skills to quickly familiarize team members with one another and rapidly establish mutual trust/support, and the capability to readily establish and modify plans based upon changes in patient condition.[12]

Recommendation: Spend the time to understand the team, environment, and organizational culture present in the setting you wish to study.

Further reading and exemplars:

Sundstrom, E., De Meuse, K.P., Futrell, D. (1990). Work teams: Applications and effectiveness. *American Psychologist*, 45, 120-133.

Andreatta PB. A typology for health care teams. *Health Care Manage. R*. 2010;35(4):345-354.

Lesson #2: Never Underestimate the Value of a Conceptual Framework

The famed social psychologist Kurt Lewin once noted "There is nothing so practical as a good theory."[26] A theory provides an organized conceptual framework for identifying key variables relevant to a particular domain and explains how they are related. To Lewin's point regarding practical utility, conceptual frameworks are critically important to the development of team and leadership training programs as they (1) guide selection of appropriate instructional targets and (2) provide a blueprint of the variables and relationships that should be the focus of measurement and analysis.[16]

Healthcare team research has been criticized for not adhering to evidence-based, theoretically sound models of team effectiveness.[1] Building a conceptual model is not trivial and requires extensive empiric testing and revision to establish its validity. As clinicians however, we can work with team science experts to identify models from the social sciences literature appropriate for healthcare teams. Figure 1 provides one such example of a conceptual model for teamwork and leadership in resuscitation teams. This framework is described by Kozlowski, et al[27] and is based upon a much earlier theory of team functioning[28] that characterizes how performance in teams is generated. In brief, this

model provides a structure for understanding how team leadership relates to inputs (e.g., training, experience, resources), teamwork behaviors (e.g., coordination, monitoring, strategizing) and outcomes (e.g., patient care, team efficacy, cohesion). In highly dynamic teams, i.e., resuscitation teams, leadership and teamwork processes underlie performance effectiveness and act to mitigate threats to patient safety through improved situation monitoring, coordination, and communication.[29,30] This highlights the dynamic nature of teams and teamwork, where outputs from one team event feedback as inputs into the next.[28,31,32] Such feedback is necessary if teams are to adapt to new knowledge, tasks, or situations.[33]

From a research standpoint, conceptual models such as Figure 1 outline predicted relationships between critical variables and demonstrates where team and leadership effects should be measured. As one of its first tasks, our research group led a consensus-building effort involving emergency medicine and team science experts. The result of this work was an emergency medicine teamwork taxonomy and framework that has been cited as an example of a robust conceptual framework for healthcare teams and research.[29,34] This conceptual work has since provided the foundation of our interdisciplinary research and continues to inform our determination of targets for training and assessment.

Recommendation: Frame training design, measurement, and research questions around a conceptual model. This will support the development of an evidence-based product and sustainable research program rather than constant pursuit of stand-alone studies.

Further reading and exemplars:

Fernandez R, Kozlowski SWJ, Shapiro MJ, Salas E. Toward a definition of teamwork in emergency medicine. *Acad. Emerg. Med.* 2008;15(11):1104-1112.

Burke CS, Stagl KC, Salas E, Pierce L, Kendall D. Understanding team adaptation: A conceptual analysis and model. *J. Appl. Psychol.* 2006;91(6):1189-1207.

Lesson #3: Develop a Shared Mental Model among Collaborators

Despite best intentions, describing the activities of a healthcare team from a team science perspective is challenging for clinicians. We think in terms of patients, orders, results, diagnostics, and disposition. Describing the nature of the clinical environment, how tasks are presented, and how clinicians receive information is foreign to us, and we often lack the language and terminology needed to effectively communicate with our team science collaborators.

By the same token, social scientists think in terms of how the thoughts, behaviors, and relationships among people shape and are shaped by individual, group or organizational factors. Although they possess general expertise in general theory, research methodologies, and practical program implementation, they lack specific understanding of what it's like to work on a healthcare team, the tasks and procedures that define our jobs or positions, and the institutional/systemic conditions which make up the healthcare system. To be effective collaborators and partner, social scientists and healthcare providers must work closely to develop a shared understanding of healthcare teams and organizations.

Consequently, efforts must be made to facilitate development of a common mental model around healthcare teams and leadership. For team science experts, it is critical to facilitate direct observation of a healthcare setting and teams of interest. They will bring a very different perspective, and as a result will observe interactions, environmental factors, and processes that clinicians consider routine and therefore unremarkable. However, these "unremarkable" phenomena often explain why trained skills and behaviors do not transfer to the clinical setting, and why measurement systems fail to capture the complex nature of teams in the work environment.

It is equally important for clinicians to develop a working understanding of relevant theory and terminology from the social sciences to allow them to effectively incorporate research and practice from these domains. An easy method to facilitate this education is by engaging in conversation with social science collaborators during their direct observations of healthcare teams or potential projects of mutual interest. Such exchanges provide opportunities to elaborate and explore theories and concepts that are new to us in a more familiar context. In *Table 1* we provide a brief glossary of terms used commonly in the team training literature. This list is by no means comprehensive, but is offered as a starting point for further reading.

Recommendation: Seeing is believing. Never underestimate the value of direct observation. Invite social science collaborators into the clinical environment for extended observation periods. It is highly likely they will notice critical team interactions, environmental factors, and communication patterns that had gone previously unnoticed.

Recommendation: Develop a working knowledge of the "language" of social sciences. When a term or construct is unclear or seems duplicative, consult with an expert to ensure you apply the concept correctly in your work.

Lesson #4: Training is More Than an Experience

Increases in team and leadership training research have paralleled the widespread implementation of simulation-based healthcare education. Simulation-based training recreates the contextual background of a healthcare environment, allowing individuals and teams to experience an authentic clinical interaction with patients and other healthcare team members in a safe and controlled environment.[35] While the potential advantages of simulation are obvious, simulation is just a technique. Without strong instructional strategies and supporting learning mechanisms, simulation-based training is simply very expensive *practice* rather than well-designed *training*.

Many areas in the "applied" social sciences (industrial/organizational psychology, organizational behavior, human factors) specialize in the development of theory and evidence-based recommendations for constructing team and leadership training.[4,36,37] These frameworks go beyond considering only the physical fidelity of a training environment and include comprehensive treatments of instructional design.[38] For example, as physicians, we rarely consider how training design impacts learner motivation or how error management during training impacts the acquisition of new skills. However, these—and many other factors—reside within the purview of team and leadership training

scientists. The point of this lesson is to acknowledge that the selection of instructional strategies should be supported by scientific principles[15]—and the application of those scientific principles to improve the performance of healthcare teams and leaders can be greatly informed by meaningful collaborations with social scientists.

Recommendation: Choose instructional strategies that will optimize training outcomes based on the learners, teams, and healthcare environment.

Further reading:

Goldstein, I. & Ford, J.K. (2002). *Training in organizations* (4th ed.). Belmont, CA: Wadsworth Thomson Learning.

Salas, E., DiazGranados, D., Klein, C., Burke, C.S., Stagl, K.C., Goodwin, G.F., & Halpin, S.M. (2008). Does team training improve team performance? A meta-analysis. *Hum Factors,* 50, 903-933.

Lesson #5: Assessment Should Be The First Thought, Not The Afterthought

It is quite easy to get lost in the "glitz and glam" of designing a new training program; however, without an adequate understanding of *what* trainees should learn and *how* that can be measured, training is all show and no substance. In the context of teams and leadership training, assessing team and team leader performance is challenging. Physicians tend to focus on performance-based outcomes, such as getting the correct diagnosis, recognizing errors, and following clinical guidelines. While these are important outcomes to assess, it is equally critical that the teamwork and leadership processes which directly

impact such team performance and clinical outcomes are also measured (see Figure 1).[39,40] Social scientists who study group functioning possess expertise in measurement development and the analysis of complex work teams and team leaders. They can guide decisions related to the design of appropriate measurement tools, methods for data collection, and analysis of multilevel phenomena such as team leadership. Without their expertise, we risk oversimplifying the assessment of important teamwork behaviors and leadership skills.

We have recently published guidelines for the development of team-based measures in simulation-based training that incorporate best practices from team science.[39] These guidelines highlight the importance of measuring both team process (teamwork effectiveness) and performance (medical effectiveness). Further, they provide recommendations for constructing measurement items, establishing evidence of content validity, and implementing a measurement system in a reliable, effective manner. This work is just one example of how collaborative efforts with team scientists have informed rigorous approaches to assessment; other excellent examples are available as well.[41,42] Once again, the lesson here is that the practices we adopt in healthcare team and leadership training should follow rigorous standards of best practice, many of which have been elaborated by our social science colleagues.

Recommendation: The assessment of team and leadership performance is a science! Social scientists can provide expertise beyond standard medical education assessment and psychometrics.

Further reading:

Grand JA, Pearce M, Rench TA, et al. Going DEEP: guidelines for building simulation-based team assessments. *BMJ Qual Saf.* 2013;22(5):436-448.

Rosen MA, Salas E, Wilson KA, et al. Measuring Team Performance in Simulation Based Training: Adopting Best Practices for Healthcare. *Simul Healthc.* 2008;3(1):33-41.

Conclusion

In summary, the provision of healthcare is accomplished through complex interactions of individuals, teams, units, and organizations. The skills and knowledge needed to understand how to train, measure, and improve these components are not provided during standard medical education. Partnerships between clinical providers (pediatricians, nurses, social workers, etc.) and applied social scientists can be highly rewarding and result in robust research and training programs. We as clinicians provide the opportunity for measurement in a discipline that is still largely understudied from a workplace perspective. They provide the insight and expertise to improve the way we interact with one another to provide safe patient care. These partnerships result in more robust training and research programs, and, as a result, are highly valued by funding agencies.

Acknowledgements

The authors would like to acknowledge the experts in their collaborative research team:
Steve W. J. Kozlowski, PhD (Professor, Department of Psychology, Michigan State University)
Georgia T. Chao, PhD (Associate Professor, Broad School of Management, Michigan State University)

This project was funded by grants from the Agency for Healthcare Research and Quality (1R18HS020295 [RF] and 1R18HS022458 [RF]) and the Department of Defense US Army Medical Research and Materiel Command [W81XWH-10-2-0023 (RF)]. The funding sources had no role in the preparation, review, or approval of the manuscript.

References

1. Baker DP, Day R, Salas E. Teamwork as an essential component of high-reliability organizations. *Health Serv. Res.* 2006;41(4):1576-1598.

2. Morgeson FP, DeRue DS, Karam EP. Leadership in teams: A functional approach to understanding leadership structures and processes. *J Manage.* 2010;36(1):5-39.

3. Zaccaro SJ, Rittman AL, Marks MA. Team leadership. *Leadersh Q.* 2001;12(4):451-483.

4. Kozlowski SWJ, Gully SM, Salas E, Cannon-Bowers JA. Team leadership and development: Theory, principles, and guidelines for training leaders and teams. In: Beyerlein MM, Johnson DA, Beyerlein ST, eds. *Advances in interdisciplinary studies of work teams: Team leadership.* Vol 3. US: Elsevier Science/JAI Press; 1996:253-291.

5. Kunzle B, Kolbe M, Grote G. Ensuring patient safety through effective leadership behaviour: A literature review. *Saf Sci.* 2010;48(1):1-17.

6. Kozlowski SWJ, Watola DJ, Nowakowski JM, Kim BH, Botero IC. Developing adaptive teams: A theory of dynamic team leadership. In: Salas E, Goodwin GF, Burke CS, eds. *Team effectiveness in complex organizations: Cross-disciplinary perspectives and approaches*. New York, NY: Routledge Academic; 2009:113-155.

7. Risser DT, Rice MM, Salisbury ML, et al. The potential for improved teamwork to reduce medical errors in the emergency department. *Ann. Emerg. Med.* 1999;34(3):373-383.

8. Leape LL, Berwick DM. Five years after to err is human - What have we learned? *JAMA.* 2005;293(19):2384-2390.

9. Bleetman A, Sanusi S, Dale T, Brace S. Human factors and error prevention in emergency medicine. *Emerg Med J.* 2012;29(5):389-393.

10. Cosby KS. A framework for classifying factors that contribute to error in the emergency department. *Ann. Emerg. Med.* 2003;42(6):815-823.

11. Who is the resuscitation team leader? In: *American Academy of Pediatrics / American Heart Association NRP Instructor Update*. Vol. 22; 2013.

12. Rosenman ED, Shandro JR, Ilgen JS, Harper AL, Fernandez R. Leadership training in health care action teams: a systematic review. *Acad. Med.* 2014;89(9):1295-1306.

13. Blumenthal DM, Bernard K, Bohnen J, Bohmer R. Addressing the Leadership Gap in Medicine: Residents' Need for Systematic Leadership Development Training. *Acad. Med.* 2012;87(4):513-522.

14. van Schaik SM, Von Kohorn I, O'Sullivan P. Pediatric resident confidence in resuscitation skills relates to mock code experience. *Clin. Pediatr. (Phila.).* 2008;47(8):777-783.

15. Baker D, Gustafson S, Beaubien J. *Medical teamwork and patient safety: The evidence-based relation.* Rockville, MD: Agency for Healthcare Research and Quality;2007.

16. Bordage G. Conceptual frameworks to illuminate and magnify. *Med. Educ.* 2009;43(4):312-319.

17. Pronovost PJ, Holzmueller CG, Ennen CS, Fox HE. Overview of progress in patient safety. *Am. J. Obstet. Gynecol.* 2011;204(1):5-10.

18. Salas E, Rosen MA, King HB. Integrating Teamwork into the "DNA" of Graduate Medical Education: Principles for Simulation-Based Training. *J. Grad. Med. Educ.* 2009;1(2):243-244.

19. Rosenman ED, Ilgen JS, Shandro JA, Harper AL, Fernandez R. Team leadership assessment tools in health care action teams: A systematic review. *Acad. Med.* (in press).

20. Andreatta PB. A typology for health care teams. *Health Care Manage. Rev.* 2010;35(4):345-354.

21. Sundstrom E, de Meuse KP, Futrell D. Work Teams: Applications and effectiveness. *Am. Psychol.* 1990;45(2):120-133.

22. Steiner ID. *Group process and productivity.* New York: Academic Press; 1972.

23. Van de Ven AH, Delbecq AL, Koenig Jr R. Determinants of coordination modes within organizations. *Am. Sociol. Rev.* 1976:322-338.

24. Hackman JR. The psychology of self-management in organizations. In: Pallack MS, Perloff RO, eds. *Psychology and work: Productivity, change, and employment*. Washington, DC: American Psychological Association; 1986.

25. Klein KJ, Ziegert JC, Knight AR, Xiao Y. Dynamic delegation: Hierarchical, shared and deindividualized leadership in extreme action teams. *Adm. Sci. Q.* 2006;51(4):590-621.

26. Lewin K, Cartwright D. *Field Theory in Social Science : Selected Theoretical Papers.* 1951.

27. Kozlowski SWJ, Gully SM, McHugh PP, Salas E, Cannon-Bowers JA. A dynamic theory of leadership and team effectiveness: Developmental and task contingent leader roles. In: Ferris GR, ed. *Research in personnel and human resource management*. Greenwich, CT: JAI Press; 1996:253-305.

28. McGrath J. *Groups: Interaction and Performance.* Englewood Cliffs, New Jersey: Prentice-Hall; 1984.

29. Fernandez R, Kozlowski SWJ, Shapiro MJ, Salas E. Toward a definition of teamwork in emergency medicine. *Acad. Emerg. Med.* 2008;15(11):1104-1112.

30. 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(11):2551-2562.

31. Kozlowski SWJ, Gully SM, Nason ER, Smith EM. Developing adaptive teams: A theory of compilation and performance across levels and time. In: Ilgen DR, Pulakos ED, eds. *The changing nature of performance: Implications for staffing, motivation, and performance*. San Franscisco: CA: Jossey-Bass; 1999:241-292.

32. Marks MA, Mathieu JE, Zaccaro SJ. A temporally based framework and taxonomy of team processes. *Acad. Manage. Rev.* 2001;26(3):356-376.

33. Burke CS, Stagl KC, Salas E, Pierce L, Kendall D. Understanding team adaptation: A conceptual analysis and model. *J. Appl. Psychol.* 2006;91(6):1189-1207.

34. Eppich W, Howard V, Vozenilek J, Curran I. Simulation-based team training in healthcare. *Simul. Healthc.* 2011;6 Suppl:S14-19.

35. Bradley P. The history of simulation in medical education and possible future directions. *Med. Educ.* 2006;40:254-262.

36. Salas E, Nichols DR, Driskell JE. Testing three team training strategies in intact teams - A meta-analysis. *Small Group Res.* 2007;38(4):471-488.

37. Salas E, DiazGranados D, Klein C, et al. Does team training improve team performance? A meta-analysis. *Hum. Factors.* 2008;50(6):903-933.

38. Goldstein IL, Ford JK. *Training in Organizations: Needs Assessment, Development, and Evaluation.* Wadsworth; 2002.

39. Grand JA, Pearce M, Rench TA, et al. Going DEEP: guidelines for building simulation-based team assessments. *BMJ Qual Saf.* 2013;22(5):436-448.

40. Cannon-Bowers JA, Salas E. A framework for developing team performance measures in training. In: Brannick MT, Salas E, Prince C, eds. *Team performance assessment and measurement: Theory, methods, and applications*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers; 1997:45-62.

41. Healey AN, Undre S, Vincent CA. Developing observational measures of performance in surgical teams. *BMJ Qual Saf.* 2004;13:I33-I40.

42. Rosen MA, Salas E, Wilson KA, et al. Measuring Team Performance in Simulation-Based Training: Adopting Best Practices for Healthcare. *Simul Healthc.* 2008;3(1):33-41.

43. Hackman JR. The design of work teams. In: Lorsch JW, ed. *Handbook of Organizational Behavior*. Englewood Cliffs, NJ: Prentice Hall; 1987:315-342.

44. Edmondson AC. Speaking up in the operating room: How team leaders promote learning in interdisciplinary action teams. *J Manage Stud.* 2003;40(6):1419-1452.

45. Kozlowski SWJ, Grand JA, Baard SK, Pearce M. Teams, teamwork, and team effectiveness: Implications for human systems integration. In: Boehm-Davis D, Durso F, Lee J, eds. *The handbook of human systems integration*. Washington, DC: APA; 2015.

46. LePine JA, Piccolo RF, Jackson CL, Mathieu JE, Saul JR. A meta-analysis of teamwork processes: Tests of a multidimensional model and relationships with team effectiveness criteria. *Pers. Psychol.* 2008;61:273-307.

47. Brett-Fleegler M, Rudolph J, Eppich W, et al. Debriefing assessment for simulation in healthcare development and psychometric properties. *Simul Healthc.* 2012;7(5):288-294.

48. Salas E, Klein C, King H, et al. Debriefing Medical Teams: 12 Evidence-Based Practices and Tips. *Jt Comm J Qual Saf.* 2008;34(9):518-527.

49. Bowers CA, Braun CC, Morgan Jr BB. Team workload: Its meaning and measurement. In: Brannick MT, Salas E, Prince C, eds. *Team performance assessment and measurement: Theory, methods, and applications*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers; 1997:85-108.

50. Burtscher MJ, Manser T. Team mental models and their potential to improve teamwork and safety: A review and implications for future research in healthcare. *Saf. Sci.* 2012;50(5):1344-1354.

51. Klimoski R, Mohammed S. Team mental model: Construct or metaphor? . *J Manage.* 1994;20(2):403-437.

52. Beal DJ, Cohen RR, Burke MJ, McLendon CL. Cohesion and performance in groups: A meta-analytic clarification of construct relations. *J. Appl. Psychol.* 2003;88(6):989-1004.

53. Kozlowski SWJ, Ilgen DR. Enhancing the effectiveness of work groups and teams (Monograph). *Psychol. Sci. Public Interest.* 2006;7:77-124.

54. Kozlowski SWJ, Bell BS. Team learning, development, and adaptation. In: Sessa VI, London M, eds. *Group learning*. Mahwah, NJ: Lawrence Erbaum Associates; 2008:15-44.

55. Gully SM, Incalcaterra KA, Joshi A, Beauien JM. A meta-analysis of team-efficacy, potency, and performance: interdependence and level of analysis as moderators of observed relationships. *J. Appl. Psychol.* 2002;87(5):819-832.
56. Zaccaro SJ, Blair V, Peterson C, Zazanis M. Collective efficacy. In: Maddux J, ed. *Self-efficacy, adaptation, and adjustment*. New York: Plenum; 1995:305-328.
57. Salas E, Sims DE, Burke CS. Is there a "big five" in teamwork? *Small Group Res.* 2005;36(5):555-599.

Table 1. Team-related terms and definitions

Term or Construct	Definition	Reference
Industrial-organizational psychologist	Industrial-organizational psychologists (IOPs)* apply the rigor and methods of psychology to the scientific study of the workplace. IOPs study how the thoughts, behaviors, emotions, and relationships of people in organizations shape and are shaped by individual, group, unit, and organizational factors.	Society of Industrial and Organizational Psychology (www.siop.org)
Work Team	Two or more individuals who share common goals, are part of a larger organizational system, and are formed to execute organizational tasks	Hackman[43]
Interdisciplinary Action Team (IAT)	Work teams in which members with specialized skills must improvise and coordinate their actions in high-pressured, unforgiving situations; IATs often function within "high reliability organizations" characterized by high level of risk in an arena where failure has dire consequences	Edmondson[44] Klein et al[25]
Team Process	The interactions among team members that combine their collective resources to resolve (or fail to resolve) task demands. Processes therefore form the basis of teamwork competencies	Kozlowski et al[45] McGrath[28]
Coordination	Organizing the sequencing and timing of team activities	Fernandez et al[29] LePine et al[46] Marks et al[32]
Back-up Behavior	Team members' assist other team members with their tasks, balance work loads, and compensate for areas of deficiencies	
Monitoring	Tracking and communicating information related to the team's progress toward goals	
Debriefing	Team leader or team member–driven critical evaluation of the events that transpired during the team's performance, often used to allow individuals to discuss individual and team-level performance, identify errors, and develop a plan to improve their next performance	Brett-Fleegler et al[47] Salas et al[48]
Team Leaders	Directs and coordinates activities, assesses overall team performance, assigns roles, monitors and develops team attitudes and behaviors, facilitates problem solving and error recognition, facilitates feedback/debriefing	Kozlowski et al[4] Kunzle et al[5] Rosenman et al[12]
Team Task Work	Represents what teams have to do, forms the basis of assigned roles and team goals, and determines the workflow structure and need for coordination to accomplish team goals	Bowers et al[49]
Team Mental Models	Shared, organized understanding and mental representation of knowledge or beliefs relevant to the team and the team's tasks	Burtscher[50] Klimoski & Mohammed[51]
Team Cohesion	Desire of group members to remain united to reach a common goal; the commitment of members to the group's tasks	Beal et al[52] Kozlowski & Ilgen[53]
Adaptability	The ability of a team or individual team members to adjust their strategy, behaviors, and/or capacity in response to unanticipated changes in the task, environment, or team.	Burke et al[33] Kozlowski[54]
Team Efficacy	A shared belief in a team's collective capability to organize and execute courses of action required to meet the team's task demands	Gully et al[55] Zaccaro et al[56]
Closed Loop Communication	Following-up with a team member to verify that a message was correctly received and clarifying with the sender of a message that the message was received as intended.	Salas et al[57]

*IOP = Industrial-organizational psychologist

Figure 1. Dynamic Team Leadership Model