This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

TECHNICAL REPORT

Outcome Measures for Effective Teamwork in Inpatient Care

Final Report

Melony E. Sorbero, Donna O. Farley,
Soeren Mattke, Susan Lovejoy

Prepared for the Agency for Healthcare Research and Quality

RAND HEALTH

This work was sponsored by the Agency for Healthcare Research and Quality (AHRQ) under contract No. 290-02-0010. The funding for this study was provided by DoD through an Interagency Agreement with AHRQ. The research was conducted in RAND Health, a division of the RAND Corporation.

Library of Congress Cataloging-in-Publication Data

Outcome measures for effective teamwork in inpatient care : final report / Melony E. Sorbero ... [et al.].
p. cm.
Includes bibliographical references.
ISBN 978-0-8330-4315-3 (pbk. : alk. paper)
1. Health care teams. 2. Outcome assessment (Medical care) 3. Medicine—Quality control. 4. Medicine—Safety measures. 5. Medical errors—Prevention. I. Sorbero, Melony E. II. Rand Corporation.
[DNLM: 1. Outcome Assessment (Health Care) 2. Patient Care Team—organization & administration. 3. Hospitals, Military—organization & administration. 4. Inpatients. 5. Medical Errors—prevention & control. 6. Quality of Health Care. WX 162.5 O94 2008].

R729.5.H4.O98 2008
362.1068—dc22

2008002079

Published 2008 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: http://www.rand.org
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Summary

The Department of Defense (DoD) has been one of the leaders in actions to improve teamwork, which it has pursued with the goal of achieving safer care and reducing adverse events for patients served by its military hospitals. DoD and the Agency for Healthcare Research and Quality (AHRQ) have worked together to develop tools that can be used to evaluate how improved teamwork in delivering care is achieving safer outcomes for its patients. In 2004, AHRQ modified its Patient Safety Evaluation Center contract with RAND to add an analytic study to identify and test measures that have the potential to capture improvements in teamwork practices. The funding for this study was provided by DoD through an Interagency Agreement with AHRQ.

PURPOSE OF THE RESEARCH

The purpose of this project was to identify those patient safety or quality-of-care measures that could be expected to be affected by changes in teamwork effectiveness in health care (referred to here as *teamwork-relevant measures*) for three clinical areas. DoD was seeking tools to evaluate the effect on patient outcomes of improved teamwork in delivering care. This work addressed one step in the process of moving from teamwork training to teamwork practices that improve outcomes of care—the need to identify measures most likely affected as teamwork practices improve in an organization. It was an important step toward developing the capability to accurately document and assess teamwork effects.

IMPORTANCE OF TEAMWORK FOR PATIENT SAFETY

Patient safety as a problem came to widespread national attention in 2000 with the publication of the Institute of Medicine report *To Err Is Human*. Problems in communication—one of the central components of effective teamwork—have been documented as a contributing factor to both a large percentage of the sentinel events reported to the Joint Commission and to medication errors resulting in fatalities (Joint Commission, 2004a; US Pharmacopeia, 2003a,b). Clinical areas with complex and interconnected systems, such as emergency departments, surgical suites and intensive care, are at greatest risk for teamwork failures that can cause medical errors (IOM 2001). A retrospective review of malpractice claims for emergency departments suggested that appropriate teamwork might have averted more than 60 percent of the deaths and major permanent impairments that were reviewed (Risser et al., 1999).

Teamwork is the cooperative effort by individuals in a group to accomplish a common goal. Effective teamwork includes, but goes beyond, effective communication. Cannon-Bowers and colleagues (1995) identified three areas in which competencies are needed to achieve effective teamwork: teamwork knowledge, teamwork skills, and teamwork attitudes. Achieving and sustaining effective teamwork in the delivery of health care has become a patient safety priority for the U.S. health system.

CURRENT TEAMWORK IMPROVEMENT INITIATIVES

The Department of Defense (DoD) has been one of the leaders in actions to improve teamwork. It funded several medical team training initiatives across military hospitals with the goals of achieving safer care and reducing adverse events. It implemented programs modeled on

Crew Resource Management: MedTeams™, Medical Team Management (MTM), Dynamics Outcomes Management©, and, most recently, TeamSTEPPS. AHRQ made TeamSTEPPS training materials publicly available in fall 2006, through AHRQ.

A variety of health care organizations in the United States has implemented teamwork training and improvement initiatives. Presented here are some examples of key initiatives and the clinical measures they use to assess the effects of their initiatives. It is important to distinguish between the actions taken to improve teamwork (a quality-improvement process) and the effects of those improvements (which are considered in the monitoring and feedback step in the improvement process). All three organizations in the examples below are examining both changes in their teamwork processes and the effects of those changes on clinical outcomes, staff outcomes, and business outcomes:

- ***VHA Inc***., an alliance of 2,400 not-for-profit hospitals, launched a program in 20 of its hospitals in fall 2005, entitled Transformation of the Operating Room. The hospitals are implementing selected teamwork behaviors, including pre- and post-surgical briefings, and time-outs.
- ***Kaiser Permanente*** implemented a "Preoperative Safety Briefing" in its 30 hospitals, which it reports has reduced nursing staff turnover and wrong-site surgeries, and has increased detection of near misses (Landro, 2005).
- The ***Institute for Healthcare Improvement*** (IHI) is promoting teamwork through a number of its initiatives. The Improving Perinatal Care program, which is now available to hospitals throughout the United States, aims to improve care by applying evidence-based interventions and using teamwork techniques such as SBAR (Situation-Background-Assessment-Recommendation) and conflict resolution. The Transforming Care at the Bedside initiative also includes a teamwork component; the changes proposed to improve teamwork/vitality include the use of SBAR and other communication tools, enhancing collaboration and conducting multidisciplinary rounds, and enhancing teamwork among nursing staff.

It is clear from these early activities that health care organizations are identifying outcome measures that they intuitively believe are affected by teamwork. However, two issues complicate the ability to work effectively with and interpret changes in these measures. First, many initiatives assess the simultaneous effects of multiple interventions, only one of which is teamwork improvement, making it difficult to isolate the unique contribution of teamwork improvement to outcomes. Second, only limited evidence exists regarding which process and outcome measures are most directly and strongly affected by changes in teamwork effectiveness.

CONCEPTUAL FRAMEWORK

Figure S.1 provides a simple conceptual framework for the scope of work that was performed in this project. As shown in the figure, the provision of team training is expected to improve team performance, which, in turn, should result in better execution of the procedures or other activities involved in the health care being provided. These improvements in health care activities should then lead to improvements in patient outcomes—for example, fewer wrong-site surgeries or fewer cases of wrong medication dosage.

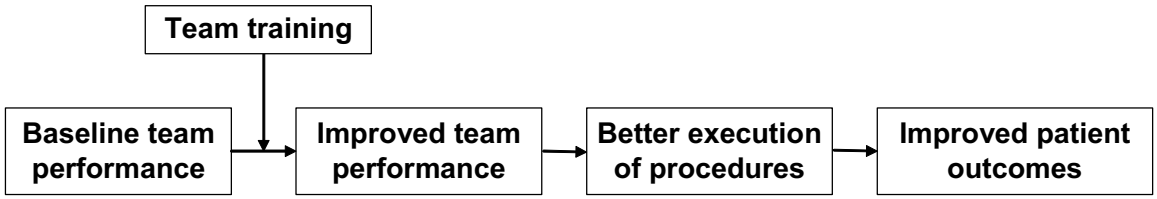

Figure S.1. Relationships Between Team Training, Teamwork Practices, and Outcomes

This project identified teamwork-relevant process and outcome measures using a multistep approach. We conducted a review of the health care literature to identify studies that assessed teamwork training and improvement activities and assessed the current state of knowledge regarding teamwork effects. Information from the literature review and other sources was used to select three clinical areas as the focus of this project. Candidate teamwork-relevant measures were identified for each of the clinical areas. These measures were rated by a clinical advisory panel with expertise in patient safety, measurement, and teamwork and the extent to which they relate to or are affected by teamwork practices. The highly rated measures were empirically tested using DoD administrative health care data. Recommendations for use of these measures were developed with the input of the clinical advisory panel, and potential areas for additional work were identified.

REVIEW OF THE LITERATURE ON TEAMWORK AND PATIENT SAFETY

The literature review focused on studies that examined teamwork effects on behaviors on the job or simulations and organizational impacts. Three categories of articles arose from our review: (1) cross-sectional studies of the effects of teamwork practices on organizational processes and patient outcomes, (2) quasi-experimental pre/post studies that examined the effects of interventions to improve teamwork and communication on care delivery processes, and (3) quasi-experimental studies that evaluated formal teamwork-training programs, which had a variety of study designs regarding pre/post measurement and use of controls. The following are our key findings for each of these three groups of studies:

- The strongest and most consistent evidence of a relationship between teamwork and patient safety comes from cross-sectional studies performed in ICUs, where adverse events occur frequently enough to detect variations. In these studies, nurses' assessments of better teamwork were related to lower risk-adjusted mortality rates and ICU length of stay for medical ICU patients, but not for surgical ICU patients.
- Studies of interventions to improve teamwork and communication generally show promising effects of improved teamwork on the quality-of-care processes. However, the interventions frequently implemented teamwork at the same time as other quality-improvement interventions, which makes it difficult to isolate the effects of the teamwork component of the intervention. Furthermore, all but one of the intervention studies used a combination of pre-/post-intervention without a control group and post-only methods to evaluate the intervention, so it was not possible to determine whether observed differences are due to the intervention of interest or to other factors that might be occurring simultaneously and affecting the outcomes examined.

- Half of the studies of teamwork training limited their evaluations to participants' attitudes toward and assessment of the training, as well as to changes in participants' understanding of the principles and skills covered in the training. Teamwork training was generally well received by participants, and some studies showed participants improved their knowledge of teamwork principles. Some studies found improvements in observer-rated behaviors and observed errors, although results are weakened by lack of controls for other factors that also might affect these outcomes. The one study that compared changes in the training group to a control group that did not receive training found significant improvements in team behaviors as a result of the teamwork training, but no improvements in clinical errors were observed.

The literature on medical teamwork is still immature, but it is developing rapidly. Virtually all of the studies found some positive relationships between teamwork or interventions and their process and/or outcome measures. From this review, we conclude that there is moderate evidence for positive relationships between teamwork implementation and patient outcomes, with the most consistent evidence being in the ICU setting. The current teamwork-training literature provides some evidence that teamwork-training programs can reduce errors in clinical practices, but they do not provide evidence on the ultimate effects on patient outcomes other than patient satisfaction.

These studies also offer insights regarding measures that could be constructed to assess effects of teamwork training on patient outcomes. A wide variety of measures was used in these studies. The most commonly used were patient satisfaction, mortality (both risk-adjusted and unadjusted), and hospital length of stay. Measures of quality of care were also used, but they varied in how quality of care was measured, ranging from patient reported to provider reported to direct observation.

IDENTIFICATION OF CLINICAL AREAS TO ADDRESS

To identify clinical areas for our study, we adapted selection criteria developed and used by the Institute of Medicine for setting action priorities for its 2003 report *Priority Areas for National Action: Transforming Health Care Quality* (Adams and Corrigan, 2003). The IOM criteria are grouped into three broad domains—impact, improvability, and inclusiveness. *Impact* encompasses the real and perceived magnitude of the problem, both to the patient and family and at the system level. *Improvability* reflects the existence of a performance gap and the possibility of narrowing it. *Inclusiveness* refers to the extent to which the clinical area encompasses a variety of types of patients and the ability to generalize findings to other clinical areas.

Using a structured approach, the RAND project team selected three clinical areas for which we would assess outcome measures. First, we created a list of candidate settings that plausibly could be included in this project from the project team's and project officer's knowledge of the existence of process or outcome measures, the literature on patient safety and quality of care, and that relevant care was delivered in at least some Military Treatment Facilities (MTFs). Next, we evaluated the candidate settings based on the decision criteria, using DoD hospital data on hospital volume and costs, the literature-review results, and the project officers' and project team's expert knowledge. These were labor and delivery, surgery, and treatment of acute myocardial infarction. The two areas of labor and delivery and surgery clearly scored highest and were included in the study. The treatment of acute myocardial infarction (AMI), from its

initial presentation in the emergency room through its treatment in the hospital was included as the third clinical area because quality measures were known to exist for this area.

IDENTIFICATION, RATING, AND SELECTION OF MEASURES

A multistep process was used to select candidate teamwork-related measures for each of the three clinical areas. It included the use of a clinical advisory panel to rate the measures on their relationship to teamwork. The steps in the process are listed in Table S.1, and the actions taken in each step are described in Chapter 4.

Table S.1.
Measure-Selection Process

Step	Description
1	Developed a list of possible safety and quality process and outcome measures for labor and delivery, surgery, and treatment of acute myocardial infarction
2	Assembled a clinical advisory panel
3	Clinical advisory panel members rated each measure on its relationship to teamwork and technical soundness[a]
4	Developed a list of surviving measures, ranked by median teamwork-relatedness scores and median soundness scores from the first ratings
5	Held meeting of the clinical advisory panel to discuss the ratings
6	Clinical advisory panel members rated each surviving measure and newly suggested measures
7	Developed a final list of surviving measures, ranked by median teamwork-relatedness scores and median soundness scores from the second ratings
8	Distributed ratings and rankings to panel members for final comments and feedback

[a]Assessment of the extent to which the measure accurately captures the frequency of actual events that are occurring based on the literature or the panel's clinical judgment.

We included consideration of both patient safety and quality measures because many measures fall in a gray area that could be defined as either safety or quality, depending on the viewer's perspective. For example, complications of surgery could be the direct result of an error during the procedure or they could be due to poor-quality postsurgical follow-up. We did not want to artificially constrain the possible pool of outcomes to consider.

The clinical advisory panel performed two rounds of ratings of a comprehensive set of candidate measures identified for the three clinical areas. In each round of ratings, the panel members rated each measure according to its sensitivity to teamwork and its technical soundness. Presented in Table S.2 are summaries for each of the three clinical areas of the number of measures the clinical advisory panel rated in the first round of ratings, the number of measures added or eliminated in the rating process, and the resulting number of measures rated highly by the clinical advisory panel.

The changes to the original lists of measures varied substantially by clinical area. The labor and delivery subgroup eliminated 20 process measures and 23 outcome measures. They added five process measures and six outcome measures and suggested revisions to other measures. The surgery subgroup eliminated 29 process measures and 37 outcome measures. They also

suggested the addition of 23 process measures and 22 outcome measures, which included several sets of already-established measures. The AMI subgroup eliminated five process measures and four outcome measures and added none. This result reflects the well-established set of quality and safety measures for AMI care.

Appendix C lists the measures that the advisory panel identified as having priority because of their expected sensitivity to teamwork effectiveness. This list is separated into groups of process measures and outcome measures. Within each group, we identify which measures were successfully tested with the DoD health care data; unsuccessfully tested with the DoD health care data due to lack of needed information, such as detailed pharmacy information for inpatient stays; or identified in advance as requiring information not contained in the DoD health care data. Appendix D provides descriptions of each of the measures.

Table S.2.
Number and Types of Measures Rated by Clinical Advisory Panel

	Number of Measures, by Clinical Area		
	Labor and Delivery	Surgery	AMI
Process measures			
Originally identified	22	26	32
Added in rating process	5	23	0
Eliminated in rating process	20	29	5
Resulting measures rated highly	7	20	27
Outcome measures			
Originally identified	Mother: 21; Neonate: 6	38	4
Added in rating process	Mother: 2; Neonate: 4	22	0
Eliminated in rating process	Mother: 17; Neonate: 6	37	4
Resulting measures rated highly	Mother: 6; Neonate: 4	23	0

Panelists also suggested a number of concepts for consideration at the panel meeting (Appendix E). These are clinical and operational constructs that the panelists thought likely to be related to teamwork but that have not been operationalized as measures—i.e., specifications do not exist. The panel members rated the concepts fairly highly for development and testing of new measures.

RESULTS OF EMPIRICAL TESTING OF SELECTED MEASURES

Table S.3 presents the eight highly rated outcome measures that could be constructed using the DoD health care data. None of the process measures could be constructed with the administrative data. Five labor and delivery outcome measures were successfully tested with the DoD administrative health care data. Two of the measures were for mothers and three were for neonates. Three surgery outcome measures were successfully tested with the DoD administrative health care data.

Table S.3.
Highly Rated Measures That Could Be Constructed Using DoD Administrative Data

Labor and Delivery
Uterine Rupture
Maternal Death
Intrapartum Fetal Death
Birth Trauma, Injury to Neonate–C-Sections
Birth Trauma, Injury to Neonate–Vaginal Birth
Surgery
Failure to Rescue
Foreign Body Left in During Procedure
Mortality in Low-Mortality DRG
AMI
None

At the level of the individual hospital, occurrences of events for all the measures were too low to enable estimation of statistically significant differences in rates across years. Thus, an individual MTF could not use the measures to assess the effect of implementing an intervention to improve teamwork. At the system level, occurrences of events for only two measures were sufficiently high to test for statistically significant differences in rates over time, using data aggregated for the entire DoD health system. Specific results for each clinical area are highlighted.

For *labor and delivery* measures:

- Uterine ruptures, maternal deaths, and intrapartum fetal deaths. The frequencies of events were so low that even data pooled across all DoD hospitals were too small a sample to detect statistically significant differences over time.
- Birth trauma outcomes. Data would have to be pooled across groups of military hospitals to detect statistically significant differences over time, even for the hospitals with the largest volume of deliveries.
- Delays in obtaining complete and accurately coded records for administrative data create a risk that information on events and rates may be neither accurate nor timely.

For *surgery* measures:

- Mortality in low-mortality Diagnosis Related Groups (DRGs) and foreign body left in during surgical procedure. The frequencies of events were so low that even data pooled across all DoD hospitals were too small a sample to detect statistically significant differences over time.

- Failure to rescue. The number of patients in the denominator at individual hospitals was very small, which also results in the inability to detect significant differences, even at the system level.
- Because of the evidence that high volume is a contributor to safer surgical care, it may be appropriate to "regionalize" surgeries so that they are performed at MTFs with higher volumes.

For *care of AMI* measures:

- All of the military hospitals had small numbers of AMI discharges, so this clinical area is likely to be a lower priority for DoD to focus on for further identification and testing of teamwork-sensitive measures.

DISCUSSION AND CONCLUSIONS

The scope of work defined for this study was to identify process-of-care and outcome measures that are sensitive to teamwork for three clinical areas that the DoD, health care organizations, or other entities could use to assess the effects of teamwork-training and -improvement interventions on patient care and outcomes. The clinical areas selected were labor and delivery, surgery, and treatment for AMI. In this project, we worked with the clinical advisory panel to identify teamwork-related measures based on their clinical judgment using a modified-Delphi process, as well as published evidence. To our knowledge, this is the first study to use a systematic process to assess the teamwork relatedness of measures.

The clinical advisory panel assessed many of the candidate measures as being highly related to teamwork. Across the three clinical areas, the panel members rated 54 of the 108 candidate process measures (50 percent) and 33 of the 97 candidate outcome measures (34 percent) as highly related to teamwork.

Many of the outcome measures identified in this study and all of the process measures require information that is not available in administrative data, but that is available in medical charts.

The results of the measure-selection process and empirical testing of the highly rated measures led to a far-ranging examination of issues related to the ability to construct and effectively use teamwork-related measures. These topics fell into four areas: (1) the use of process-of-care and outcome measures, (2) data sources for construction of teamwork-related measures, (3) the application of measures of low frequency events, and (4) the need for a multidisciplinary team to identify and test teamwork-related measures. These issues are discussed briefly here and are detailed in Chapter 6.

The use of process of care and outcome measures. Process and outcome measures contribute different information for assessments of quality of care. The goals of a quality-measurement activity should drive decisions regarding which process or outcome measures should be used and how to use them.

Data sources for construction of teamwork-related measures. Various types of data could be used to assess the effects of improvements in quality or safety practices. The choice of data source is determined not only by the availability of needed data in each source but also by the

available resources. Because each data source has strengths and/or weaknesses, it would be better to use measures that have been based on several data sources. The use of measures being reported for other purposes would help ensure data availability and integrity.

The application of measures of low-frequency events. The patient outcome measures tested in this study are very-low-frequency events, making them difficult to use as rates. However, a hospital could track the occurrence of events (the numerators), each of which is a serious and preventable event. When an event occurs, it would trigger an investigation of the underlying causes, and the hospital would take remedial action as part of its existing performance-improvement process.

The need for a multidisciplinary team to identify and test teamwork-related measures. To ensure the face validity[1] and technical soundness of measures identified as being teamwork-sensitive, it is important that both clinical experts and people with research and analytic skills participate in the process.

Potential Areas for Additional Work

Several specific areas for which additional work is needed were identified as this project proceeded:

- First, to explore the use of data from electronic healthcare records (EHRs), surveillance systems, and other data systems for calculating process measures for the three clinical areas in this study
- Second, to empirically test the extent to which the measures identified by the clinical advisory panel in this project are related to teamwork practices. One approach for such testing could implement teamwork-improvement interventions in a particular clinical area while measuring a range of outcome measures and the extent to which teamwork behaviors actually were being used.
- Third, to develop other measures that are considered to be sensitive to teamwork. Our advisory panel identified a number of concepts during this project that could provide a starting point for this work.
- Fourth, to identify and test relevant measures for other important clinical areas. The literature suggests that there are other clinical areas that are sensitive to teamwork—most notably the emergency department and intensive care units. A similar process could be used.
- Fifth, to assess the availability of data for measures already developed for other reporting processes. The measures reported to various entities potentially provide a rich source of additional measures for which large numbers of hospitals are collecting and reporting data.
- Sixth, to develop a comprehensive patient-safety reporting system that is designed using currently existing surveillance systems as a guide. Critical to the successful development of such systems would be identifying the range of questions the data from

[1] *Face validity* is the assessment that the measure appears that it will measure what it is supposed to measure.

the surveillance system would be able to address and develop standardized definitions, data-collection and data-entry methods, and audit standards and methods.

The task of identifying outcome measures that are sensitive to teamwork practices is clearly complex and involves many challenges. This study has taken an important step in embarking on that process by identifying a number of process and outcome measures that, in the judgment of our clinical advisory panel, are related to teamwork, and starting the process of testing these measures. As future work is undertaken to build on this initial study, researchers, clinicians, and policymakers can draw on not only the technical results of this study but also on the frameworks established to guide the process and to assess the numerous relevant issues that need to be addressed.