

ORIGINAL ARTICLE

Patient Safety Culture and the Ability to Improve: A Proof of Concept Study on Hand Hygiene

Martine G. Caris, MD;^{1,2} Pim G. A. Kamphuis, MSc;² Mireille Dekker, MSc;² Martine C. de Bruijne, PhD;³ Michiel A. van Agtmael, MD;¹ Christina M. J. E. Vandenbroucke-Grauls, MD²

OBJECTIVE. To investigate whether the safety culture of a hospital unit is associated with the ability to improve.

DESIGN. Qualitative investigation of safety culture on hospital units following a before-and-after trial on hand hygiene.

SETTING. VU University Medical Center, a tertiary-care hospital in the Netherlands.

METHODS. With support from hospital management, we implemented a hospital-wide program to improve compliance. Over 2 years, compliance was measured through direct observation, twice before, and 4 times after interventions. We analyzed changes in compliance from baseline, and selected units to evaluate safety culture using a positive deviance approach: the hospital unit with the highest hand hygiene compliance and 2 units that showed significant improvement (21% and 16%, respectively) were selected as high performing. Another 2 units showed no improvement and were selected as low performing. A blinded, independent observer conducted interviews with unit management, physicians, and nurses, based on the Hospital Survey on Patient Safety Culture. Safety culture was categorized as pathological (lowest level), reactive, bureaucratic, proactive, or generative (highest level).

RESULTS. Overall, 3 units showed a proactive or generative safety culture and 2 units had bureaucratic or pathological safety cultures. When comparing compliance and interview results, high-performing units showed high levels of safety culture, while low-performing units showed low levels of safety culture.

CONCLUSIONS. Safety culture is associated with the ability to improve hand hygiene. Interventions may not be effective when applied in units with low levels of safety culture. Although additional research is needed to corroborate our findings, the safety culture on a unit can benefit from enhancement strategies such as team-building exercises. Strengthening the safety culture before implementing interventions could aid improvement and prevent nonproductive interventions.

Infect Control Hosp Epidemiol 2017;38:1277–1283

In recent years, interest in the influence of hospital safety culture on professional performance has grown, specifically with regard to guideline adherence¹ and infection control.² In infection control, hand hygiene has proven particularly important.³ Large interventional studies have shown that increases in hand hygiene compliance can decrease nosocomial infection rates.^{4,5} Still, adherence to hand hygiene guidelines is notoriously poor.⁶

Many methods have been applied to enhance hand hygiene compliance,⁷ but achieving structural improvement is challenging, and interventions rarely have long-term effects.^{8,9} In addition, newly developed interventions are typically less successful when applied in other hospitals.¹⁰ Although differences in organizational factors may play a role, failure to implement

previously successful interventions is often attributed to differences in hospital culture.

Not only is there great variation in hand hygiene compliance among hospitals,¹¹ differences are also observed among units of the same hospital.^{12–14} As hospital units often work with designated teams and care for a specific patient population, this intrahospital variation could be attributed to differences in the safety culture at the unit level. Although changing the safety culture is challenging, it has been suggested that improving the safety culture could positively influence outcomes,^{1,2} and interventions to change the organizational safety culture have been shown to improve infection control.^{15,16}

The relationship between patient safety culture and the ability to improve has not yet been clearly defined, but it could

Affiliations: 1. Department of Internal Medicine, VU University Medical Center, Amsterdam, Netherlands; 2. Department of Medical Microbiology and Infection Control, VU University Medical Center, Amsterdam, Netherlands; 3. Department of Public and Occupational Health, Amsterdam Public Health Research Institute, VU University Medical Center, Amsterdam, Netherlands.

PREVIOUS PRESENTATION. An abstract of the findings in this manuscript was presented as a poster at the annual ECCMID conference on April 24, 2017, in Vienna, Austria (Abstract P1513).

Received June 9, 2017; accepted September 3, 2017; electronically published October 2, 2017

© 2017 by The Society for Healthcare Epidemiology of America. All rights reserved. 0899-823X/2017/3811-0002. DOI: 10.1017/ice.2017.209

provide insight on how efforts to increase hand hygiene compliance, or guideline adherence in general, can be optimized. In our hospital, we assessed the effects of a 2-year, institution-wide hand hygiene improvement program, and we observed large differences among hospital units. We investigated the patient safety culture on these units and assessed the relationship between the level of safety culture and the ability to improve hand hygiene compliance.

METHODS

Study Design

We conducted a mixed-methods study by performing a qualitative investigation following a before-and-after study. We observed hand hygiene compliance in each hospital unit before and after interventions; we evaluated changes in compliance over 2 years, and we assessed safety culture through semi-structured interviews.

In 2014, we launched an extensive hand hygiene improvement project. Several hospital-wide interventions provided the infrastructure and requisites for improvement, and individual hospital units were called upon to be responsible for their own improvements. Hospital management declared hand hygiene a top priority. We compiled a "Hand Hygiene Improvement Toolkit," after an extensive literature review of effective interventions (see the Supplementary Material online).⁹ All units received feedback on baseline compliance. Hospital management then sent the Toolkit to unit managers and encouraged them to devise a plan of action for improvement, using Toolkit interventions they considered useful for their team. Unit managers were presented with compliance results after every measurement and were encouraged to discuss these results with the staff. Possible explanations for findings were addressed, including any problems the unit might experience. We additionally conducted pilot tests to select the alcohol-based hand rub that healthcare workers preferred, and we installed dispensers on the ends of all hospital beds to enhance availability.

Hand Hygiene

Study Population. We measured hand hygiene compliance on all units between January 2014 and March 2016. We selected 8 units for closer monitoring; these units represented a cross-section of the hospital (ie, surgical and nonsurgical units, intensive care units and non-intensive care units, pediatric and adult patient wards). On these units, we performed 2 baseline measurements and 4 postintervention measurements.

Data Collection. Observers were trained according to the WHO's Hand Hygiene Technical Reference Manual and Training Films. Observations were unannounced and discrete, but not covert, and were registered in iScrub Lite, an application based on the WHO Five Moments of Hand Hygiene.¹⁷ Measurements took place on at least 2 nonconsecutive days.

A minimum of 2 observers collected data for at least 140 hand hygiene opportunities, per unit, per measurement, as proposed by the WHO.¹⁸

Statistical Analysis. We calculated compliance using the sum of all observed opportunities in which hand hygiene was performed divided by the sum of all observed opportunities in which hand hygiene was indicated. We assessed changes in compliance through longitudinal logistic regression analyses; we corrected for correlated observations through stratification per unit and by adding a time-dependent covariate.

Interviews

Study Population. 5 hospital units were selected to investigate the relationship between safety culture and the ability to improve. We used the positive deviance approach, which identifies behavior that enables groups or individuals to outperform their peers.¹⁹ We defined positive deviance as the ability to improve hand hygiene compliance during the intervention period and selected the 2 best performing and 2 least performing units. A fifth unit that did not improve, but consistently showed the hospital's highest compliance, was also included as high performing. With purposeful sampling, we selected interviewees from each unit, to encompass both managers' and nonmanagers' perspectives, and both medical and nursing points of view: the management (medical director and nurse manager), 2 doctors and 2 nurses (to encompass both managers' and nonmanagers' perspectives), and both medical and nursing points of view, until data saturation. Interviewees had to have been employed for at least 24 months to ensure both pre- and postintervention experiences.

Data Collection. The interview guide consisted of open-ended questions based on COMPaZ, the validated Dutch version of the Hospital Survey on Patient Safety Culture.²⁰ To fit our study, some adaptations were made. (The interview guide, COMPaZ description, and adaptations are provided in the Supplementary Material online.) An independent, experienced observer (P.K.) conducted semistructured interviews from May through July 2016. To prevent bias, he had no knowledge of each hospital unit's compliance prior to the interviews.

Analysis. Interviews were transcribed verbatim. Analysis followed 3 steps: (1) Open coding was conducted to name and categorize phenomena and to ensure data completeness; (2) with axial coding, connections were drawn between answers; and (3) selective coding further refined answers while linking them to the dimensions of patient safety culture. Quotes that exemplified responses from the same unit were selected to illustrate meaning. The coding frame was developed iteratively as 2 researchers (M.C. and P.K.) read the transcripts. To prevent bias in the coding frame, P.K. was still blinded to hand hygiene performance, and M.C. was blinded to the respondent's unit. Recurrent themes were noted, both topics that were covered by the interview guide and topics raised by participants. Excerpts from the transcripts were allocated to these codes. After double-coding 5 transcripts, we discussed

findings and defined the coding structure. We then proceeded with a single coder (P.K.) for the remaining transcripts. To avoid coder drift, we regularly evaluated whether adjustments in the coding frame were needed.

The Manchester Patient Safety Assessment Framework (MaPSaF) proposed categorization of safety culture maturity in 5 levels (Table 1),²¹ based on earlier adaptations.^{22,23} The MaPSaF method has been adapted for all healthcare settings and is listed by the WHO as a valid way to assess safety culture.²⁴ We used this framework to assess the level of safety culture: individual responses were categorized as pathological, reactive, bureaucratic, proactive or generative, receiving 1 to 5 points, respectively. A summary score was calculated to assign an overall level of safety culture to each unit.

RESULTS

Hand Hygiene

We observed 6,401 hand hygiene opportunities in 8 hospital units (Figure 1). Mean baseline compliance was 46% (range, 33%–74%). Units 1 and 4 showed the largest improvements (21% and 16%, respectively). Unit 2 consistently showed the

hospital's highest compliance (74%). These 3 units were selected as high performing. Units 3, 6, and 7 showed no changes from baseline. During interventions, unit 7 underwent reorganization and was excluded because such changes can affect safety culture and can confound findings. We selected units 3 and 6 as low performing.

Safety Culture

We interviewed 24 respondents, 4 on unit 3, and 5 on all other units (see Distribution in the Supplementary Material online). Table 2 shows unit characteristics. High-performing units showed high levels of safety culture, while low-performing units showed low levels. The most striking differences were found in the dimensions described in the following section. (A full description and additional quotes are provided in the Supplementary Material.)

Teamwork and Hierarchy

High-performing units consistently reported close collaboration and involvement of unit management. Units 1 and 2 considered their unit free of hierarchy. The managers on unit 4

TABLE 1. Categorization of Safety Culture in 5 Levels, Proposed by the Manchester Patient Safety Assessment Framework²¹

Level of Safety Culture	Description
Generative	Managing patient safety is an integral part of everything we do.
Proactive	We are always on the alert/thinking about patient safety issues that might emerge.
Bureaucratic	We have systems in place to manage patient safety.
Reactive	We take patient safety seriously and do something when we have an incident.
Pathological	Why do we need to waste our time on patient safety issues?

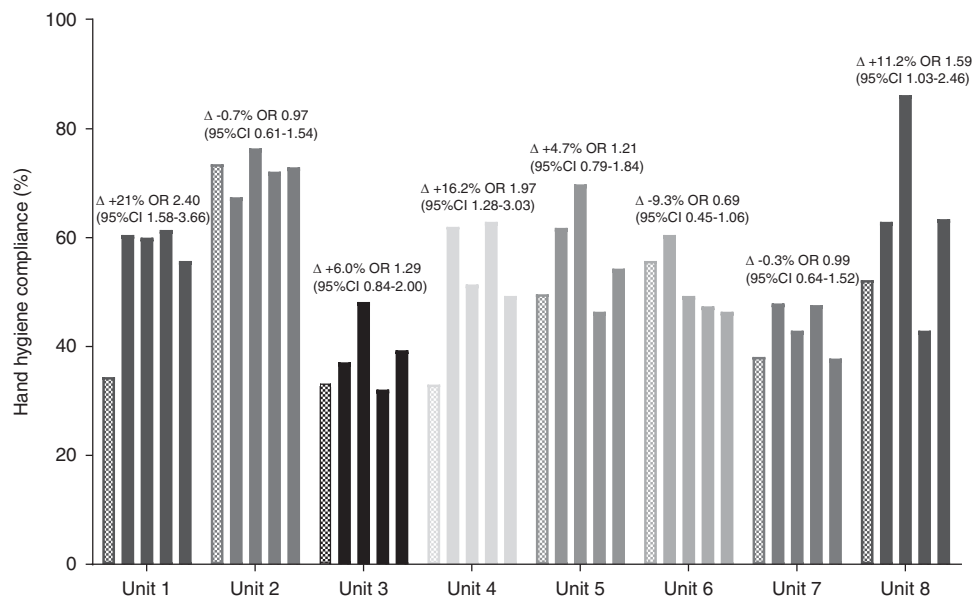


FIGURE 1. Hand hygiene compliance per unit, per measurement. First bar represents pooled baseline compliance, other bars represent measurements during the intervention period. OR, odds ratio; CI, confidence interval.

TABLE 2. Characteristics of Selected Hospital Units

Selection Criteria	Level of Safety Culture	Hand Hygiene Compliance			ICU	Specialties	Interventions
		Baseline, %	Δ , %	OR (95% CI)			
High-performing	Proactive, generative	74	-1	0.97 (0.61–1.54)	Yes	1 medical	6
High-performing	Proactive, generative	33	+21	2.40 (1.58–3.66)	Yes	1 medical	8
High-performing	Proactive	33	+16	1.97 (1.28–3.03)	No	1 medical, 1 surgical	9
Low-performing	Bureaucratic	33	+6	1.29 (0.84–2.00)	No	1 medical, 1 surgical	4
Low-performing	Pathological	56	-9	0.69 (0.45–1.06)	No	2 surgical	4

NOTE. Δ , change from baseline; OR, odds ratio; CI, confidence interval; ICU, intensive care unit.

set the standards, but with staff involvement, resulting in collective efforts to improve.

“Hierarchy is almost nonexistent. There are just differences in responsibilities.” (doctor HU2)

Low-performing units showed opposing points of view on collaboration. Medical staff and managers mentioned that existing hierarchy was not an obstacle to collaboration, while nursing staff expressed contrasting opinions.

“There [...] is some discontent. [...] projects that were forced through, of which the [nursing] team had a clear opinion, and still does. Which is ignored. And that can be difficult sometimes.” (nurse HU3)

Overall Perception of Safety

On high-performing units, staff were aware of the consequences of noncompliance and showed a clear and consistent attitude toward patient safety.

“[The department manager] has a clear vision on quality and safety. [...] We are doing projects on medication safety and prescribing errors. [Hand hygiene] is an integral part of your work.” (doctor HU 4)

On these units, safety issues were anticipated and efforts were made to improve patient safety in general, while low-performing units described more reactive or even pathological approaches.

“We try to, well, keep an eye on the aspects of patient safety, assessment of scores, fall risk, things like that [...]. We try to do, what we can, to monitor patient safety, but things can go wrong, also in our unit.” (medical director HU3)

“[Other units] all stick to the rules, while we have a tendency to work around them. Or deviate from them.” (nurse HU6)

Addressing Noncompliance

Addressing coworkers in cases of noncompliance was common on high-performing units. On low-performing units, this was not the case; staff were mainly focused on their own performance.

“I always do that. [...] that’s just common practice for the unit.” (doctor HU4)

“[...] with co-workers, I don’t really pay attention. It’s not on me. I have enough on my plate.” (nurse HU6)

Feedback and Improvement

Participation in hand hygiene improvement interventions was obligatory on high-performing units, closely involving staff and managers.

“Everyone had to pass the test [on hand hygiene technique] and everyone did, it received a lot of attention, also from [unit] management, I think that’s important.” (nurse HU2)

Low-performing units showed discrepancies in their views on improvement strategies. On unit 3, the nurse manager was scarcely aware of interventions, while staff specifically mentioned measures that had created more awareness. In contrast, the nurse manager of unit 6 mentioned many interventions that were not recognized by staff.

Combining Specialties

Although it was not part of the interview guide, collaboration with different specialties on 1 unit emerged as an important factor. Nursing staff on these wards consistently described differences in communication with the medical staff of the 2 specialties. Measures taken to align the specialties did not seem to have an effect.

“So the logistics are different. That can be difficult. To work with. [...] They just are in different fields and have [...] their own way of communicating.” (nurse HU3)

DISCUSSION

We assessed the ability of individual hospital units to improve hand hygiene compliance during a hospital-wide improvement program. We observed large differences in safety culture between high-performing and low-performing units. Units with high levels of safety culture showed improvement or had high baseline compliance, while units with lower levels of safety culture did not.

These differences were striking because all units had enjoyed the same opportunities, resources, and support to improve compliance. Interestingly, units that cared for patients of 2 different medical specialties consistently showed difficulties in collaboration between medical and nursing staff. This factor clearly had an impact on the safety culture in the unit and appeared to be a barrier to improvement. This finding is supported by earlier studies showing that effective leadership improves safety performance²² and that team training can reduce surgical mortality^{25,26} and forms the basis of the TeamSTEPPS approach to safety and quality.²⁷

Although a minor finding, high-performing units had implemented more interventions (6, 8, and 9 interventions) than low-performing units (4 interventions each). This finding is in line with studies showing that less hierarchical and more collaborative units more easily accept new ideas²⁸ and that units with higher levels of safety culture are more open to interventions to improve performance.²³

Although hand hygiene is the most effective strategy to prevent healthcare-associated infections, compliance is poor and notoriously hard to improve. Several researchers have observed differences in culture between hospitals that may impact the success of interventions.^{12,29,30} It has been suggested that hand hygiene compliance reflects the perceived vulnerability of patients.¹² Critical pediatric care units have higher level of compliance,¹³ which could reflect their overall safety culture. The highest level of compliance in our hospital was observed on the pediatric critical care unit. Of the 2 other high-performing units, one unit does not provide intensive care and the other unit does; however, their baseline compliance was low. In addition, while the 2 low-performing units both care for vulnerable patients, this did not affect either safety culture or compliance. This finding strengthens the idea that safety culture influences the ability to improve more than absolute hand hygiene compliance.

The idea that culture influences performance is not a new concept. Earlier publications have clearly demonstrated the importance of organizational culture in improving adherence to infection control measures^{16,30} and correlations between unit culture and successful practice have been observed.^{22,28} However, most studies focus on changing culture at the hospital level, with huge numbers of employees (>20,000) undergoing safety culture training,³¹ presumably against considerable cost and time investments. A few intervention studies have shown that changing (elements of) hospital or unit culture can enhance adherence to infection control measures.^{15,31–33} However, safety culture is usually not measured at the unit level,^{12,29,30,34} and simplistic correlations such as ‘a strong culture leads to good performance’ have not been scientifically supported.²

Our study has strengths and limitations. The use of a hand hygiene observation tool with clearly defined standard operating procedures adds to the value of our findings. Observations were unannounced and discrete, but not covert. Overestimation of absolute compliance rates is probable,⁶ as

individuals tend to modify their behavior when they become aware of being observed (ie, the “Hawthorne effect”).³⁵ With ongoing interventions, the Hawthorne effect may have had greater influence over the course of our study. However, instead of absolute compliance, we used changes in compliance, which do not rely on validity but on responsiveness of the measurement tool. Still, the Hawthorne effect should be taken into account when interpreting these findings. We defined “high performing” as the hospital’s highest compliance or showing the greatest improvement in compliance. Still, our high-performing units showed 49%–74% compliance. Although compliance rates approaching 100% have been reported, in the Netherlands compliance is generally low,⁶ making the ability to improve, rather than absolute compliance, acceptable and relevant as an outcome.

We performed a single-center study; our findings may therefore not be completely generalizable. However, a multi-center study would present problems of comparability because we aimed to assess the influence of safety culture on the ability to improve when all prerequisites for optimal compliance have been met, and, most importantly, are the same for all units. In addition, we selected units to represent an average cross-section of a hospital, thus enhancing generalizability. Safety culture is a complex topic, and its role in the ability to improve has not been previously defined. Therefore, we gained in-depth knowledge by adapting the most commonly used questionnaire for our interview guide.^{36,37} Both management and nonmanagement perspectives were obtained, as well as both medical and nursing points of view, with which we achieved data saturation. Although our sample was small, differences between the high-performing and low-performing units were unmistakable, indicating strong associations.

Although a strong safety culture appears to be a prerequisite for change, a reverse relationship has been hypothesized as well; working together toward the same goal can positively influence teamwork. In our study, safety culture may have improved with interventions, although a recent study showed that successful improvement strategies in catheter-associated infections were not associated with changes in safety culture.³⁸ To our knowledge, our study is the first exploration of the relationship between level of safety culture and the ability to improve. Repeating safety-culture assessment before and after interventions, preferably through interviews, could further confirm this relationship. In our study, teamwork and addressing noncompliance proved important components of unit culture. Resolving these issues before implementing interventions (eg, through team-building exercises) could provide the changes needed to achieve improvement. Future studies, especially interventional trials targeting low levels of safety culture, could investigate this more explicitly.

Our findings may have important implications for the implementation of hand hygiene interventions. Costly and time-consuming interventions may not affect compliance when they are applied in hospital units with a low level of safety

culture. In addition, although hand hygiene is an essential aspect of safe care, it is only one of many. Our findings, therefore, do not apply to hand hygiene alone but possibly to improvement strategies in general. Factors that hinder a high level of unit safety culture might prove pivotal to the success of improvement programs.

ACKNOWLEDGMENTS

The authors would like to thank L. A. Armstrong, Drs A. M. Kaiser, H. van de Laar, Dr S. D. van der Werff, and Dr P. W. van Wijk, for their contributions to the collection of hand hygiene compliance data.

Financial support: No financial support was provided relevant to this article.

Potential conflicts of interest: All authors report no conflicts of interest relevant to this article.

Address correspondence to Martine G. Caris, MD, Department of Internal Medicine, VU University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, Netherlands (m.caris@vumc.nl).

SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2017.209>

REFERENCES

- Dodek P, Cahill NE, Heyland DK. The relationship between organizational culture and implementation of clinical practice guidelines: a narrative review. *JPEN J Parenter Enteral Nutr* 2010;34:669–674.
- De Bono S, Heling G, Borg MA. Organizational culture and its implications for infection prevention and control in healthcare institutions. *J Hosp Infect* 2014;86:1–6.
- Pittet D, Allegranzi B, Sax H, et al. Evidence-based model for hand transmission during patient care and the role of improved practices. *Lancet Infect Dis* 2006;6:641–652.
- Pittet D, Hugonnet S, Harbarth S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet* 2000;356:1307–1312.
- Kirkland KB, Homa KA, Lasky RA, Ptak JA, Taylor EA, Splaine ME. Impact of a hospital-wide hand hygiene initiative on healthcare-associated infections: results of an interrupted time series. *BMJ Qual Saf* 2012;21:1019–1026.
- Huis A, Holleman G, Van Achterberg T, Grol R, Schoonhoven L, Hulscher M. Explaining the effects of two different strategies for promoting hand hygiene in hospital nurses: a process evaluation alongside a cluster randomised controlled trial. *Implement Sci* 2013;8:41.
- Huis A, Van Achterberg T, De Bruin M, Grol R, Schoonhoven L, Hulscher M. A systematic review of hand hygiene improvement strategies: a behavioural approach. *Implement Sci* 2012;7:92.
- Erasmus V, Daha TJ, Brug H, et al. Systematic review of studies on compliance with hand hygiene guidelines in hospital care. *Infect Control Hosp Epidemiol* 2010;31:283–294.
- Tromp M, Huis A, De Guchteneire I, et al. The short-term and long-term effectiveness of a multidisciplinary hand hygiene improvement program. *Am J Infect Control* 2012;40:732–736.
- Gould DJ, Hewitt-Taylor J, Drey NS, Gammon J, Chudleigh J, Weinberg JR. The CleanYourHandsCampaign: critiquing policy and evidence base. *J Hosp Infect* 2007;65:95–101.
- Creedon SA. Hand hygiene compliance: exploring variations in practice between hospitals. *Nurs Times* 2008;104:32–35.
- Cantrell D, Shamriz O, Cohen MJ, Stern Z, Block C, Brezis M. Hand hygiene compliance by physicians: marked heterogeneity due to local culture? *Am J Infect Control* 2009;37:301–305.
- Homa K, Kirkland KB. Determining next steps in a hand hygiene improvement initiative by examining variation in hand hygiene compliance rates. *Qual Manag Health Care* 2011;20:116–121.
- Saint S, Conti A, Bartoloni A, et al. Improving healthcare worker hand hygiene adherence before patient contact: a before-and-after five-unit multimodal intervention in Tuscany. *Qual Saf Health Care* 2009;18:429–433.
- Peterson TH, Teman SF, Connors RH. A safety culture transformation: its effects at a children's hospital. *J Patient Saf* 2012;8:125–130.
- Larson EL, Early E, Cloonan P, Sugrue S, Parides M. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. *Behav Med* 2000;26:14–22.
- Hlady CS, Severson MA, Segre AM, Polgreen PM. A mobile handheld computing application for recording hand hygiene observations. *Infect Control Hosp Epidemiol* 2010;31:975–977.
- Hand Hygiene Technical Reference Manual*. Geneva: World Health Organization; 2009.
- Curry LA, Spatz E, Cherlin E, et al. What distinguishes top-performing hospitals in acute myocardial infarction mortality rates? A qualitative study. *Ann Intern Med* 2011;154:384–390.
- Smits M, Christiaans-Dingelhoff I, Wagner C, Wal G, Groenewegen PP. The psychometric properties of the 'Hospital Survey on Patient Safety Culture' in Dutch hospitals. *BMC Health Serv Res* 2008;8:230.
- Law MP, Zimmerman R, Baker GR, Smith T. Assessment of safety culture maturity in a hospital setting. *Healthc Qual* 2010; 13 Spec No: 110–115.
- Westrum R. A typology of organisational cultures. *Qual Saf Health Care* 2004;13:ii22–ii27.
- Parker D, Lawrie M, Hudson P. A framework for understanding the development of organisational safety culture. *Safety Science* 2006;44:551–562.
- Organizational tools. World Health Organization website. http://www.who.int/patientsafety/research/methods_measures/human_factors/organizational_tools/en/. Published 2017. Accessed May 10, 2017.
- Young-Xu Y, Neily J, Mills PD, et al. Association between implementation of a medical team training program and surgical morbidity. *Arch Surg* 2011;146:1368–1373.
- Neily J, Mills PD, Young-Xu Y, et al. Association between implementation of a medical team training program and surgical mortality. *JAMA* 2010;304:1693–1700.
- Epps HR, Levin PE. The TeamSTEPPS approach to safety and quality. *J Pediatr Orthop* 2015;35:S30–S33.
- Kilbride HW, Powers R, Wirtschaffer DD, et al. Evaluation and development of potentially better practices to prevent neonatal nosocomial bacteremia. *Pediatrics* 2003;111:e504–e518.
- Cumbler E, Castillo L, Satorie L, et al. Culture change in infection control: applying psychological principles to improve hand hygiene. *J Nurs Care Qual* 2013;28:304–311.

30. Kilbride HW, Wirtschafter DD, Powers RJ, Sheehan MB. Implementation of evidence-based potentially better practices to decrease nosocomial infections. *Pediatrics* 2003;111:e519–e533.
31. Hoyt DB. Looking forward. How Memorial Hermann Health System innovative approach to improved surgical quality and patient safety. *Bull Am Coll Surg* 2013;98:7–8.
32. Pronovost P. Interventions to decrease catheter-related bloodstream infections in the ICU: the Keystone Intensive Care Unit Project. *Am J Infect Control* 2008;36(S171):e1–e5.
33. Jain R, Kralovic SM, Evans ME, et al. Veterans Affairs initiative to prevent methicillin-resistant *Staphylococcus aureus* infections. *N Engl J Med* 2011;364:1419–1430.
34. Hessels AJ, Genovese-Schek V, Agarwal M, Wurmser T, Larson EL. Relationship between patient safety climate and adherence to standard precautions. *Am J Infect Control* 2016;44:1128–1132.
35. Hagel S, Reischke J, Kesselmeier M, et al. Quantifying the Hawthorne effect in hand hygiene compliance through comparing direct observation with automated hand hygiene monitoring. *Infect Control Hosp Epidemiol* 2015;36:957–962.
36. Fleming M. Patient safety culture measurement and improvement: a “how to” guide. *Healthc Q* 2005. 8 Spec No 14–19.
37. Nieva VF, Sorra J. Safety culture assessment: a tool for improving patient safety in healthcare organizations. *Qual Saf Health Care* 2003;12(Suppl 2):ii17–ii23.
38. Meddings J, Reichert H, Greene MT, et al. Evaluation of the association between Hospital Survey on Patient Safety Culture (HSOPS) measures and catheter-associated infections: results of two national collaboratives. *BMJ Qual Saf* 2017;26:226–235.