Sustaining Improvement in Hand Hygiene and Health Care–Associated Infections

"The data from this study suggest that procedure-specific processes to reduce infections related to devices such as central lines or ventilators or others, such as urinary catheters, may not achieve extremely low rates of infection unless they are accompanied by high rates of hand hygiene compliance."

—Using the Targeted Solutions Tool®
to Improve Hand Hygiene Compliance
Is Associated with Decreased
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Infection Prevention and Control

Using the Targeted Solutions Tool® to Improve Hand Hygiene Compliance Is Associated with Decreased Health Care–Associated Infections

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In 2006 Memorial Hermann Health System (MHHS) began a journey to become a high reliability organization (HRO).[1] HROs maintain high levels of quality and safety over long periods with very few adverse events, despite the potential for large-scale harm.[2,3] The ultimate goal for hospitals and health care systems striving for high reliability is zero harm for patients and health care workers.[4]

Consisting of 12 hospitals and more than 200 ambulatory care organizations, specialty programs, and services in the greater Houston area, MHHS employs more than 24,000 staff and has more than 5,000 physicians. As part of its journey to high reliability, MHHS aimed to reduce its rates of health care–associated infections (HAIs) and, in 2007, began conducting Robust Process Improvement® (RPI®) projects[5] to address HAIs. Although these efforts were effective,[1] MHHS believed that lower rates of HAIs were possible by directly addressing hand hygiene compliance,[6–8] which had not been done in its previous RPI projects. Although studies have demonstrated that improving hand hygiene in hospitals reduces rates of infection,[9,10] spreading and sustaining improved compliance have proved difficult.[11,12] As part of its efforts to reduce HAIs, MHHS chose to voluntarily participate, as did seven other organizations, in the Joint Commission Center for Transforming Healthcare's (the Center's) 2009 inaugural project, which was designed to improve hand hygiene compliance.[13] As described by Chassin et al., the project participants systematically identified effective and reliable strategies for collecting hand hygiene compliance data, determined root causes and contributing factors for noncompliance, and implemented specific interventions to address each factor.[13] In collaboration with the eight organizations, the Center then leveraged this information to create a step-by-step application for hand hygiene (called the Targeted Solutions Tool® [TST®]), which guides Joint Commission–accredited organizations through an improvement project to increase hand hygiene compliance.[14]

MHHS also helped test the TST methodology and the even-

Article-at-a-Glance

Background: In 2010 Memorial Hermann Health System (MHHS) implemented the Joint Commission Center for Transforming Healthcare's (the Center's) Web-based Targeted Solutions Tool® (TST®) for improving hand hygiene throughout its 12 hospitals after participating in the Center's first project on hand hygiene, pilot testing the TST, and achieving significant improvement for each pilot unit. Because hand hygiene is a key contributing factor in health care–associated infections (HAIs), this project was an important part of MHHS's strategy to eliminate HAIs.

Methods: MHHS implemented the TST for hand hygiene in 150 inpatient units in 12 hospitals and conducted a systemwide process improvement project from October 2010 through December 2014. The TST enabled MHHS to measure compliance rates, identify reasons for noncompliance, implement tested interventions provided by the TST, and sustain the improvements. Data on rates of ICU central line–associated bloodstream infections (CLABSIs) and ventilator-associated pneumonia (VAP) were also collected and analyzed.

Results: Based on 31,600 observations (October 2010–May 2011), MHHS's systemwide hand hygiene compliance baseline rate averaged 58.1%. Compliance averaged 84.4% during the "improve" phase (June 2011–November 2012), 94.7% in the first 13 months of the "control phase" (December 2012–December 2014) and 95.6% in the final 12 months ($p < 0.0001$ for all comparisons to baseline). Concomitantly, adult ICU CLABSI and VAP rates decreased by 49% ($p = 0.024$) and 45% ($p = 0.045$), respectively.

Conclusion: MHHS substantially improved hand hygiene compliance in its hospitals and sustained high levels of compliance for 25 months following implementation. Adult ICU CLABSI and VAP rates decreased in association with the hand hygiene compliance improvements.

tual Web-based application.[14] Four MHHS hospitals had units participate in different stages of TST development: Memorial Hermann The Woodlands Hospital, which participated in the initial hand hygiene project; Memorial Hermann Northeast Hospital and Memorial Hermann Heart & Vascular Institute-Texas Medical Center, both of which piloted the implementation of solutions from the original project as the TST was being developed; and Memorial Hermann Northwest Hospital, which piloted the Web-based TST application. All pilot units in the four hospitals achieved significant improvements in hand hygiene compliance while participating in the project. For example, The Woodlands' piloting units increased hand hygiene compliance from 27% to 80% during the initial test phase of the Center's inaugural hand hygiene project; the other three participating units achieved similar results. Because of improvements achieved by the four piloting hospitals' units, MHHS chose to implement the TST for hand hygiene in all 12 of its hospitals when it became available in September 2010.

MHHS hospitals comprise approximately 3,225 total beds, of which 659 (20%) are intensive care beds. The 12 hospitals span a wide range of services from a small (81-bed) community hospital to medium (250–290 beds) and large (420–560 beds) community hospitals. MHHS's large tertiary care hospital houses a Level 1 trauma center, a burn center, as well as cardiac, neurosurgical, and transplant (heart, liver, pancreas, and kidney) services. MHHS also includes a children's hospital and two rehabilitation hospitals. During the study period, the vast majority of MHHS's inpatient units were comprised of single-bedded rooms. A small number of two-bed rooms existed in 1 of the 12 hospitals, and these were converted to single-bedded rooms during the study period.

In this article, we describe how MHHS spread the implementation of the hand hygiene TST to all its hospitals. We hypothesized that the TST would enable substantial increases in hand hygiene compliance across the system and facilitate the maintenance of high levels of performance following the implementation of improvement interventions. In addition, MHHS measured rates of ICU central line–associated bloodstream infections (CLABSIs) and ventilator-associated pneumonia (VAP) in all its hospitals to assess the relationship between improving hand hygiene compliance and these HAIs. Previous evaluations of the TST's impact on hand hygiene compliance have not assessed any association with rates of HAIs.[14] We hypothesized that improvements in hand hygiene compliance, if substantial enough, would be associated with declines in the rates of these HAIs.

Methods

THE TST FOR HAND HYGIENE

The TST for hand hygiene is a systematic, Web-based application founded on RPI methodologies, which include Lean, Six Sigma, and change management, that guides health care organizations through a series of steps to increase hand hygiene compliance; it has been described in detail elsewhere.[14,15] The TST mirrors the five stages of a Six Sigma project (Define, Measure, Analyze, Improve, and Control [DMAIC]). In the next section, we describe the specific actions that MHHS took in implementing the TST. For purposes of reporting results, we have divided the study's time line into three main periods, as follows:

1. The "baseline" period included the collection of data on hand hygiene compliance before the implementation of improvement interventions.

2. The "improve" phase included the time during which interventions were implemented.

3. The "control" phase, which followed the deployment of specific improvement actions, was intended to assess whether MHHS was able to sustain any improvements realized during the improve phase.

Although we describe the primary activities that took place during each of these periods, as a practical matter, we know that some improvements were initiated toward the end of the baseline period and that some improvements continued into the control phase. In the first three years that the hand hygiene TST was available, organizations that used it improved compliance from a baseline average of 57.9% to 83.5% ($p < 0.0001$).[14,16]

LEADING AND MANAGING THE TST PROJECTS AT MEMORIAL HERMANN HEALTH SYSTEM

MHHS's hand hygiene initiative had a project lead [A-C.F.] who was the master black belt (MBB) for quality, patient safety, and infection control, and who also led the initial hand hygiene project and subsequent pilots through the Center. At each hospital, the chief nursing officer (CNO) served as executive sponsor and was responsible for identifying process owners at the facility and unit levels. Most of the process owners primarily held nursing leadership positions; some of the members held respiratory therapy and infection prevention positions. Several of these members had also participated in the Center's inaugural hand hygiene project or subsequent pilots and then continued on during the larger initiative. The MBB provided on-site support as needed and virtual support via biweekly conference calls for the process owners and other team members who wished to participate. During the first year of baseline data and contributing factors collection, the project required 50% of the MBB's time.

Each hospital has a hand hygiene team composed of the facility process owner and a subset of unit process owners. The CNO at each hospital also served as executive sponsor driving the local initiative with the MBB's help. MHHS began TST projects in three waves or rounds because of the number of hospitals and units implementing the TST and the coordination involved for its system (Appendix 1, available in online article). Because local leaderships were more familiar with their hospitals than was the MBB, leadership at each site determined which units participated in each wave, and all 150 units were eligible to use all three rounds, as necessary, to complete training and implementation. Included in these waves also were the two units from The Woodlands and one unit from each of the three hospitals that participated in the Center's initial hand hygiene project and subsequent pilots.

LEVERAGING THE TST TO CONDUCT A SYSTEMWIDE HAND HYGIENE IMPROVEMENT PROJECT

MHHS progressed through its improvement project between October 2010 and December 2014 to increase hand hygiene compliance by collecting reliable data, identifying compliance barriers, implementing proven intervention solutions to address barriers, and sustaining these interventions, as represented in the six steps, which we now describe.

Step 1. Getting Started. During this step, the executive sponsors for each hospital and participating unit identified the lead process owners. To ensure accountability at the operational unit level, all process owners were operational hospital managers, directors, or executives rather than members of the quality or infection control departments. With the exception of Northeast Hospital, which included an infection preventionist as a process owner because of her previous participation in the hospital's initial pilot project, the only criterion set for determining the lead process owners was that they were not to be infection preventionists.

With the support of senior leadership, MHHS's quality, patient safety, and infection control leadership and the project lead determined the project's objectives and goals and then established the following time line and goals:

■ Collect reliable data and identify contributing factors (October 2010 through May 2011).

■ Determine solutions to address contributing factors and implement solutions (June 2011 through November 2012).

■ Increase hand hygiene compliance in each unit by 30 percentage points above each unit's baseline or to 90% by one year following the implementation of solutions.

On the basis of results achieved by the piloting units, MHHS selected these goals (1) with the knowledge that an increased compliance rate of 80% to 90% was possible for most of its units and (2) with the expectation that the units with lower baselines could be motivated to achieving much higher rates of compliance. To organize and manage the rollout, a key spreadsheet of monthly performance goals was developed and provided to all lead process owners to facilitate efforts in their units (Appendix 1).

Step 2. Training Secret Observers and Just-in-Time (JIT) Coaches. To collect reliable data, the TST methodology engages anonymous secret observers who hold unbiased positions and are able to observe hand hygiene compliance.[17–19] These observers—whose identities are completely unknown to the individuals being observed—do not interfere with the caregivers' work. Their role is to observe and collect data. At MHHS, selected staff members were trained on accurate data collection by accessing modules in the TST that required watching training videos and passing a certification examination (score of at least 90%). We did not calculate formal rates of interrater reliability among secret observers. As it became necessary to deploy additional secret observers during the course of the project (for example, if their roles became known to unit staff), the same training program and certification examination were used for the new observers. The secret observers were also trained to identify and record some contributing causes of noncompliance (for example, caregivers' hands were full of supplies, no alcohol hand rub dispenser near door to patient room, or caregiver needed several trips in and out of a room to complete a task [frequent entry or exit]). However, other contributing causes could not be observed (for example, perception that hand hygiene was not required or perception of skin irritation). Therefore, in addition to the secret observers, the TST also provides training for JIT coaches, who observed noncompliance, obtained information regarding contributing factors for noncompliance, and provided feedback to noncompliant individuals.[7] Secret observers and JIT coaches were trained during training fairs held for participating units to maintain anonymity.

Clinical staff and nonclinical staff, including environmental services, dietary, plant operations, and chaplains, were eligible to participate as secret observers and JIT coaches. Only secret observers' data were used to calculate rates of noncompliance. When a JIT coach observed a noncompliant individual, he or she intervened to identify contributing factors and root causes for noncompliance and briefly educated the individual about hand hygiene protocol. All JIT coaches were opinion leaders staffed in their respective units and did not serve as secret observers. We recognized that the activities of the JIT coaches

could influence hand hygiene behavior by themselves. Their work was concentrated in the last three months of the eight-month baseline period (March through May 2011; see Appendix 1.) Because they collected a limited number of observations during a relatively brief time period, we believed that any improvement effect due to those activities would be limited. Therefore, we defined the baseline period as continuing until specific interventions began to be deployed in June 2011.

   Step 3. Measuring Baseline Compliance. Between October 2010 and May 2011, all participating units were asked to obtain a collective total of 20 observations per day from secret observers for 14 nonconsecutive 24-hour days, including day, night, and weekend shifts, with data recorded on the Hand Hygiene Observation and Contributing Factor Form (Appendix 2, available in online article), which was developed entirely by the Center's collaborative hand hygiene project and based on measures and identified contributing factors. The observers recorded compliance data on a paper version of the form, printed from the TST. The data were transcribed into the TST database by designated, separately trained individuals. We did not attempt to construct a truly random sample of observations of hand hygiene compliance; nor did we attempt to calculate the percentage of all opportunities to clean hands that was represented in the secret observers' data.

   All caregivers were included in the secret observers' assessments of hand hygiene compliance, including physicians, nurses, dietitians, respiratory therapists, phlebotomists, food services workers, and environmental services staff. Only visitors were excluded, as were the rare emergency situations requiring resuscitation or other emergent interventions. Data were collected on the basis of observations made on entry and exit of a patient's room and then entered into the TST's database. For example, an attending physician's hand hygiene compliance or noncompliance on leaving a patient's room would constitute one observation. By the end of May 2011, MHHS had collected 31,600

Variability in Ranking of Contributing Causes of Hand Hygiene Noncompliance Among 11 Memorial Hermann Health System (MHHS) Hospitals, October 2010–June 2011
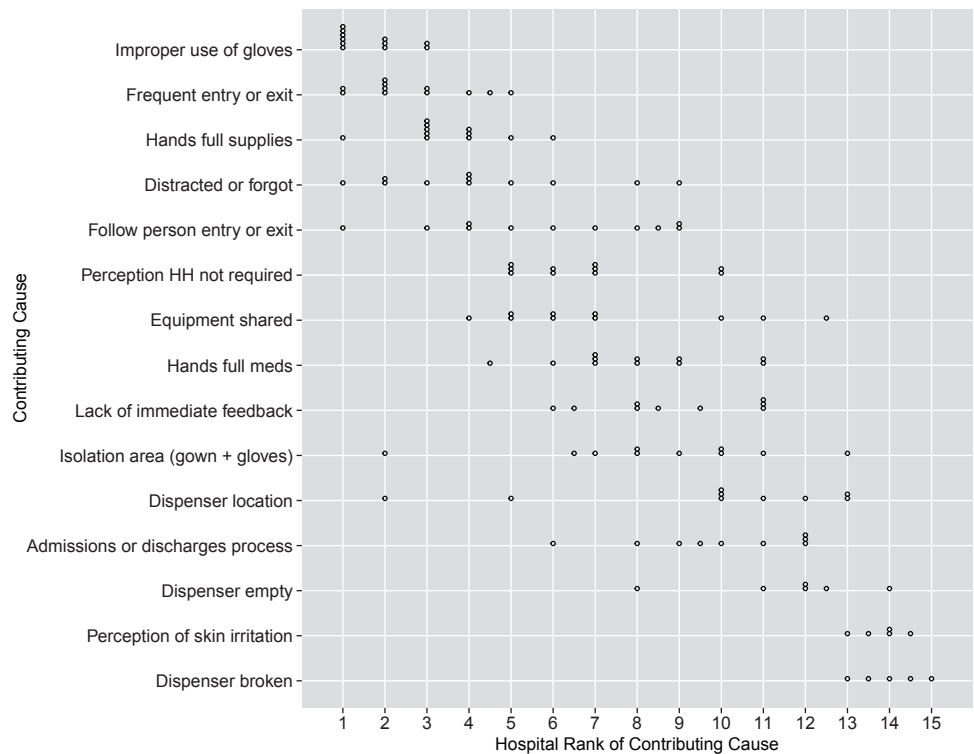

Figure 1. *The figure displays a strip plot that shows each contributing cause (○) and a distribution of its ranking from 1st to 15th among all causes across the 11 MHHS hospitals included in this analysis. HH, hand hygiene; meds, medications.*

observations assessing baseline compliance. All data were entered into the TST, which provided real-time data analysis.

   Step 4. Determining Factors. During the February through June 2011 time period, each unit collected a minimum of 30 observations (50 observations when possible) to identify contributing factors and root causes for noncompliance. We assumed that a collection of 30 to 50 observations would be sufficient to reveal which factors most commonly contributed to a unit's noncompliance. Importantly, the most prominent contributing causes of hand hygiene noncompliance varied from unit to unit and hospital to hospital. Figure 1 (above) displays a strip plot that shows each contributing cause and a distribution of its ranking from 1st to 15th among all causes across the 11 MHHS hospitals included in this analysis. Thus, the most frequent contributing cause (improper use of gloves) ranked first in six hospitals, second in three, and third in two. The next most common (frequent entry or exit) ranked first in two hospitals, second in four, third in two, fourth in one, tied

Contributing Factors to Hand Hygiene Noncompliance for 11 Memorial Hermann Health System (MHHS) Hospitals, October 2010–June 2011
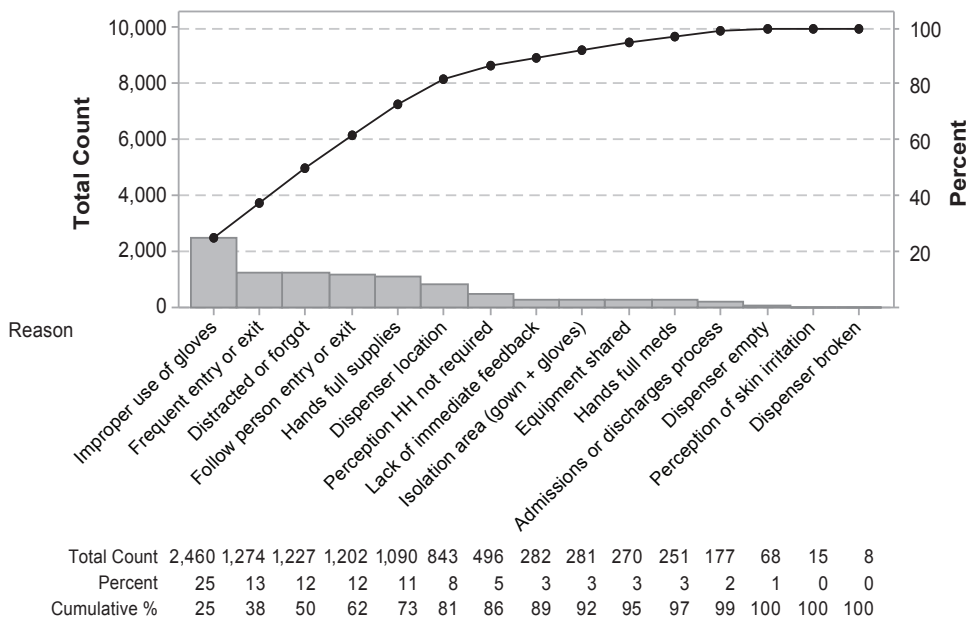

Total Count	2,460	1,274	1,227	1,202	1,090	843	496	282	281	270	251	177	68	15	8
Percent	25	13	12	12	11	8	5	3	3	3	3	2	1	0	0
Cumulative %	25	38	50	62	73	81	86	89	92	95	97	99	100	100	100

Figure 2. *A Pareto chart, which was produced by the Targeted Solutions Tool® (TST®), was used to graph the frequency of each factor across 11 MHHS hospitals, with 9,944 observations represented in the contributing causes of noncompliance contained in the strip plot and Pareto chart. HH, hand hygiene.*

for fourth in one, and fifth in one. The substantial variability in the most important contributing causes by hospital was expected and entirely consistent with the experience in the Center's hand hygiene project and of other hospitals using the TST.[13,14] A Pareto chart, which was produced by the TST, was used to graph the frequency of each factor across 11 MHHS hospitals (Figure 2, above). A total of 9,944 observations were represented in the contributing causes of noncompliance contained in the strip plot and Pareto chart. The top six contributing factors identified throughout the system—which accounted for 81% of noncompliance observations—were, in order of average ranking, as follows:

1. Improper use of gloves
2. Frequent entry or exit
3. Distracted or forgot
4. Following a person during entry or exit
5. Hands full of supplies
6. Ineffective or inconvenient placement of hand gel dispenser or sink

Step 5. Implementing Solutions. Some units began deploying interventions as early as June 2011. By August 2011, how-

ever, every unit was asked to select targeted solutions that had been tested and recommended by the TST to address its specific contributing factors.[13,14,16] Participating units implemented a variety of interventions to address their contributing factors, including the following:

- Using a code word to remind a distracted individual to perform hand hygiene (to address "Health care worker was distracted")
- Relocating or adding hand gel dispensers to more convenient locations ("Ineffective or inconvenient placement of hand gel dispenser or sink")
- Using visual cues to prompt hand hygiene ("Health care worker forgot")
- Providing a surface for individuals carrying meals, supplies, or medications to place items and allow hand hygiene to be performed ("Caregiver's hands were full . . . no convenient place to put supplies to facilitate hand hygiene")

Units with similar contributing factors were encouraged to collaborate. By the end of September 2011, each unit was required to establish a plan for implementing its solutions. By the end of December 2011, each unit was required to implement its solutions.

Each unit had a process owner who spearheaded baseline data collection, identification of the contributing factors to noncompliance, and implementation of targeted solutions using the implementation guides readily available via the TST. Implementation of interventions continued on a rolling basis through November 2012. Thus, we refer to the period from June 2011 through November 2012 as the improve phase of the study, when different interventions continued to be deployed.

Step 6. Sustaining the Gains. In December 2012 MHHS entered the final step of the TST, "Sustaining the Gains," which is equivalent to the control phase of a Six Sigma project. To sustain the interventions and related improvements, MHHS conducts executive-level monthly operating reviews with each hospital entity to track 60+ quality measures, 1 of which addresses hand hygiene. Each participating unit continues to

collect and input data accordingly (20 observations of hygiene compliance per month). For all quality measures, if there is a decline in performance, the hospital senior leadership team is expected to address the issues using RPI. In addition, each hospital's hand hygiene team is responsible for sustaining performance. Since December 2012 MHHS has continued to record approximately 10,000 observations per month into the TST. Compliance rates continue to be monitored. If a decrease in compliance occurs, the TST provides for reinstituting the collection of data on contributing causes by secret observers and the JIT coaches to find the reasons for the decrease. As with the initial deployment, the data on contributing causes lead to the selection and implementation of the appropriate targeted solutions. There is no set protocol that defines what level of decreased compliance should trigger these corrective actions. Those decisions are left to each hospital's hand hygiene team and monitored by leadership.

To acknowledge the accomplishments of individual units and hospitals for reducing rates of specific HAIs to zero, MHHS created the High Reliability Certified Zero Award.[1] Between April 2011 and October 2013, 105 Certified Zero Awards were presented to units that did not experience an HAI, patient safety incident, or hospital-acquired condition event for a continuous one-year period; 35 of the Zero Awards concerned HAIs.

MEASURING HEALTH CARE–ASSOCIATED INFECTIONS

Rates of ICU CLABSI and VAP were measured throughout the study period and for several years before it in a standardized manner by certified infection control practitioners using definitions established by the Centers for Disease Control and Prevention (CDC) through its National Healthcare Safety Network (NHSN).[20] NHSN definitions and measurement procedures were taught and monitored by the MHHS physician epidemiologist throughout the study period. CLABSI rates were measured separately for neonatal ICUs (NICUs) and for adult ICUs. The NHSN definition for VAP was revised beginning in 2013, so we were able to include VAP data for analysis only through December 2012. We were not able to include other HAIs (for example, catheter-associated urinary tract infections and methicillin-resistant *Staphylococcus aureus*) in this analysis, because data for those HAIs were not collected in the same standardized way during the study period.

STATISTICAL METHODS

To evaluate the impact of the interventions on hand hygiene compliance, we used an interrupted time series analysis with a segmented generalized linear mixed model.[21] For purposes of assessing rates of improvement in hand hygiene compliance and HAIs, data from the MHHS hospital that participated in the Center's first project were excluded because that hospital began its improvements considerably before the baseline data collection period defined in this study for the other 11 MHHS hospitals. The model fit separate slopes and intercepts in each of the baseline, improve, and control study phases, allowing the slopes and intercepts within each study period to vary across hospitals. Because we had control phase data for 25 months, we examined the first 13 months (control 1) and the last 12 months (control 2) separately. Least squares means of the fixed effects from this model were then used to calculate the marginal compliance rate within each study phase. We used an *F*-test to evaluate the ratio of the baseline to the control variance.

We evaluated the impact of the intervention on adult ICU CLABSI, NICU CLABSI, and VAP in several different ways. Because all of these outcomes are rare events, we used Poisson regression techniques.[22,23] When the number of these specific infections within hospitals was very small, we aggregated the data over hospitals by month and then analyzed them with a Poisson regression. This method was used to analyze NICU CLABSI (for which only one of six hospitals included in the analysis had more than five of these outcomes over the study period) and VAP (for which only one out of nine hospitals included in the analysis had more than five outcomes over the study period). For the analysis of ICU CLABSI (for which six of eight hospitals had more than five outcomes), we used a Poisson hierarchical mixed model to evaluate the covariate trends in outcome rates, using hospital as the random effect. The Poisson regression and Poisson hierarchical mixed model analyses both adjust for the number of patient-days at risk (that is, central line–days for CLABSI and ventilator-days for VAP). The Poisson hierarchical mixed model additionally adjusts for the correlation of longitudinal outcome rates within hospital. Because the covariates hand hygiene compliance, time, and study phase are all highly confounded with each other, preventing the evaluation of all of these variables in a statistical model at the same time, a series of analyses was undertaken to evaluate the impact of each covariate separately. Least squares means were calculated in the analysis using study phase as the covariate to estimate the marginal outcome rates for each study period.

Adult ICU and NICU CLABSI data were available for the entire 51-month study period (October 2010–December 2014), while VAP data were available for only 27 months (October 2010–December 2012). Thus, we were able to evaluate both CLABSI outcomes in all three study phases but VAP data only for the baseline and improve phases. Hospitals were included in

Box Plot of Monthly Hand Hygiene Compliance Rates for 11 Memorial Hermann Health System (MHHS) Hospitals, October 2010–December 2014
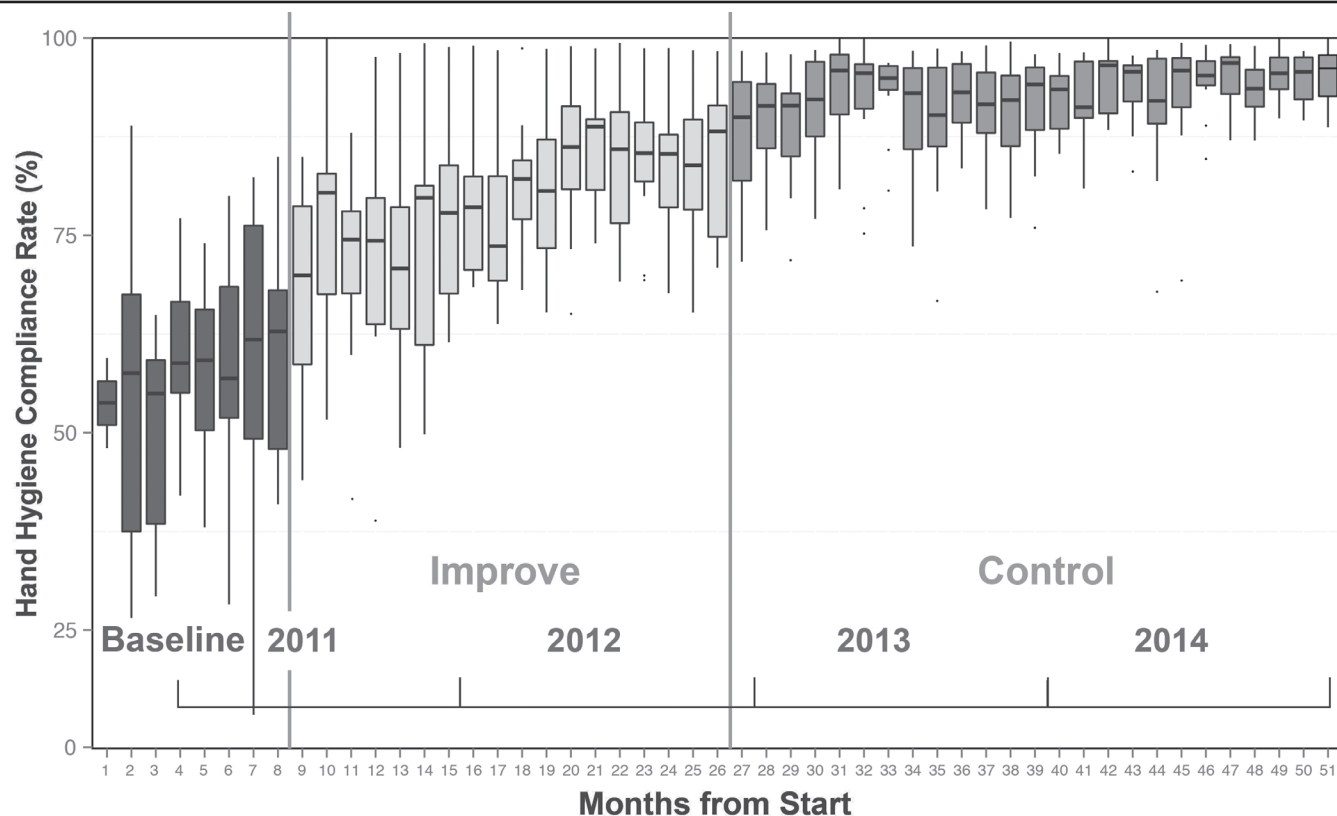

Figure 3. *The box plot displays monthly hand hygiene compliance rates for 11 MHHS hospitals for all three time periods of the study—baseline, improve, and control.*

the outcomes analyses if they provided the relevant service. Thus, 8 the 11 hospitals had adult ICUs and were included in the adult ICU CLABSI analysis. The 6 hospitals with NICUs and any central line–days were included in the NICU CLABSI analyses, and the 9 hospitals that treated patients on ventilators were included in the VAP analyses. All statistical tests were conducted at the 0.05 level of significance.

Results

IMPROVEMENT IN HAND HYGIENE COMPLIANCE

A box plot[24] displaying monthly hand hygiene compliance rates for all 11 hospitals for all three time periods of the study is shown in Figure 3 (above). Overall, hand hygiene compliance improved by 37.5 percentage points between baseline and the end of the control phase, a relative increase of 65%. Average compliance during the baseline period (October 2010–May 2011) was 58.1%, with a 95% confidence interval (CI) of 42.7% to 72.1%. During the improve phase (June 2011–November 2012), average compliance increased to 84.4%. In the control

phase, compliance averaged 94.7% in the first 13 months and 95.6% in the final 12 months. The generalized linear mixed model demonstrated that the compliance rates in the improve phase and in both parts of the control phase were statistically significant different ($p < 0.0001$) from the baseline period. The interrupted time series analysis showed that compliance was increasing during the baseline (slope = 0.101, $p = 0.026$) and improve (slope = 0.078, $p = 0.001$) phases and stabilized in the control phase (slope = 0.033, $p = 0.095$). The variability of the compliance rates among hospitals decreased significantly in the control phase (standard error of the mean = 1.6%) compared to baseline (standard error = 7.3%) ($p < 0.001$).

ASSOCIATION OF IMPROVED HAND HYGIENE COMPLIANCE WITH DECLINES IN SELECTED HAIS

Beginning in May 2007—before the current effort to improve hand hygiene compliance—MHHS had implemented other interventions to reduce ICU CLABSI and VAP. Those interventions focused on care processes specific to each of these

Monthly Central Line–Associated Bloodstream Infection (CLABSI) Rates: All Neonatal ICUs at 7 Memorial Hermann Health System (MHHS) Hospitals, April 2007–December 2014
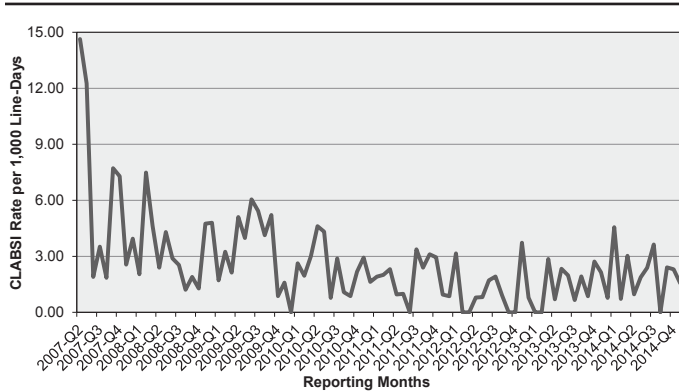

Figure 4. *The trajectory of the aggregate rates of the CLABSI rates for the seven MHHS hospitals with neonatal ICUs is shown. Q, quarter.*

Monthly Central Line–Associated Bloodstream Infection (CLABSI) Rates: All Adult ICUs at 9 Memorial Hermann Health System (MHHS) Hospitals, January 2006–March 2015
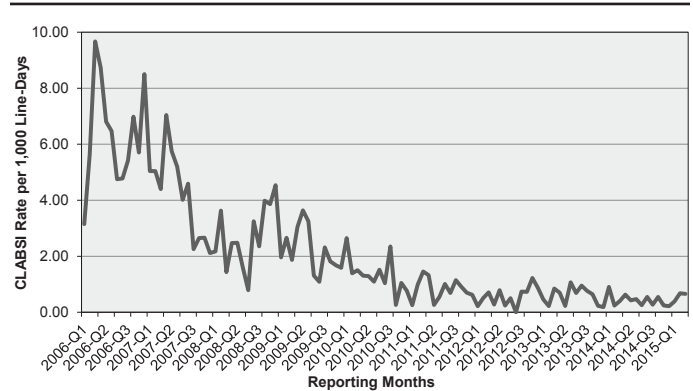

Figure 5. *The trajectory of the aggregate rates of the CLABSI rates for the nine MHHS hospitals with adult ICUs is shown. Q, quarter.*

HAIs, commonly referred to as the central line and VAP "bundles"—procedure-specific care processes aimed at reducing the frequency of infection in these clinical situations.[25,26] The trajectory of the aggregate rates of these HAIs across all MHHS hospitals is shown in Figure 4 (above) for NICU CLABSI, Figure 5 (above, right) for adult ICU CLABSI, and Figure 6 (right) for VAP. We do not attempt here to demonstrate an association between those interventions and the temporal declines in these HAI rates before the current study period. Rather, we present this information to establish the context for the hand hygiene improvement effort. Thus, in these MHHS hospitals a substantial effort had been undertaken to implement the CLABSI and VAP bundles before the hand hygiene improvement initiative described here.

We also examined aggregate monthly MHHS data on adult ICU CLABSI and VAP to determine whether the rates of those HAIs were stable in the 12 months—October 2009–September 2010—immediately preceding the study period. Using Poisson regression analysis with time as the covariate, we found no time trend for either adult ICU CLABSI (p = 0.822) or VAP (p = 0.640). Plotting the same data using a control chart with variable denominator sizes showed that both rates were well in control and stable with no out-of-control patterns.

Adult ICU CLABSI rates decreased throughout the study period—from 0.83 per 1,000 central line–days at baseline to 0.42 in the last part of control (p = 0.024). VAP rates decreased as well—from 1.04 per 1,000 ventilator–days at baseline to

Monthly Ventilator-Associated Pneumonia (VAP) Rates: All Adult ICUs at 10 Memorial Hermann Health System (MHHS) Hospitals, January 2006–December 2012
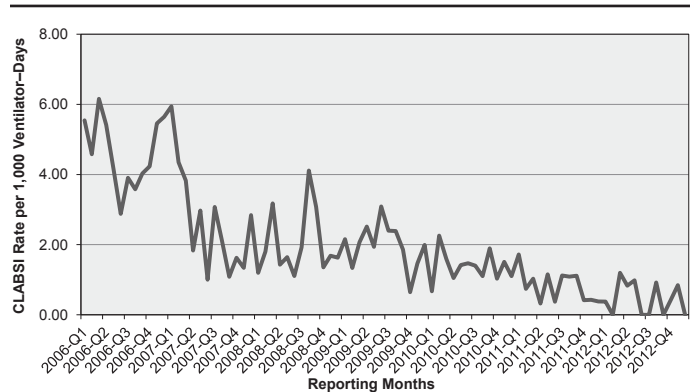
Figure 6. *The trajectory of the aggregate rates of the VAP rates across the 10 MHHS hospitals with patients on ventilators is shown. Q, quarter.*

0.57 during improve (p = 0.045). NICU CLABSI rates did not change significantly. The rate in the baseline period was 1.97 per 1,000 NICU central line–days and 1.84 during control (p = 0.503). These latter events, however, were very uncommon, and the present study was not powered sufficiently to detect the magnitude of change observed for the other two outcomes. Power calculations showed that to detect a 50%

Table 1. Main Results by Study Phase											
Study phase	Dates	No. of months	Hand hygiene compliance (%)	No. of observations (000s)	*P* value vs. baseline	Adult ICU CLABSI rate (per 1,000 line-days)	Line-days (000s)	*P* value vs. baseline	VAP rate* (per 1,000 vent days)	Vent-days (000s)	*P* value vs. baseline
Baseline	Oct 2010– May 2011	8	58.1	31.6	—	0.83	29.1	—	1.04	22.1	—
Improve	June 2011– Nov 2012	18	84.4	145.1	< 0.001	0.63	70.5	0.298	0.57	45.8	0.045
Control 1	Dec 2012– Dec 2013	13	94.7	121.3	< 0.001	0.58	56.1	0.196	NA†	NA	NA
Control 2	Jan 2014– Dec 2014	12	95.6	110.1	< 0.001	0.42	49.7	0.024	NA	NA	NA

CLABSI, central line–associated bloodstream infection; VAP, ventilator-associated pneumonia; vent, ventilator; NA, not available.

* Improve period for VAP is June 2011 through December 2012.

† Data for VAP not available after December 2012 because of change in definition. (See text).

decline in the baseline rate with 80% power at a 0.05 significance level, a sample size of 493,900 NICU central line–days would have been required—more than 16 times greater than the actual number of NICU central line–days observed during the 25-month control phase of this study (*N* = 29,601). Because the study was so underpowered to detect differences in NICU CLABSI rates, no further analyses of this outcome were undertaken.

The main results of the analyses of hand hygiene compliance, adult ICU CLABSI, and VAP rates are summarized in Table 1 (above). Poisson regression analysis demonstrated a significant negative rate of change for VAP rates over time (slope = –0.049, *p* = 0.011) throughout the study period. The Poisson hierarchical mixed model analysis, controlling for the correlation of outcome rates within hospitals, demonstrated a significant negative rate of change for adult ICU CLABSI rates over the study period (slope = –0.015, *p* = 0.020). In the separate analyses using hand hygiene compliance as the covariate, Poisson regression demonstrated a significant negative rate of change for VAP rates as hand hygiene compliance increased (slope = –2.25, *p* = 0.023). The hierarchical Poisson regression for adult ICU CLABSI rates demonstrated a similarly negative rate of change as hand hygiene compliance increased, but the *p* value fell just short of the 5% level of significance (slope = –1.19, *p* = 0.063).

Discussion

In the quest to reduce HAIs, achieving and sustaining high levels of hand hygiene compliance have proved elusive goals for health care organizations, despite the high priority placed on them by organizations such as the World Health Organization and the CDC.[27,28] MHHS used the TST[29,30] to improve hand hygiene across its 12 hospitals. We evaluated the extent of improvement in hand hygiene compliance and the temporal association between that improvement and the rates of adult ICU and NICU CLABSI and VAP. Because one of MHHS's hospitals had participated in the Joint Commission Center for Transforming Healthcare's original hand hygiene improvement project,[13] had implemented hand hygiene improvement interventions throughout the hospital, and had increased compliance before the systemwide implementation of the TST, we limited this evaluation to MHHS's other 11 hospitals.

Using the TST, MHHS hospitals increased hand hygiene compliance from a baseline of 58.1% to 95.6% by the last 12 months of the control phase, a relative improvement of 65% (*p* < 0.0001).

These results compare favorably to the Center's original project, on which the development of the TST was based.[13] In that project, eight hospitals improved hand hygiene compliance from 47.5% to 81.0% (a relative increase of 70.5%) and sustained those improvements over the 11-month control phase of that project. One previous evaluation of the TST in 174 health care organizations demonstrated an increase in hand hygiene compliance from a baseline of 57.9% to 83.5% during the improve phase.[14] That study did not collect control phase data to assess for how long improvements were sustained. In the present study, a similar level of compliance was achieved during its improve phase (84.4%), but a higher level was achieved in the control phase and sustained for 25 months. The present study also demonstrated that MHHS achieved another important goal of the TST's control phase: reducing variability among its hospitals around a high level of average performance in hand hygiene compliance. Figure 3 shows that reduced variability visually, and the data analysis

demonstrated that the reduction was statistically significant.

This study also evaluated the association between rising rates of hand hygiene compliance and rates of two important HAIs: adult ICU CLABSI and VAP. We used Poisson regression analysis to assess the association of each of these outcomes in three different ways, using three different independent variables: study phase (baseline versus improve [VAP] or control [CLABSI]), the 51 months of the study period, and monthly hand hygiene compliance. These analyses produced six tests of association. Five of the six were statistically significant (study phase for both CLABSI and VAP, time in months during the study period for CLABSI and VAP, and monthly hand hygiene compliance for VAP). The sixth test (monthly hand hygiene compliance for CLABSI) was in the hypothesized direction of lower CLABSI rates with higher rates of compliance, but the *p* value of 0.063 did not meet the conventional 5% threshold of significance. We believe that these data provide strong evidence that MHHS's success in achieving and sustaining high levels of hand hygiene compliance likely played a significant role in reducing the rates of adult ICU CLABSI and VAP across the hospitals in its system.

Of further note, the baseline rate of adult ICU CLABSI was 0.83 per 1,000 line-days, which is considerably lower, for example, than the postintervention mean of 1.4 achieved in Michigan by 70 adult ICUs at 15 to 18 months of follow-up in the Keystone project.[31] It is also substantially lower than the 2009 United States national average of 1.65, as estimated by the CDC.[32] Similarly, the baseline VAP rate of 1.04 is lower than the CDC–estimated 2009 national rates for medical ICUs in major teaching (1.9) or in other hospitals (1.4), in surgical ICUs (3.8), or in combined medical/surgical ICUs (2.0 in major teaching hospitals, 1.4 in small [≤ 15 beds] units or 1.2 in larger [> 15 beds] units in other hospitals).[33] We believe that these low baseline rates were likely due to MHHS's previous implementation of the CLABSI and VAP bundles.[25,26] The data in Figures 4, 5, and 6 are consistent with but do not by themselves provide a robust test of this hypothesis. However, we believe that any effect of the previous implementation of the bundles on ICU CLABSI or VAP rates took place well before the hand hygiene improvement initiative. The aggregate data on rates of adult ICU CLABSI and VAP showed no time trend in the 12 months before the hand hygiene TST deployment began.

The data from this study suggest that procedure-specific processes to reduce infections related to devices such as central lines or ventilators or others, such as urinary catheters, may not achieve extremely low rates of infection unless they are accompanied by high rates of hand hygiene compliance.

CRITICAL SUCCESS FACTORS

Several critical success factors likely contributed to the significant increase in hand hygiene compliance during MHHS's TST RPI project. Leadership support and oversight were key to success because leaders allocated the necessary resources to complete the project, which was part of a larger initiative to becoming an HRO. Also key, the RPI project was led by an MBB seasoned in RPI methodology.

Leadership support enabled MHHS to spend critical time in each step of the TST, beginning with the first four steps of the TST process, "Getting Started," "Training Secret Observers and Just-in-Time (JIT) Coaches," "Measuring Baseline Compliance," and "Determining Factors," which mirror the Define, Measure, and Analyze phases of the Six Sigma DMAIC process. By spending adequate time in these initial phases before undertaking improvement interventions, staff were shown the value of accurate and robust data collection so that solutions would be targeted to address root causes and optimize the probability of hardwiring the improvement. Because of the perceived urgency of identifying and addressing problems, health care organizations conducting process improvement projects may rush through or entirely skip the first three phases of DMAIC and begin implementing improvements prematurely. By doing so, these organizations may not be able to completely define their problems nor collect robust data to accurately measure compliance or identify contributing factors. In these instances, root causes may not effectively be addressed, and the same problems will likely continue to appear.[34,35]

Also central to the project's success was the TST methodology and Web-based application, which guided MHHS on how to collect, input, and analyze reliable data from a sampling of observations provided by secret observers. When measuring hand hygiene compliance in the past, MHHS estimated its baseline compliance between 80% and 95%. Through the TST, MHHS accurately measured a compliance rate of 58.1% (95% CI, 42.7% to 72.1%). When estimated using the TST methodology, compliance was statistically significantly lower than previously estimated using known observers. In addition, implementing proven solutions targeted at the respective unit-level factors, as opposed to systemwide generic and standardized solutions,[13] contributed to the interventions' effectiveness and sustainability. Compliance rates continue to be monitored monthly using the TST and are reported throughout the organization, both contributing to the sustainability of the improvements. The hand hygiene measurement and improvement process is now considered "standard work"[36,37]—that is, work that is standard across the system—and will be continued

indefinitely. In addition, significant gains in hand hygiene compliance early in the project became motivating factors in their own right. As implementation matured, the sustained increase in hand hygiene compliance was associated temporally with a decrease in HAI rates throughout the system.

LIMITATIONS

This study has several limitations. The TST was not implemented using a randomized controlled design. Factors other than the interventions derived from the TST may have contributed to the observed increases in hand hygiene compliance. Although the training of the secret observers who collected data on hand hygiene compliance was standardized and maintained throughout the 51 months of the project, we did not formally assess interrater reliability among the observers. This study demonstrated a prolonged (25-month) period of sustained high levels of compliance following the deployment of TST–mediated interventions. The TST is designed to be used by organizations with no expertise in RPI.[14] However, MHHS has a strong RPI program, and its TST implementation was led by an MBB. Although 174 initial TST users demonstrated a level of improvement from baseline to the improve phase comparable to that reported here,[14] we do not know whether organizations without RPI expertise would experience the same level of sustained improvement (in the control phase) as demonstrated by MHHS. Finally, although we observed a substantial decrease in adult ICU CLABSI and VAP rates in temporal association with the increases in hand hygiene compliance, factors other than improved hand hygiene (for example, the Certified Zero Award recognition program) may have contributed to the reduction in these HAIs.

Conclusion

Using the steps and tools embedded in the TST for hand hygiene, from a baseline level of 58.1%, MHHS achieved a 65% relative improvement in hand hygiene compliance across 11 hospitals. A high level of compliance (94.7%) was achieved in the first 13 months of the control phase and sustained at 95.6% for the last 12 months of the study period. Baseline rates of adult ICU CLABSI and VAP were relatively low (0.83 per 1,000 line-days and 1.04 per 1,000 ventilator-days, respectively). In temporal association with the increases in hand hygiene compliance, these HAI rates decreased further, by relative rates of 49% and 45%, respectively. **J**

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References

1. Shabot MM, et al. Memorial Hermann: High reliability from board to bedside. *Jt Comm J Qual Patient Saf.* 2013;39:253–257.
2. Chassin MR, Loeb JM. The ongoing quality improvement journey: Next stop, high reliability. *Health Aff (Millwood).* 2011;30:559–568.
3. Wolterman D, Shabot MM: A new standard: Aim for safety of planes, nuclear plants. *Mod Healthc.* 2011 Aug 1;41(31):27.
4. Chassin MR, Loeb JM. High-reliability healthcare: Getting there from here. *Milbank Q.* 2013;91:459–490.
5. Joint Commission Center for Transforming Healthcare. Robust Process Improvement®. Accessed Nov 29, 2015. http://www.centerfortransforming healthcare.org/about/rpi.aspx.
6. Centers for Disease Control and Prevention. Hand Hygiene in Healthcare Settings: Guidelines. (Updated: May 19, 2011.) Accessed Nov 29, 2015. http://www.cdc.gov/handhygiene/Guidelines.html.
7. Joint Commission Center for Transforming Healthcare. Facts About the Hand Hygiene Project. Dec 2014. Accessed Nov 29, 2015. htttp://www .centerfortransforminghealthcare.org/projects/detail.aspx?Project=3.
8. World Health Organization. Clean Care Is Safer Care. Accessed Nov 29, 2015. http://www.who.int/gpsc/5may/en/.
9. Pittet D, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet.* 2000 Oct 14;356:1307–1312.
10. Rosenthal VD, Guzman S, Safdar N. Reduction in nosocomial infection with improved hand hygiene in intensive care units of a tertiary care hospital in Argentina. *Am J Infect Control.* 2005;33:392–397.
11. Larson E, Kretzer EK. Complaince with handwashing and barrier precautions. *J Hosp Infect.* 1995;30 Suppl:88–106.
12. Huis A, et al. A systematic review of hand hygiene improvement strategies: A behavioural approach. *Implement Sci.* 2012 Sep 14;7:92.

13. Chassin MR, Mayer C, Nether K: Improving hand hygiene at eight hospitals in the United States by targeting specific causes of noncompliance. *Jt Comm J Qual Patient Saf.* 2015;41:4–12.

14. Chassin MR, et al. Beyond the collaborative: Spreading effective improvement in hand hygiene compliance. *Jt Comm J Qual Patient Saf.* 2015;41: 13–25.

15. Joint Commission Center for Transforming Healthcare. Project Detail: Hand Hygiene Project. Accessed Nov 29, 2015. http://www.centerfortransforminghealthcare.org/projects/detail.aspx?Project=3.

16. Joint Commission Center for Transforming Healthcare. FAQs: Hand Hygiene TST®. Accessed Nov 29, 2015. http://www.centerfortransforming healthcare.org/faq.aspx?CategoryId=49#1111.

17. The Joint Commission. *Measuring Hand Hygiene Adherence: Overcoming the Challenges.* Oak Brook, IL: Joint Commission Resources, 2009. Accessed Nov 29, 2015. http://www.jointcommission.org/assets/1/18/hh_monograph.pdf.

18. Kohli E, et al. The effect of recognized observers on measurement of hand hygiene compliance in high and low performing inpatient units (abstract). Paper presented at the Annual Meeting of the Society for Healthcare Epidemiology of America, Orlando, FL, Apr 7, 2008.

19. Gould DJ, et al. Measuring hand washing performance in health service audits and research studies. *J Hosp Infect.* 2007;66:109–115.

20. Centers for Disease Control and Prevention. Outline for Healthcare-Associated Infections Surveillance. Apr 2006. Accessed Nov 29, 2015. http://www.cdc.gov/nhsn/PDFS/OutlineForHAISurveillance.pdf.

21. Gebski V, et al. Modelling interrupted time series to evaluate prevention and control of infection in healthcare. *Epidemiol Infect.* 2012;140:2131–2141.

22. Cameron AC, Trivedi PK. *Regression Analysis of Count Data*. Cambridge, UK: Cambridge University Press, 1998.

23. Molenberghs G, Verbeke G. *Models for Discrete Longitudinal Data.* New York City: Springer Science+Business Media, 2005.

24. Tukey JW. *Exploratory Data Analysis*. Reading, MA: Addison-Wesley, 1977.

25. The Joint Commission. Preventing Central Line–Associated Infections: Useful Tools, An International Perspective. CVC Insertion Bundles. Nov 20, 2013. Accessed Nov 29, 2015. http://www.jointcommission.org/assets/1/6/CLABSI _Toolkit_Tool_3-18_CVC_Insertion_Bundles.pdf.

26. Munro N, Ruggiero M. Ventilator-associated pneumonia bundle: Reconstruction for best care. *AACN Adv Crit Care.* 2014;25:163–175.

27. World Health Organization (WHO). *WHO Guidelines on Hand Hygiene in Health Care.* Geneva: WHO, 2009. Accessed Nov 29, 2015. http://apps.who .int/iris/bitstream/10665/44102/1/9789241597906_eng.pdf.

28. Boyce JM, Pittet D; Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/ APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. *MMWR Recomm Rep*. 2002 Oct 25;5(RR-16):1–45.

29. Joint Commission Center for Transforming Healthcare. Targeted Solutions Tool for Hand Hygiene. Accessed Nov 29, 2015. http://www.centerfor transforminghealthcare.org/tst_hh.aspx.

30. Joint Commission Center for Transforming Healthcare. Facts About the Targeted Solutions Tool® (TST®). Aug 2015. Accessed Nov 29, 2015. http:// www.centerfortransforminghealthcare.org/assets/4/6/TST_Fact_Sheet.pdf.

31. Pronovost P, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med.* 2006 Dec 28;355:2725–2732. Erratum in: *N Engl J Med.* 2007 Jun 21;356:2660.

32. Srinivasan A, et al.; Centers for Disease Control and Infection. Vital signs: Central line-associated blood stream infections—United States, 2001, 2008 and 2009. *MMWR Morb Moral Wkly Rep.* 2011 Mar 4;60(8):243–248.

33. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN) Report, Data Summary for 2009, Device-Associated Module. Dudeck MA, et al. 2010. Accessed Nov 29, 2015 http://www.cdc.gov /nhsn/PDFs/dataStat/2010NHSNReport.pdf.

34. Arthur J. *Lean Six Sigma for Hospitals: Simple Steps to Fast, Affordable, and Flawless Healthcare.* New York City: McGraw-Hill, 2011.

35. Futerer SL. *Lean Six Sigma Case Studies in the Healthcare Enterprise*. New York City: Springer, 2014.

36. Barnas K. ThedaCare's business performance system: Sustaining continuous daily improvement through hospital management in a lean environment. *Jt Comm J Qual Patient Saf.* 2011;37:387–399.

37. Womack JP, Jones DT. *Lean Thinking: Banish Waste and Create Wealth in Your Corporation,* 2nd ed. New York City: Free Press, 2003.

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Appendix 1. Time Line for Implementation of the Targeted Solutions Tool® (TST®) at Memorial Hermann Health System (MHHS)

Task	Lead Responsibility	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	March 2011	April 2011	May 2011	June 2011
Senior Leadership Alignment & Resourcing													
1. Develop system hand hygiene policy	Ginny Kennedy/QPS	■											
2. Communicate hand hygiene goal for FY11 to sites which is: *Establish reliable measurement system and identify contributing factors by unit.* FY12 will focus on targeted solutions based on FY11 data.	Dr. Shabot/Juan Inurria/QPS		■										
3. Provide site overview of hand hygiene plan to CNOs, Quality Dirs, Quality Pt Safety Council	Anne-Claire France/QPS	■	■										
Site-Specific Work Before CTH Web Portal Go-Live													
4. Identify facility-based site hand hygiene implementation team resources: • Executive Sponsor (CNO) • Facility Process Owner	Site Leadership	■	■	■									
5. If there is a need to stagger go-lives, devise how to divide all pt care units into three rounds.	Site Leadership	■	■	■									
6. Identify Round ONE Participating Units and Round ONE Process Owner	Site Leadership	■	■	■									
7. As requested, site-specific orientation to the CTH methodology is provided to each facility based implementation team including Executive Sponsor, Process Owners, Quality Directors, and ICPs.	Anne-Claire France/QPS		■	■									
8. Build a team of 3–7 in each round ONE participating unit	Round One Process Owners			■									
9. Identify 2-3 secret observers/data collectors per round one participating unit (EVS, Dietary, Plant Ops, Chaplains, make great secret observers)	Process Owner & Unit Teams			■									
10. Identify 1-2 JIT coaches per round ONE participating unit	Process Owner & Unit Teams			■									

		July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	March 2011	April 2011	May 2011	June 2011
Appendix 1. Time Line for Implementation of the Targeted Solutions Tool® (TST®) at Memorial Hermann Health System (MHHS) (continued)	Lead Responsibility												
CTH Portal Go-Live Sept 12													
11. Identify who will have access to Web-based CTH Portal	Process Owner & Unit Teams	▒											▒
12. Access and Play with CTH Portal	All identified to Access												
13. Round ONE secret observers trained and certified using portal resources	Site Team				■								
14. Identify Round TWO participating units and Process Owners	Site Leadership				■■	▮							
15. Round ONE secret observers initiate baseline data collection on participating units – use portal resources (collect 2 weeks of data and lock in process stability)	Site Team					■							
16. Round ONE Secret Observers continue to collect compliance data	Site Team					■	■	■	■	■	■	■	■
17. Identify Round TWO Secret Observers	Site Leadership						▮						
18. Lock in baseline data reflecting stable process for Round ONE – use portal resources. If data not stable then address special causes and collect addl data.	Site Team/QPS						■						
19. Train Round TWO Secret Observers using Web portal	Site Team							▮					
20. Identify Round THREE participating units and process owners	Site Team							▮					
Identify Contributing Factors													
21. Train round ONE just-in-time (JIT) coaches to collect contributing factors – use Web portal	Site Team						■						
22. Identify Round THREE Secret Observers	Site Team									▮			
23. Round TWO secret observers initiate baseline data collection on participating units – use portal resources (collect 2 weeks of data and lock in process stability)	Site Team								▮	▮			

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Appendix 1. Time Line for Implementation of the Targeted Solutions Tool® (TST®) at Memorial Hermann Health System (MHHS) (continued)

	Lead Responsibility	July 2010	Aug 2010	Sept 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	March 2011	April 2011	May 2011	June 2011
24. Round TWO secret observers continue to collect compliance data	Site Team									red	red	red	red
25. Round ONE JIT coaches collect contributing factors for non-compliance. Use portal resources	Site Team								navy				
26. Train Round THREE Secret Observers using Web portal	Site Team										light blue		
27. Identify contributing factors for Round ONE Units – use portal resources	Site Team									navy			
28. Train Round TWO JIT coaches to collect contributing factors	Site Team										red		
29. Round TWO JIT coaches collect contributing factors for non-compliance. Use portal resources	Site Team										red	red	
30. Identify contributing factors for Round TWO Units – use portal resources	Site Team												red
31. Round THREE secret observers initiate baseline data collection on participating units – use portal resources (collect 2 weeks of data and lock in process stability)	Site Team										light blue	light blue	light blue
32. Round THREE secret observers continue to collect compliance data	Site Team											light blue	light blue
33. Train round THREE JIT coaches to collect contributing data	Site Team										light blue		
34. Round THREE JIT coaches collect contributing factors for non-compliance. Use portal resources	Site Team											light blue	light blue
35. Identify contributing factors for Round THREE Units – use portal resources	Site Team												light blue

QPS, Quality and Patient Safety; FY, fiscal year; CNO, chief nursing officer; Dirs, directors; Pt, patient; CTH, Joint Commission Center for Transforming Healthcare; ICP, infection control preventionist; EVS, environmental services; Ops, operations; JIT, just-in-time; addl, additional.

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Appendix 2. Hand Hygiene Data Collection Form

Hand Hygiene Observation and Contributing Factor Form

Date of observations: Collected by: Role (circle one): Observer Coach   Unit:

Instructions:
1. Use a separate row for each entry or exit.
2. When there is a defect (wash in/out=no), check any applicable observed contributing factor.
3. The "observed by asking" section is for JIT coaches only.
4. Emergency situations are EXCLUDED from the data collection process.

Circle role of health care professional observed

RN = Nurse
NA = Nursing Assistant
MD = Doctor
RT = Respiratory Therapy
PT = Physical Therapy
Diet = Dietary Technician
Lab = Lab Technician
HSK = Housekeeping
CM / SW = Case Mgmt / Social Worker
Pharm = Pharmacist
Rad = Radiology Tech
all others please identify in comments

Column headers:
1. Observation Number
2. Check box if observed during rounds / Enter hour of observation (military) time / in 24-hour
3. (Role) RN NA MD RT PT Diet Lab HSK CM/SW Pharm Rad Other
4. Entry or exit: EN EX
5. Did person wash?: Yes No

Possible Contributing Factors to Washing

Observable:
6. Dispenser location
7. Dispenser empty
8. Dispenser broken
9. Equipment broken
10. Hands full supplies
11. Hands full meds
12. Improper use of gloves
13. Follow use of gloves
14. Frequent person entry or exit
15. Admissions or discharge process
16. Isolation area (gown + gloves)
17. Lack of immediate feedback
18. Distracted or forgot

Non Observable:
19. Perception HH not required
20. Perception of skin irritation
21. Other contributing factor

22. Comments

(Observation rows 1–10, columns: role RN NA MD RT PT Diet Lab HSK CM/SW Pharm Rad Other; EN EX; Yes No)

Contributing Factors

6. Dispenser location is not in path of person or is obstructed or hidden
7. Dispenser is empty
8. Dispenser is broken
9. Equipment shared or disposal area (use of equipment shared between patients (i.e., vital sign machine, portable x-ray, etc.)
10. Hands full: supplies or equipment (e.g., food trays, lab supplies)
11. Hands full meds
12. Gloves (e.g., improper use of or not washing before or after putting gloves on or off)
13. Person entering or exiting followed someone who did not wash
14. Frequent entry and exit of patient area
15. Admissions or discharge process
16. Isolation area (gown + gloves when required)
17. Lack of immediate feedback to person for hand hygiene compliance
18. Distractions/forgets/lack of knowledge/chose not to wash
19. Perception that if nothing is touched in the patient care area hand hygiene is not necessary
20. Perception of skin irritation or dislike of alcohol-based hand rub
21. Other

AP4