

Multidisciplinary Quality Improvement Intervention to Achieve Sustained Improvement in Hand Hygiene Reliability in a Pediatric Intensive Care Unit

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Abstract

Introduction: Suboptimal hand hygiene (HH) remains a significant modifiable cause of healthcare-associated infections in the intensive care unit. We report a single-center, quality improvement project aimed at improving adherence to optimal HH among physicians, nurse practitioners, and nursing staff, and to sustain any improvement over time. **Methods:** A key driver diagram was developed to identify 5 primary drivers of change: leadership support, education initiatives, patient-family engagement, increased audit frequency, and individual feedback to promote accountability. We examined HH compliance over 3 years in 3 phases (pre-intervention, intervention, and post-intervention). The intervention period involved a multimodal approach designed to influence unit culture as well as individual HH practice. HH screens were installed outside the patient rooms to provide just-in-time reminders and display of regularly updated HH adherence data for provider groups. **Results:** We recorded 6,563 HH opportunities, providers included nurses (66%), attendings (12%), fellow/resident (16%), and nurse practitioners (NP) (6%). All clinical groups demonstrated HH compliance >90% during the post-intervention period. The improvements in practice were sustained for a year after the intervention. **Conclusion:** Our report highlights modifiable factors that impact HH and may inform quality improvement interventions aimed at improving HH compliance at other centers. (*Pediatr Qual Saf* 2019;4:e227; doi: 10.1097/pq9.000000000000227; Published online November 6, 2019.)

INTRODUCTION

The World Health Organization's 2018 hand hygiene (HH) campaign focused on the prevention of sepsis, with the slogan "It's in your hands—prevent sepsis in healthcare."¹ Healthcare-associated infections

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To cite: Albert BD, Petti C, Caraglia A, Geller M, Horak R, Barrett M, Hastings R, O'Brien M, Ormsby J, Sandora TJ, Kleinman M, Priebe GP, Mehta NM. Multidisciplinary Quality Improvement Intervention to Achieve Sustained Improvement in Hand Hygiene Reliability in a Pediatric Intensive Care Unit. *Pediatr Qual Saf* 2019;6:e227.

Received for publication July 15, 2019; Accepted October 2, 2019.

Published online November 6, 2019

DOI: 10.1097/pq9.000000000000227



remain a significant preventable cause of sepsis and other complications that lead to patient morbidity and mortality. HH remains an important and effective method to prevent healthcare-associated infections in this high-risk environment and is, therefore, a high-impact target for quality improvement (QI) programs in the intensive care unit (ICU).

HH compliance among healthcare workers remains low and is particularly lower in the ICU setting as compared with other hospital settings. In a recent systematic review, overall average baseline HH compliance rate in the ICU before improvement initiatives was 41%.² The authors identified a multitude of human factors contributing to poor HH compliance. Adoption and sustainability of best practices at the bedside have been challenging, with many centers reporting low HH compliance as well as slow rates of improvement.

The central objective of our multidisciplinary quality improvement project was to increase HH compliance. Based on our baseline compliance before this project, we elected our initial HH adherence improvement goal as >90% by all core clinical providers in the pediatric intensive care unit (PICU). We developed a step-wise, multimodal approach using pre-identified key drivers to promote awareness, education, transparency, and motivation

to achieve this target. Our secondary objective was to maintain improvements in HH compliance for at least a 6-month post-intervention period.

METHODS

Description of the Pre-Intervention Phase

Setting. The Medical-Surgical Intensive Care Unit (MSICU) at Boston Children's Hospital is a 30-bed PICU with ~2,100 admissions per year in a quaternary 410-bed children's hospital. The MSICU staff is composed of 31 attending physicians, 16 critical care fellows, 5 pediatric residents (per month), 6 NP, and 150 nurses. The patient population includes children with a variety of diagnoses, including those requiring stem cell and solid organ transplantation; patients undergoing general and subspecialty surgical procedures; as well as patients requiring extracorporeal membrane oxygenation (ECMO) therapy. Twenty-seven of the thirty rooms are individual patient rooms with a wall-mounted dispenser of alcohol-based foam hand sanitizer and bottles of alcohol-based gel hand sanitizer near the entrance. Also, personal protective equipment is available in carts outside each patient room, as well as a sink with soap and water and wall-mounted dispenser of alcohol-based foam hand sanitizer inside each room.

Project Team. The project planning committee included senior unit leadership, including the unit quality improvement (QI) director, QI manager, medical directors, unit-based infection prevention nurse, and the nurse manager. Other members of the committee included infection preventionists, attending physicians, critical care fellows, clinical nurse specialists, nurses, and pharmacists. The Division of Critical Care Medicine provided administrative support and other resources including trained personnel for regular, random, "secret shopper" HH audits.

Baseline Data Collection. We recorded baseline HH compliance data for 1 year from August 2014–August 2015. We conducted random and concealed audits during both day and night shifts by multiple trained observers, using a commercially available mobile application called iScrub Lite (Swipesense, Inc. Chicago, Ill.) to record details of the HH procedure around patient opportunities.³ We categorized healthcare professionals based on their clinical discipline. We recorded the HH procedure during each patient encounter as compliant if the provider used an alcohol-based hand sanitizer when entering and exiting a patient's room. Observers captured encounters before and after patient contact when entering and exiting the patient room. We did not record hand washing in a sink inside the room. Unit culture includes using hand sanitizer upon exiting a room, even if hand washing was performed inside the room. Observers underwent training on iScrub Lite use and participated in a pilot phase with

expert supervision from critical care QI specialists to develop uniform auditing methods.

Project Design. After clarifying the goal of achieving >90% compliance, the interdisciplinary project committee conducted multiple brainstorming sessions and constructed a key driver diagram to identify targets for intervention (Fig. 1). This process allowed us to identify multimodal interventions to address the 5 primary drivers of change described below.

Description of the Intervention Phase

Buy-In From Unit Leaders. The involvement of physician and nursing leadership was the first step in our intervention. As part of the project team, the nurse manager, medical director, and quality director participated in weekly safety rounds in the PICU to remind staff about the importance of HH. Unit leadership was also involved in organizing the HH challenges that were conducted during the intervention phase. The project team modeled appropriate HH practice, and we posted photos of leadership demonstrating correct HH on electronic display screens outside patient rooms. Throughout the intervention phase, unit leaders discussed monthly data on HH compliance. We regularly presented these data at unit-wide meetings, divisional weekly clinical conferences, trainee sessions, and leadership meetings.

Education and Awareness Campaign. Our QI team conducted 2 HH challenges during the intervention period, each lasting 1 week in duration (Fig. 3). The challenges aimed to increase awareness and education about HH while creating competition between each professional category (attending physician, trainee physician, NP, and bedside nurse). HH t-shirts, buttons, posters, and email notifications were used to raise awareness during these campaigns. We rewarded the best performing group after each challenge with food incentives such as free coffee, pizza, and ice cream socials.

Transparency and Just-in-Time Reminders. Our main intervention was to provide timely reminders, just-in-time prompts, and encouragement for HH compliance by providing data and educational tips to providers at the point of contact with patients. To achieve this, we installed electronic visual display screens above the hand sanitizer dispensers outside patient rooms (Fig. 2). The screens displayed HH compliance comparing provider groups (attending physician, trainee physician, NP, and bedside nurse). The screens displayed relevant information/messages about preventing infections in the PICU and motivating visuals of unit leaders and attending physicians performing HH. We updated the screens every week to reflect current HH compliance data and relevant educational content. The purpose of these screens was to provide transparency on our HH performance (compliance rates) to engage families, to motivate providers, and to

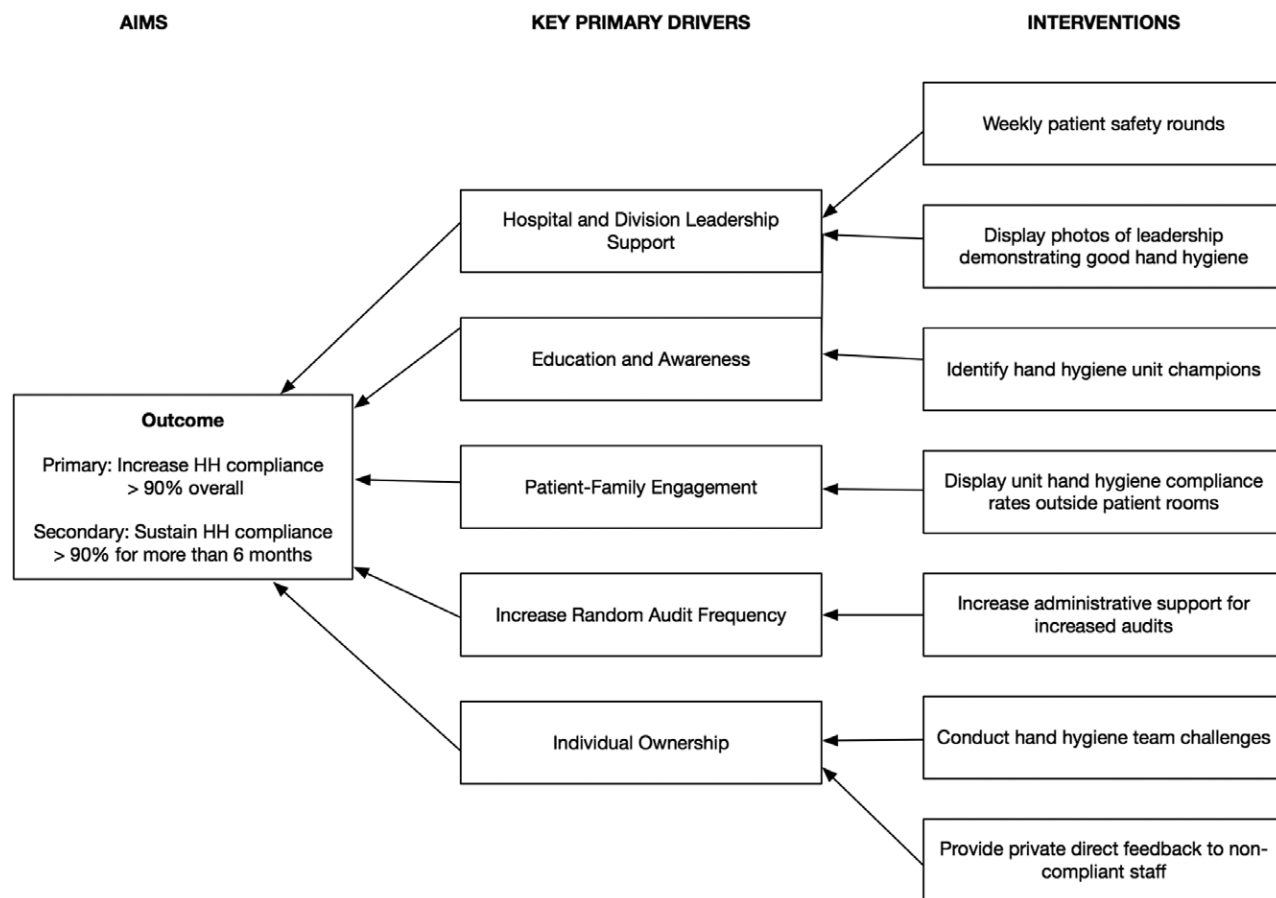


Fig. 1. Key driver diagram—increasing HH compliance in a PICU.

improve general awareness. QI leaders engaged in proactive education to the staff and provided just-in-time corrective advice to providers following any opportunities where HH practice was suboptimal. During leadership rounds, reminders about HH and personal protective equipment were given in real-time. Individuals with >1 instance of HH noncompliance received direct communication from unit leaders to understand individual barriers and to provide clear feedback on their performance and expectations. This feedback was given in private sometime after the event during a separate meeting. Parents were encouraged to discuss displayed results and our infection control measures with their care team members.

Description of Post-Intervention Phase

Sustaining the Impact of Interventions. To measure the sustained impact of the bundled interventions on HH compliance, we continued regular concealed audits. We continued the visual display of our compliance on the electronic bedside screens and presentations at divisional meetings during this phase.

Data Analysis. We recorded HH compliance as a percentage of total opportunities audited for each provider group. We plotted HH compliance rates on a control chart

over time, depicting mean compliance rate, with upper and lower control limits, across the pre-intervention, intervention, and post-intervention phases of the project.⁴ We followed the SQUIRE 2.0 guidelines as a framework in the reporting of our quality improvement project.⁵

RESULTS

We recorded a total of 6,563 HH opportunities over 3 years, from August 2014 to July 2017. The observed providers included nurses (66%), attending physicians (12%), fellow/resident physicians (16%), and NPs (6%). We completed audits to record HH opportunities during all 3 periods of the study: pre-intervention period (30%), intervention period (40%), and post-intervention period (30%). We have shown a breakdown of the audits for each clinician group during the phases in Table 1.

Baseline (pre-intervention) HH compliance rates were below our goal of 90% for all groups except nursing: attending physicians (83%), resident/fellow trainees (80%), and NP (86%). Overall, HH compliance was 87% in the pre-intervention phase.

Every clinical category improved HH compliance during the intervention period. Overall compliance during this period was 93%. In the post-intervention period, all



Fig. 2. Bedside screens for just-in-time display of HH audit results, information and motivational messages.

groups achieved >90% compliance; the groups sustained this rate for 11 months. Overall, HH compliance for the unit during the post-intervention period was 93%. We have shown the average compliance for each month of the study period in a control chart with annotation in Figure 3. The mean line was shifted for the intervention and post-intervention period based on special cause variation rule of 8 points above the average.⁴

DISCUSSION

In 2014, the quality improvement team in the MSICU at Boston Children's Hospital began performing unit HH audits to supplement the longstanding audits performed in all units by the Infection Prevention and Control program. From August 2014 to August 2015, we increased the number of observations and discovered suboptimal HH compliance among nearly all clinical provider groups. These observations prompted the implementation of a step-wise multipronged intervention aimed at increasing and sustaining HH compliance. Our single-center experience of improving compliance among all clinical providers above our goal for >6 months may provide a template for efforts aimed at improving HH performance in other ICUs. Low compliance rates with HH continue to be reported in both adult and pediatric ICUs.⁶⁻⁸ Improvements in HH compliance have been previously achieved in a variety of hospital settings using multimodal interventions

that include the use of random audits, monitoring of alcohol-based hand rub application, direct feedback, standardized education materials, modeling good practices, infrastructural changes, and performance feedback strategies.^{2,9} The use of infrastructural interventions, such as placement of alcohol-based hand rub at all entry areas to patient rooms, has facilitated modest improvements in HH compliance.

Our study adds to the literature on interventions that result in improvements as well as sustainment of these improvements in HH compliance among multiple clinical disciplines. Our bundled intervention using some of the multimodal strategies that have previously been effective could be adopted and may be tested in other institutions.¹⁰⁻¹² These methods included education, motivation, social influence with the use of role models and incentives.² We also report several unique methods not previously reported in the literature, including the use of digital screens outside patient's bed space to display the HH compliance rates as a just-in-time motivator for providers, and transparency to patients and families. These electronic display screens were installed outside of 6-bed spaces as a pilot to demonstrate the need for a screen at each bed space in our ICU, for a total cost of \$30,000. This successful pilot may allow for the expansion of the installation of these screens throughout the entire unit. As described above, our study reiterates the importance of a multi-pronged intervention that addresses and changes >1 behavioral determinant.¹³

Human factors, such as clinician behavioral perception towards HH is an important determinant of compliance.^{14,15} Behavioral strategies to promote HH add benefit in addition to infrastructural changes and may be more successful in improving HH compliance.¹⁶ The control chart in Figure 3 describes natural cause variation in HH compliance, including the dip in compliance during the Fall of 2016. In the absence of a special cause variation, no new interventions were necessary during this period. In our study, the use of just-in-time reminders at patient rooms, easy access to hand sanitizer, feedback to providers on their HH procedures, dissemination of real-time compliance data, and inducements in the form of competition between provider groups were the interventions for behavioral change. Parent engagement was facilitated by the displayed results at the door and by encouraging them to discuss these findings with the providers and unit leaders.

The strengths of this study include the long study period (3 years) and the number of observations conducted (over 6,000 audits) reflective of HH practice by all the provider groups interacting with patients in the PICU. The use of covert and random HH audits allowed the capture of actual practice at the bedside. Covert audits ensured that increases in compliance were not merely a transient behavior change in the presence of auditors. To account for the Hawthorne effect on study results, we engaged in a prolonged post-intervention phase to

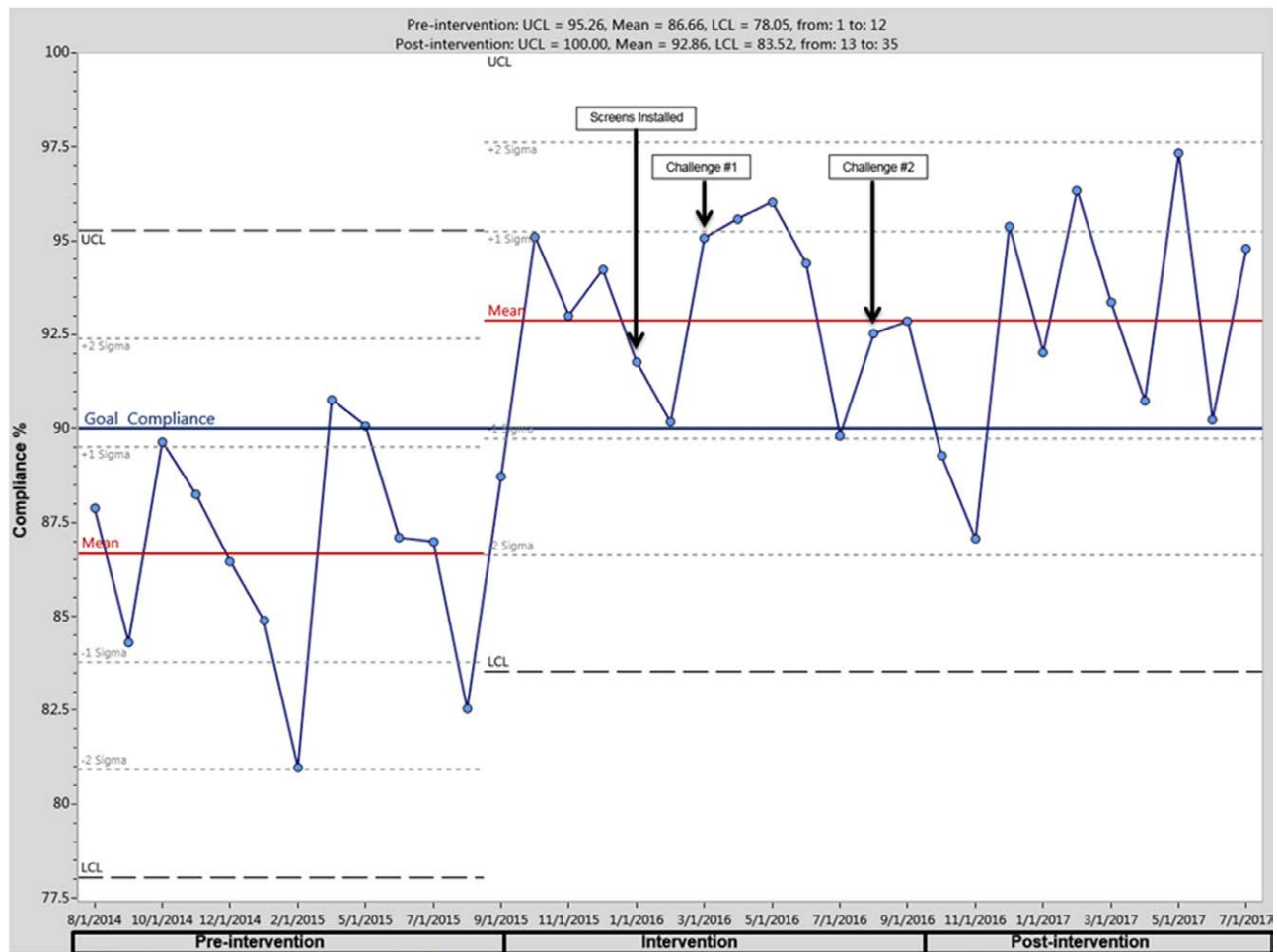


Fig. 3. Control chart of overall HH compliance among all staff (N = 6563 audits). Challenge 1 and 2 represent the HH challenges that were instituted during the intervention phase to boost education, awareness, and motivation.

Table 1. Compliant HH Audits Per Provider Group, N (%)

	Pre-Intervention Period	Intervention Period	Post-Intervention Period	Total Compliant Audits
Attending Physician	264/320 (83)	295/312 (95)	177/189 (94)	736/821 (90)
Resident/Fellow Physician	365/454 (80)	343/390 (88)	190/193 (98)	898/1,037 (87)
Critical Care Nurse	970/1,052 (92)	1,666/1,787 (93)	1,377/1,500 (92)	4,013/4,339 (92)
NP	107/124 (86)	122/126 (97)	115/116 (99)	344/366 (94)
Overall	1,706/1,950 (87)	2,426/2,615 (93)	1,859/1,998 (93)	5,991/6,563 (91)

N = successful HH audits (% = number of compliant audits/total audits).

determine the sustainability of the initial improvements in compliance beyond the booster campaigns.¹⁷ Finally, in our study, we used direct observation by experts or trained staff, and we were able to record the quality of HH in greater detail using a data capture electronic tool. Based on the WHO paradigm of the 5 moments of HH,¹⁸ we were able to observe specific moments of noncompliance during some of these moments, specifically during the entry and exit from patient rooms. We were able to provide targeted education and feedback. Compared with direct audits, electronic remote monitoring devices are often unable to describe the quality of

HH performed and the specific moment in patient-provider interaction.¹⁹

There are limitations to our study. Due to the bundled and multifaceted nature of our interventions, we were unable to assess the efficacy of individual components. We did not record the financial, time, and personnel resources that were necessary to record HH compliance. Personnel and administrative support from the Division and institutional funding for the HH screens helped support this project. The impact of the novel electronic screens cannot be individually quantified, and there is potential for awareness fatigue over time with families and providers

given the persistent display of data. Updated compliance numbers, frequent competitions, seasonal infection control messages around HH, and motivational visuals of leaders and colleagues performing HH, were aimed at reducing data fatigue. To maintain nonintrusive, random and “secret shopper” HH audits, the current study design did not accommodate detailed audits of moments inside the patient rooms. Hence, we did not capture all 5 moments of HH. We were able to capture moments before patient contact, after patient contact, and in some cases, after touching patient surroundings. Our study group is committed to a more detailed audit of select patients in future studies. The random nature of audits did not allow for controlling the proportion of observations in each discipline across the study periods. Finally, we cannot account for differences in sampling and accuracy within individual observers.

Our results demonstrate the feasibility and a template for effecting culture change where optimal HH performance is highlighted, assisted, encouraged, and improved by multimodal interventions. Eventually, the test of a culture change and successful intervention is the ability to sustain improvements in HH over an extended period. As in our study, this will require continued efforts, with intermittent boosting strategies, to maintain the awareness, motivation, and an environment that promotes good HH in the PICU.

CONCLUSIONS

We have reported improved HH compliance rates after an interdisciplinary, multipronged intervention in our medical-surgical PICU. We achieved a positive behavioral change across multiple groups of providers by using novel strategies aimed at education, buy-in, effective measurement, transparency, performance feedback, and culture change. We were able to record the improvements in HH practice for a year after the interventions. Future studies must explore individualized strategies for addressing HH compliance within specific healthcare provider groups. Strategies aimed at sustaining the improvements in practice over a longer period are desirable.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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