Utilizing Improvement Science Methods to Improve Physician Compliance With Proper Hand Hygiene

abstract

OBJECTIVE: In 2009, The Joint Commission challenged hospitals to reduce the risk of health care–associated infections through hand hygiene compliance. At our hospital, physicians had lower compliance rates than other health care workers, just 68% on general pediatric units. We used improvement methods and reliability science to increase compliance with proper hand hygiene to >95% by inpatient general pediatric teams.

METHODS: Strategies to improve hand hygiene were tested through multiple plan-do-study-act cycles, first by 1 general inpatient medical team and then spread to 4 additional teams. At the start of each rotation, residents completed an educational module and posttest about proper hand hygiene. Team compliance data were displayed daily in the resident conference room. Real-time identification and mitigation of failures by a hand-washing champion encouraged shared accountability. Organizational support ensured access to adequate hand hygiene supplies. The main outcome measure was percent compliance with acceptable hand hygiene, defined as use of an alcohol-based product or hand-washing with soap and turning off the faucet without using fingers or palm. Compliance was defined as acceptable hand hygiene before and after contact with the patient or care environment. Covert bedside observers recorded at least 8 observations of physicians’ compliance per day.

RESULTS: Physician compliance with proper hand hygiene improved to >95% within 6 months and was sustained for 11 months.

CONCLUSIONS: Instituting a hand-washing champion for immediate identification and mitigation of failures was key in sustaining results. Improving physician compliance with proper hand hygiene is achievable and a first step in decreasing health care–associated infections. Pediatrics 2012;129:e1042–e1050

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KEY WORDS

hand hygiene, handwashing, patient safety, joint commission, health care–associated infections

ABBREVIATIONS

CCHMC—Cincinnati Children’s Hospital Medical Center
GIS—general inpatient services
HCAIs—health care–associated infections
HWC—handwashing champion

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In developed countries, health care–associated infections (HCAs) affect 5% of hospitalized patients and ~9% to 37% of those admitted to intensive care units.\(^1\,^2\) The numbers are much higher in developing countries, with up to 19% of hospitalized patients acquiring a HCAI.\(^3\,^4\) The estimated HCAI incidence rate in the United States was 4.5% in 2002, corresponding to 9.3 infections per 1000 patient-days and 1.7 million affected patients, and ~99 000 deaths were attributed to HCAs.\(^5\) The annual economic impact of HCAs in the United States was ~$6.5 billion in 2004.\(^6\)

Several studies have shown that effective hand hygiene by health care professionals can reduce the incidence of HCAs.\(^7\,^8\) In 2009, with National Patient Safety Goal 7, The Joint Commission challenged hospitals to reduce the risk of HCAs through compliance with current Centers for Disease Control and Prevention\(^7\) or World Health Organization hand hygiene guidelines.\(^9\,^10\) Despite interventions, hospitals still struggle nationally with low compliance rates. A recent systematic review of observed and self-reported compliance with hand hygiene guidelines in hospitals found an overall median compliance rate of 40%.\(^11\) Compliance rates were lower in intensive care units than in other settings (30%–40% vs 50%–60%), lower among physicians than nurses (32% vs 48%), and lower before rather than after patient contact (21% vs 47%). Conducting dirty tasks (eg, involving contact with body fluids), introduction of alcohol-based hand rub or gel, performance feedback, and accessibility of materials were associated with higher compliance.

The results of ~2500 covert bedside observations in August 2006 showed that health care providers at Cincinnati Children’s Hospital Medical Center (CCHMC) performed proper hand hygiene both before and after patient care only 46% of the time (B.L.C., unpublished data). A quality improvement initiative aimed at nonphysician health care workers conducted by Linam et al on 2 CCHMC hospital units resulted in an overall health care worker compliance rate of 90%.\(^14\) However, as noted by many others,\(^13\,^15\) various surveys and observations revealed that physicians at CCHMC, with compliance rates of only \(\leq 69\%\), consistently lagged behind other care providers. On the general pediatric unit functioning as the first high reliability unit for the hospital,\(^20\) physician compliance with proper hand hygiene was only 68%.

By using improvement methods\(^21\) and reliability science,\(^22\) we expanded on Dr Linam’s work to develop and implement a sustained process to improve physician compliance with Safety Goal 7.

**METHODS**

**Setting**

CCHMC is a large, urban pediatric academic medical center located in the Midwest United States. In fiscal year 2010, CCHMC had more than 32 000 inpatient admissions in 511 registered inpatient beds. More than 2300 health profession students, residents, and fellows receive clinical and research training annually.

**Planning the Intervention**

The improvement team, consisting of a general pediatric hospitalist team leader, pediatric residents, a pediatric chief resident, third-year medical students completing their pediatrics rotation, an infectious disease and infection control fellow and attending, and a quality improvement consultant, mapped the hand hygiene process, conducted a failure mode and effects analysis,\(^23\,^24\) and examined the key drivers that prioritized interventions. The key drivers were revised over time. Figure 1 depicts the final key driver diagram. Our specific aim was to increase compliance with proper hand hygiene to >95% by general pediatric inpatient resident teams (consisting of attending physicians, residents, and medical students) on two 24-bed general inpatient units with all-private rooms. Acceptable hand hygiene was defined as use of an alcohol-based hand gel product or wipes to completely cover hands and fingers or washing with soap followed by turning off the faucet without using fingers or the palm of the hand. For patients in contact precautions, proper hygiene required entering the room wearing appropriate personal protective equipment, including gloves, and removing such equipment and washing hands before exiting the room.

**Improvement Activities**

Interventions focused on 4 main areas. Guided by improvement experts, changes were tested through a series of plan-do-study-act cycles.\(^21\) Strategies were initially tested on 1 general pediatric unit with a single inpatient general pediatric resident team consisting of an attending general pediatric hospitalist, a senior resident, 2 to 3 interns, and 2 to 3 third-year medical students and later spread to 4 other general pediatric resident teams and an additional inpatient medical unit over a 10-month period.

**Training**

- In October 2009, resident and medical student team members completed an online training module. The training occurred in team meetings at the beginning of their month-long rotation on the general pediatric teams. Resident team members were required to complete a pretest, a brief 10-minute interactive educational module, and a posttest. The module delineated proper hand hygiene practices, acceptable alternatives, commonly identified causes for failure, and a review of hospital staff
The general pediatric attending physicians were oriented at a weekly faculty meeting. The chief residents also sent an introductory e-mail about proper hand hygiene to the entire team, including outside rotating family practice residents, at the beginning of each month and discussed expectations at monthly team meetings. A letter with a link to the hand hygiene module was also sent to all community physicians who saw patients at CCHMC.

Visible reminders depicting hand hygiene expectations were also posted on the unit, including signs on patient doors that prompted health care team members to wash their hands on entering and exiting. The signs were adorned with phrases, such as “Spread the word, not the germs” or “Cross the line? Get rid of the grime,” and they included eye-catching pictures depicting germs on hands or lathering hands.

**Data Feedback**

- Initially, feedback on hand hygiene compliance was provided through daily e-mails to each team member on the pilot team by the project leader.
- Starting in December 2009, all results for team compliance were displayed on a large run chart in the resident conference room. The run chart initially displayed daily percent compliance and, later, weekly percent compliance for each team.
- For transparency of data and to incite competition among the teams, hand hygiene compliance was also intermittently announced by the pediatric chief residents during resident morning report.

**Identify and Mitigate**

- The improvement team designated a daily hand-washing champion (HWC) on each care team for family-centered rounds. The role of the HWC was to intervene with gentle, non-punitive reminders and provide alcohol gel to team members who did not perform proper hand hygiene upon entering or exiting a patient room. The HWC was identified each morning before rounds; any member of the team could fulfill this role. Typically, 1 of the third-year medical students would volunteer.

**Systems Support**

- Clinical nursing managers and housekeeping personnel were engaged to ensure appropriate placement and an adequate number of full soap and alcohol gel dispensers at the point of care. Alcohol wipes were placed in the baskets of mobile computers assigned to various resident teams. If the use of soap and water was the only acceptable mode of proper hand hygiene based on a suspected or established clinical patient diagnosis (ie, *Clostridium difficile*), “stop” signs were placed on alcohol dispensers in that room to remind team members of the appropriate hand hygiene technique.

**Data Collection**

Data were collected from June 2009 through March 2011. All team members were exposed to the interventions, but data were collected and analyzed only for resident and attending physicians.
Compliance was defined as acceptable hand hygiene before and after contact with the patient or the patient's care environment. Baseline compliance was initially collected covertly by patient attendants, as was done in the Linam et al study. At CCHMC, patient attendants provide housewide, 24-hour bedside observation of patients who are at risk for self-injury, removal of medical devices, flight, or abduction. However, they are not frequently placed in general pediatric patient rooms because these children usually do not require constant supervision. Thus, because of low numbers of observations of physicians on the general pediatric units, the role of covert bedside observer was transitioned to third-year medical students to optimize the number of physician-specific observations. All covert observers recorded hand hygiene for at least 8 observations of physicians per day, both during rounds and throughout the day. We used the same data collection tool as Dr Linam, tailoring it to only capture physician-specific data (Fig 2). Each month, a member of the improvement team oriented the medical student observers on appropriate hand hygiene techniques and data collection. To prevent the introduction of bias, the same medical student who was the covert observer for the day did not also serve as the HWC. Initially, the pediatric chief resident guaranteed that the medical students had the data collection sheets and that the collection boxes were frequently checked. After the project was in sustain mode, this role was transitioned to an administrative assistant.

**Analysis**

Run and control charts were created by using Microsoft Excel to examine the impact of interventions on physician compliance with proper hand hygiene over time. Combined team compliance data were grouped by week for ease of display. A P control chart was constructed on the basis of count data with a binomial distribution.

### Hand Hygiene Team

<table>
<thead>
<tr>
<th>General Pediatrics Team:</th>
<th>Red</th>
<th>Orange</th>
<th>Blue</th>
<th>Purple</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>Unit (circle one): A6S A6N</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Please identify who was observed:**

AT: Attending<br>Sr: Senior resident<br>IN: Intern<br>Do not record observations of your fellow medical students

**Remember to complete 8 daily before & after observations**

<table>
<thead>
<tr>
<th>Who was observed?</th>
<th>Gloves</th>
<th>Hand hygiene before patient encounter</th>
<th>Was the faucet turned off properly if washed with soap?</th>
<th>Hand hygiene after patient encounter</th>
<th>Was the faucet turned off properly if washed with soap?</th>
<th>Did the observation take place on rounds?</th>
<th>Comments/notas on noncompliance or need for reminding by Handwashing Champion</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT Sr IN</td>
<td>G</td>
<td>? N A W Y N</td>
<td>? N A W Y N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT Sr IN</td>
<td>G</td>
<td>? N A W Y N</td>
<td>? N A W Y N</td>
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<td>? N A W Y N</td>
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</tr>
</tbody>
</table>

G = Gloves (not necessary to mark anything else in the before column, but remember to observe after patient encounter)<br>Y = Unknown or not observed<br>N = No hand hygiene<br>A = Alcohol gel or wipe<br>W = Washed with water and soap (be sure to complete faucet column—automatic sinka count as "Y" for sink off properly)

Were the rooms and hallways sufficiently stocked with paper towels, soap, alcohol, etc.? Y N

If supplies were missing, please explain and give room number/location:

**FIGURE 2**

Data collection sheet used by covert bedside observers. Covert reviewers were encouraged to obtain at least 8 daily observations of physicians during rounds and throughout the day.
DISCUSSION

Improvement science is the application of the scientific method in an effort to improve the systems and processes that impact the delivery of health care.21,30 We used improvement science21 and reliability22 methods to implement a successful process for improving physician compliance with proper hand hygiene. Improvement activities focused on the key drivers to successful and sustained compliance with proper hand hygiene identified by the team after the failure mode effects analysis: training, data feedback, identify and mitigate, and systems support. As seen with other hand hygiene improvement strategies.14 including a point- and time-of-need mitigation strategy was key to our success. We believe these strategies are generalizable to other institutions.

Although education and training are low reliability tools,22 they were essential to clearly define expectations and dispel false beliefs about proper hand hygiene. Our institution did not differ from those depicted in the literature, because many physicians believed that, if they did not touch a patient themselves, hand hygiene was unnecessary. Also, health care workers may underestimate how often they touch items in the patient’s environment, such as a bedside table or television. Thus, education and training were chosen as our first intervention, and all subsequent interventions relied on the premise that physicians were knowledgeable about the proper hand hygiene expectations.

Other hospital-based hand hygiene initiatives have had short-term success with improving compliance with hand hygiene.17,31–33 but successful programs that have sustained their success are rare in the literature. The use of improvement science methodology21 and a multifactorial approach were instrumental in our ability to sustain compliance. Consistent feedback and transparency of data played an integral role in ensuring that the intervention was sustainable. Clearly displaying results in the form of a poster proved to motivate residents and incite competition with hand hygiene compliance. The addition of alcohol dispensers outside each room helped to address time constraint, 1 of the most commonly reported reasons for poor compliance.54–58 Our project complemented previous studies suggesting that health care workers prefer the use of alcohol gel over soap and water due to ease of access and less skin irritation.40,41

Most important, the institution of the daily HWC was vital in providing immediate feedback and gentle, non-punitive verbal reminders to promote and sustain compliance and shared accountability. However, when daily HWCs were not identified, compliance decreased. There was initial concern that third-year medical students would hesitate to correct or remind physicians of a higher training level, particularly the attending physician who contributed to their grade for the inpatient rotation. However, we found that the daily HWCs embraced the role, becoming more active members of the team. Champions also reported that physicians readily accepted reminders, because they did not consciously choose not to wash their hands, but frequently were too engaged in the activities of rounds and forgot. Furthermore, involving medical students instills good

### TABLE 1

<table>
<thead>
<tr>
<th>Mode of Hand Hygiene by Physicians</th>
<th>Observations (n = 3917)</th>
<th>Before Patient Encounter</th>
<th>After Patient Encounter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of washing, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None (failure)</td>
<td>69 (1.8)</td>
<td>125 (3.2)</td>
<td></td>
</tr>
<tr>
<td>Soap and water</td>
<td>24 (0.6)</td>
<td>74 (1.9)</td>
<td></td>
</tr>
<tr>
<td>Alcohol gel or wipe</td>
<td>1859 (46.9)</td>
<td>3718 (94.9)</td>
<td></td>
</tr>
<tr>
<td>Gloves*</td>
<td>1985 (50.7)</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recorded time of observations (n = 2714)</th>
<th>During rounds</th>
<th>Not during rounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations, n (%)</td>
<td>2658 (97.9)</td>
<td>56 (2.1)</td>
</tr>
</tbody>
</table>

*Personal protective equipment required; patients were in isolation. Gloves were removed after the patient encounter, and physician hand hygiene was rated as none, soap and water; or alcohol gel or wipe.
hand hygiene practices early in the careers of these future physicians and introduces them to improvement science. The medical students also provided insightful comments that exposed unanticipated failures, such as “the residents hit the alcohol dispensers and rubbed their hands together, but the dispensers were actually empty.” Although the role of HWC was best allocated to the medical students at our institution, administrative support team members who join the team daily could likely fulfill a similar role.

Our project’s aim was to improve physicians’ hand hygiene compliance, but, as hand hygiene compliance improved and was integrated into the daily routine, the residents and medical students identified other health care workers who were noncompliant. On their own initiative, HWCs expanded their role and reminded nurses, social workers, therapists, and visitors to wash their hands. This shared accountability was an unintended outcome of our work and a springboard for future improvement projects that encompass all healthcare workers.

Limitations

The use of third-year medical students as covert observers could have introduced observational bias. We chose the third-year medical students because they round with the team in the morning and observe the residents throughout the day and evening. To decrease the risk of observational bias, the data were submitted anonymously, and the observers’ participation did not affect their grade for the rotation. The limited number of available observations by patient attendants on the general inpatient units during the same time frame showed a median physician compliance with proper hand hygiene of 94%, validating our findings. Ensuring that the medical student data collection sheets were turned in every day was a challenge, and sustainability of data collection was arduous. There may also have been a Hawthorne effect, because the residents knew they were being observed but did not know who the observers were or when the observations were taking place. Of note, our initial interventions were implemented in October 2009, the same time that H1N1 influenza cases began to increase at CCHMC. Thus, the H1NI epidemic potentially affected our results favorably, because physicians were motivated to protect themselves and patients from H1N1.

Only 2% of the observations were collected outside of rounds. This could have resulted in sampling bias that...
overestimated physician compliance. Outside of rounds, without the helpful reminder of the HWC, physicians may be more likely to be noncompliant with hand hygiene.

One additional challenge of this physician-driven project was that the residents and medical students changed each month. The monthly education of residents about proper hand hygiene was time-consuming initially. Including the online module as part of the intern orientation at the beginning of the academic year helped streamline the process. Initial failures also identified educational gaps among groups not regularly on the team. Targeting training for these physicians, including community physicians, random weekend residents, and outside rotators, was difficult. In these cases, the role of the identified HWC was vital to help prevent failures by both regular team members and visitors. Initially, we struggled with sustainability of the identification of the hand-washing champion. Reminder stickers asking “who is the hand-washing champion today?” placed on a discharge prediction sheet routinely picked up by the team each morning proved helpful.

We are unable to associate our improvement in physician hand hygiene compliance with a decrease in HCAIs. The infection control program at CCHMC tracks all HCAIs on intensive care units, and surgical site infections, catheter-associated blood stream infections, and epidemiologically significant pathogens, such influenza, respiratory syncytial virus, C. difficile, and rotavirus infections, on general medical units. Because HCAIs are relatively rare on our general medical floor, which has private rooms, the infection control program does not track the specific rate.

Our next steps include spread to other resident teams and throughout the hospital and developing parent/patient-initiated interventions. We will take advantage of the momentum created by this physician-focused project to spread our learnings to other health care workers and units to foster shared accountability among the entire health care team, with the goal of decreasing housewide HCAIs. To validate our results and track compliance more specifically throughout the hospital, we have obtained badge tags that identify physicians by level of training (medical student, resident, fellow and attending) and specific division (general pediatrics, pediatric surgery, dermatology, etc). Currently the patient attendants

**FIGURE 4** Run chart showing compliance by level of training.
only track compliance by health care worker designation (nurse, physician, physical therapist, etc.). Obtaining more specific data by noting the physician specialty on their badges will aid in identifying the specialties still needing improvement and will evaluate whether the residents’ improvement in hand hygiene compliance is sustainable as they rotate to other services and units.

CONCLUSIONS

Improvement science was instrumental in developing and sustaining physician compliance with proper hand hygiene. Instituting a HWC to immediately and nonpunitively identify and mitigate failures was key in sustaining the process and results. Improving physician compliance with proper hand hygiene is achievable and the first step in decreasing HCAIs. Next steps include spreading this intervention throughout the hospital, including parent/patient-initiated interventions.

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