

FINDINGS



CLEAN HANDS SAVE LIVES:

A Systems Approach to Improving Hand Hygiene

An Issue Brief on Infection Control

INSIDE YOU WILL LEARN ABOUT:

The importance of hand hygiene in improving safety, quality, and economic impact.

A systems approach to hand hygiene that integrates environmental, operational, and personal factors for infection prevention.

New, effective, and easy-to-implement hand hygiene measures.

This issue brief was created as a benefit for the Affiliate+ Program.



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Clean Hands Save Lives: A Systems Approach to Improving Hand Hygiene

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Executive Summary

Hand hygiene is the single most important component of healthcare-associated infection prevention. Many such infections are now linked to healthcare provider reimbursement in the United States. However, maintaining and improving hand hygiene compliance has been an ongoing battle despite efforts on facility, organizational, national, and international levels. Based on a literature review, this issue brief summarizes hand hygiene promotion efforts following four main strategies. Each strategy integrates environmental, organizational/operational, and personal elements.

- Strategy 1: Increase knowledge/awareness through education. Such programs should be tailored to particular staff and include clearly articulated guidance, social influence, and leadership support.
- Strategy 2: Provide real-time monitoring/reminders. Leverage new monitoring and communication technology, stakeholder engagement, and visual (or other) cues to direct attention to hand hygiene tasks during routine work.
- Strategy 3: Make it easy to clean hands. Install hand hygiene facilities (e.g., sinks and gel dispensers) in convenient locations, and design processes more effectively to incorporate hand hygiene as an important step in the workflow and to maximize staff time in direct patient care.
- Strategy 4: Improve hand cleanliness through environmental hygiene. A clean environment can reduce the risk of pathogen transmission by contaminated hands.

Increasingly, a systems approach is used to implement multiple strategies simultaneously to maximize the impact on hand hygiene and infection prevention. This approach may help healthcare organizations to enhance safety and improve viability.

Hospital-Acquired Conditions, Infections, and Healthcare Reform

As discussed in the Healthcare Reform brief, various infections are included as part of the Hospital-Acquired Conditions (HAC) program and the related Hospital-Acquired Conditions Reduction program. In FY15, these include catheter-associated urinary tract infections (CAUTI) and central line-associated bloodstream infections (CLABSI). In FY16 they will also include surgical site infections following both colon surgery and abdominal hysterectomy. In FY17, the list will expand again to include MRSA Bacteremia and *Clostridium difficile* (C. diff). These represent two of the most challenging drug-resistant infections faced by healthcare organizations today, often referred to publicly as “superbugs.”



Strategies to Improve Hand Hygiene

The Cost of Infections

According to an analysis conducted by the Centers for Disease Control and Prevention, the annual direct medical costs of HAIs range from \$35.7 to \$45 billion (Scott, 2009).

Background

The Economic Burden of Healthcare-Associated Infections (HAIs)

According to an analysis conducted by the Centers for Disease Control and Prevention (CDC), the annual direct medical costs of HAIs range from \$35.7 to \$45 billion (Scott, 2009). In one study, the estimated average cost of each hospital-associated *Clostridium difficile* (*C. difficile*, or *C. diff*) infection was almost \$29,000, with nearly 12 additional hospital days (Lipp, 2012). Another study estimated the mean cost for *C. difficile*-associated diarrhea as \$35,000 (Palli, 2015). A recent study also found a 19-day increase in the average length of stay for patients with hospital-associated MRSA, with an estimated average additional cost of \$16,665 per patient (Carboneau, Bengel, Jaco, & Robinson, 2010). In Scott's analysis (2009), estimates for surgical site infections range from about \$12,000 to \$35,000; central line-associated bloodstream infections (CLABSI) range from about \$7,000 to \$29,000; and catheter-associated urinary tract infections (CAUTI) are approximately \$1,000.

The Role of Hand Hygiene in HAI Prevention

Hand hygiene has been considered the single most effective measure to prevent HAIs (Al-Tawfiq, Abed, Al-Yami, & Birrer, 2013). Mounting research findings indicate that healthcare workers' hands play an important role in the transmission of pathogens in healthcare environments. Healthcare providers' hands may become contaminated when they touch dirty surfaces or infected patients during care, then carry the pathogens (if proper hand hygiene is not performed) and eventually transmit them to other environmental surfaces or



patients. For example, after caring for patients with *C. difficile*, staff hand contamination ranged from 14% to 59% (Loo, 2015).

The reduction of hand contamination is an important step in the fight to break the chain of pathogen transmission through contact. In a recent study, CLABSI rates decreased from 4.08/1,000 device days to 0.42/1,000 device days following a phased multifactorial program to increase hand hygiene compliance. The authors estimated this result to equal about 50 fewer infections each year, and as many as nine fewer deaths (Johnson et al., 2014). While infections can also be reduced through contact precautions and single-bed patient rooms, the aim of this brief is to review the latest research pertaining specifically to hand hygiene. Another important aspect is maintaining environmental cleanliness (a subject covered in a separate issue brief).

Hand Hygiene Guidelines

Over many years, research has consistently suggested that improvement in healthcare provider hand hygiene performance leads to a significant reduction in HAI rates (Boyce, Pittet, Healthcare Infection Control Practices Advisory Committee, & HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force, 2002). For this reason, national and international organizations have devoted substantial efforts to the creation of evidence-based guidelines for healthcare workers' hand hygiene. In 2002, the CDC published the "Guideline for Hand Hygiene in Health-Care Settings." More recently, the World Health Organization (WHO) published the "WHO Guidelines on Hand Hygiene in Healthcare," establishing five "Moments for Hand Hygiene." These guidelines clearly define the key moments during patient care when hand hygiene should be performed, and how it should be performed. Importantly, they also clarify misleading and conflicting language by providing unified guidance in simple terms that healthcare workers can quickly understand and follow in their daily work.

WORLD HEALTH ORGANIZATION'S FIVE MOMENTS FOR HAND HYGIENE

- 1 Before patient contact
- 2 Before aseptic task
- 3 After body fluid exposure risk
- 4 After contact
- 5 After contact with patient surroundings

(For more details, visit http://who.int/gpsc/tools/Five_moments/en/).

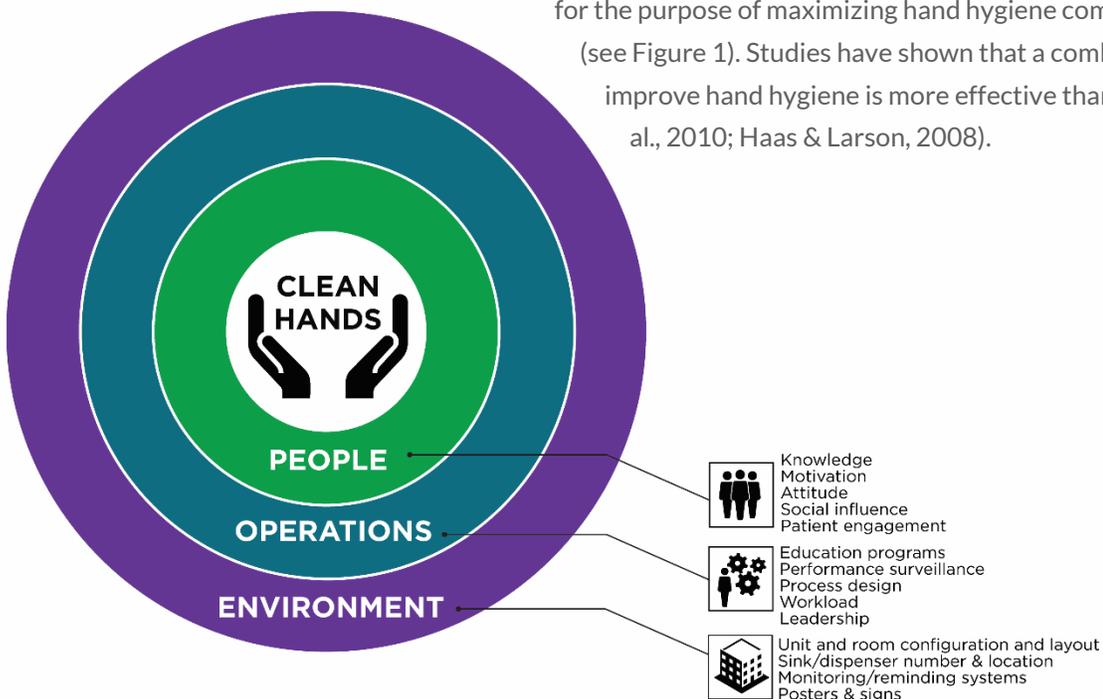


Improving Hand Hygiene Compliance: An Ongoing Battle

In addition to supporting hand hygiene improvement efforts on the national and international levels, many facilities have implemented hand hygiene improvement programs at the organizational level. However, maintaining and improving hand hygiene compliance among healthcare workers remains challenging. Multiple studies have reported that the compliance rate is still far from ideal. Healthcare providers clean their hands (using soap/water, alcohol-based gel rubs, and other methods) in only 25–60% of incidences when hand hygiene is necessary (Gould & Drey, 2013). Factors contributing to low compliance include lack of awareness of the significance of hand hygiene, inconsistent guidance on hand hygiene, skin irritation caused by cleansers and disinfectants, forgetfulness, high workload, and lack of resources (such as hand hygiene sinks and gel dispensers) (Gould & Drey, 2013).

A Systems Approach

A systems approach is emerging to address multiple factors which impact hand hygiene at the same time. This approach is a multifactorial strategy that integrates the built environment, people, and healthcare operations/processes for the purpose of maximizing hand hygiene compliance and performance (see Figure 1). Studies have shown that a combination of measures to improve hand hygiene is more effective than a single measure (Cheng et al., 2010; Haas & Larson, 2008).



*Figure 1:
The Environment,
Operations, and
People in Hand Hygiene*



The conceptual framework in Figure 2 summarizes hand hygiene improvement strategies based on a literature review of numerous recent publications. Higher hand hygiene compliance may lead to reduction in staff hand and environmental contamination (considering that providers' hands play a role in transmitting pathogens to environmental surfaces), both of which significantly reduce the risk of HAIs. HAI is an important healthcare safety and quality metric that impacts a facility's clinical outcomes and its bottom line, especially as healthcare payments/ reimbursements are increasingly linked to patient outcomes.

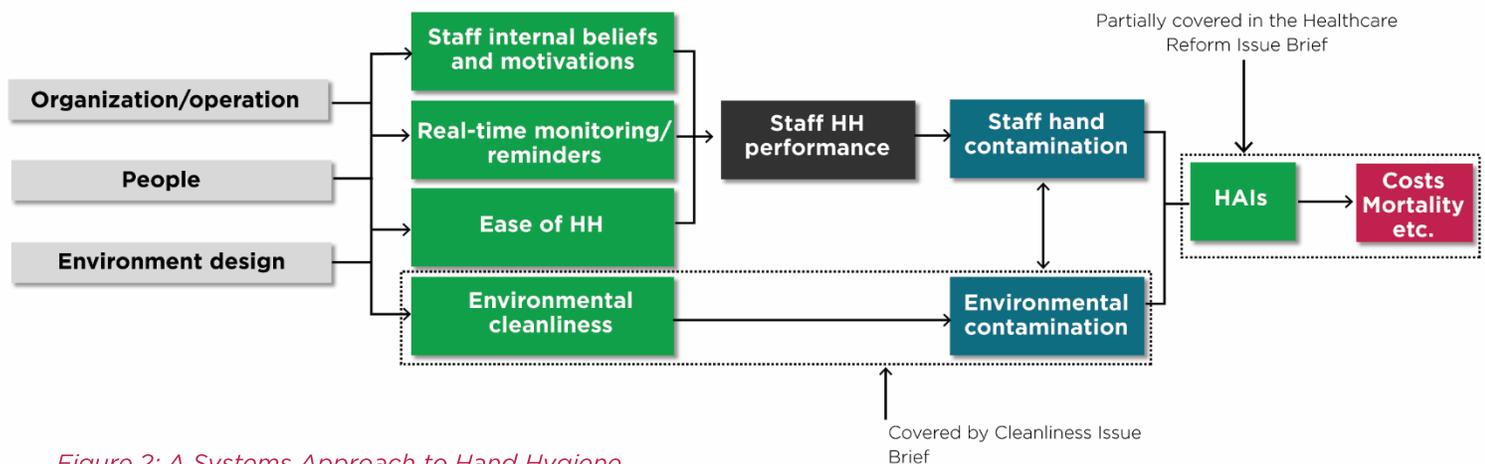


Figure 2: A Systems Approach to Hand Hygiene

Strategy #1: Increase Knowledge/Awareness Through Education

According to behavioral theories, human intentions are impacted by an individual's internal beliefs and motivations (Chagpar, Banez, Lopez, & Cafazzo, 2010). In the case of hand hygiene behavior, an individual healthcare provider's belief in the effectiveness of hand hygiene in preventing HAIs and improving patient safety is considered a very important motivating factor. Many healthcare organizations implemented educational programs aimed at increasing awareness and motivation. These programs included elements of leadership support (e.g., pressure from managers to address low compliance) and social influence (e.g., pressure from fellow staff or peers when noncompliance is observed) (Huis et al., 2013). Educational programs often involve a physical platform for delivering the message, such as computer screen savers, signs, and posters (Grant & Hofmann, 2011; Helder et al., 2012).



Several studies examined the effects of educational message content. In one study, messages emphasized the benefits of hand hygiene over the risks involved with noncompliance. This approach resulted in the reverse of a declining trend of hand hygiene compliance from a decrease of 2.3 hand hygiene events per patient day to an increase of 1.5 hand hygiene events per patient day (Helder et al., 2012, 2014). Another study compared educational messages focusing on healthcare providers' personal safety (e.g., "Hand hygiene prevents you from catching diseases") with those focusing on patient safety (e.g., "Hand hygiene prevents patients from catching diseases") and found that the latter message helped to increase the compliance rate (Grant & Hofmann, 2011). Healthcare staff reported that a poster highlighting the benefits of hand hygiene for patients and staff was better received in terms of attention,

Table 1: Hand Hygiene Strategies

Strategy	 Physical Environment Examples	 Process/Operation	 People
#1: Increase knowledge/awareness through education	Computer screen saver, sign, poster	Message content (e.g., gain-framed), well-defined hand hygiene procedure, education campaign, focus groups, leadership, signs about hand hygiene that emphasize personal safety	Social influence, motivation
#2: Provide real-time monitoring/reminders	Visibility of sinks and dispensers: <ul style="list-style-type: none"> • Sinks/dispensers in staff's vision fields during patient care • Color/materials, etc. to highlight sinks/dispensers • Signs (e.g., strip of bright red color on floor and wall) to direct attention to sinks/dispensers - Electronic monitoring system (e.g., electronic hand hygiene counters) - Video surveillance - Wireless technology - Automatic reminder (e.g., electronic motion-sensor-activated audible hand hygiene reminder) - Radio frequency identification (RFID) tracking systems	Policy of providing feedback/reports	Patient engagement in monitoring and reminding
#3: Make it easy to clean hands	Convenient locations of alcohol-based hand rub dispensers: <ul style="list-style-type: none"> • Bed-rail • Medical equipment (e.g., anesthesia machine in OR) • Sanitizer-dispensing door handle device • Wearable dispenser - Convenient locations (number) of sinks - Automated alcohol hand hygiene dispensers (e.g., battery-operated, touch-free dispenser, foot-operated sink) - Design allowing more time in patient care activities	Workload, process design (incorporate HH in workflow)	Personal habit
#4: Improve hand cleanliness through environmental hygiene	Single rooms, other environmental cleanliness methods	Refer to Cleanliness Issue Brief paper	



MEASUREMENT OF HAND HYGIENE COMPLIANCE

Several different methods of measuring hand hygiene compliance were found in the literature:

- Direct observation (overt or covert)
- Indirect observation (such as video recording)
- Hand hygiene product consumption
- Electronic systems recording use of hand hygiene devices (e.g., sensory devices, electronic counter attached to faucets/dispensers)
- Self-reporting (e.g., surveys)

For more detail, visit:
http://www.jointcommission.org/assets/1/18/hh_monograph.pdf

likability, and potential of hand hygiene promotion than another poster emphasizing the importance of hand hygiene in infection prevention (Mackert et al., 2014).

Strategy #2: Provide Real-Time Monitoring/Reminders

Healthcare work often involves multi-tasking; providers must be able to address the needs and requests of patients and fellow staff members at any given moment. Compared with other tasks, hand hygiene is sometimes put on a lower level of priority or ignored/forgotten when workloads are high. Providing ongoing real-time monitoring and reminders has been found to effectively combat this issue and improve overall hand hygiene compliance.

An electronic monitoring system that estimated hand hygiene frequency by measuring the amount of sanitizer and soap used, together with regular feedback in the form of graphic reports emailed monthly, were found to increase hand hygiene frequency by 0.17 incidences per patient hour across eight inpatient units (Conway et al., 2014). The authors estimated this to be the equivalent of four more hand hygiene events per inpatient per day. And while they indicated that this finding was statistically significant, they also indicated that the clinical significance is not known. The implementation of real-time feedback using wireless technology was found to increase the use of alcohol-based hand rubs (including frequency and amount of product used) (Marra et al., 2014). Electronic monitoring and automatic computerized reminders for failure to perform hand hygiene tasks located at patient room exits significantly increased hand hygiene compliance (Swoboda, Earsing, Strauss, Lane, & Lipsett, 2004, 2007). However, hand hygiene monitoring systems require improved measurement accuracy. In one study, radiofrequency identification (RFID) tracking systems were found to be accurate in simulated environments (accuracy rate 88.5%) but less accurate in real healthcare settings (accuracy rate 52.4%) (Pineles et al., 2014).

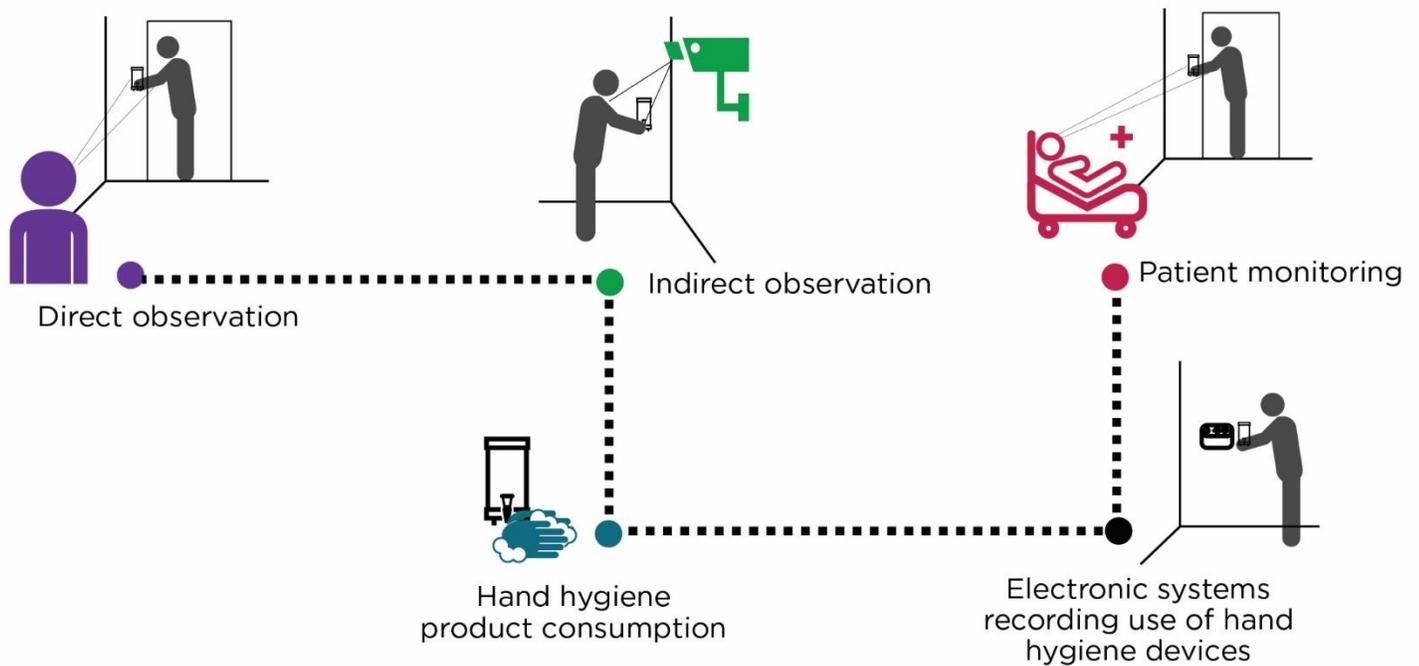
Another more labor-intensive way of implementing real-time monitoring is using video cameras, continuously monitored by auditors, to record hand hygiene compliance and provide performance feedback. Hand hygiene compliance in an intensive care unit increased from 30% pre-intervention to 80% post-intervention when this method was employed and the performance



feedback was displayed on electronic boards in hallways (Armellino et al., 2013).

In addition to electronic monitoring, providing visual or other cues for hand hygiene is another effective method. Examples include increasing the visibility of hand hygiene equipment such as sinks and gel dispensers with flashing lights or warning signs (Nevo et al., 2010). In one study, the visibility of sinks (as measured by the amount of floor area where a sink was in the line of sight by the staff) directly impacted the frequency and duration of sink use for hand hygiene purposes (Cloutman-Green et al., 2014). In a simulated experiment, physicians' hand hygiene compliance rate was significantly higher (53.8% vs. 11.4%) when an alcohol-based hand rub dispenser was placed in their field of view as they observed the "role-play" patient compared to when the dispenser was located out of view (Birnbach et al., 2010). In another example, bright red floor and wall stripes directing attention to gel dispensers as well as posters reminding staff of hand hygiene successfully increased the use of gel dispensers (Davis, 2010).

Olfactory cues may also help increase hand hygiene compliance rates. A research team conducted a simulated experiment with novice healthcare



Strategy 2: Provide Real-Time Monitoring/Reminders



providers where some were randomly assigned to standard rooms and others to rooms with active scent manipulations (Birnbach, King, Vlaev, Rosen, & Harvey, 2013). The study found that the control group (no scent) had a hand hygiene compliance rate of 51%, while participants in the experimental group (citrus scent) demonstrated a statistically significant difference with 80% compliance.

One final emerging method is the encouragement of patient observation of staff hand hygiene performance and reminders to clean their hands. A hand hygiene program in Canada integrated multiple elements including patient engagement, education, monitoring, and environmental modifications (e.g., adding gel dispensers) that resulted in better hand hygiene practice as reported by nurses (Didiodato, 2013).

Strategy #3: Make It Easy to Clean Hands

One barrier impeding hand hygiene is a lack of facilities (e.g., sinks, gel dispensers) supporting efficient hand hygiene performance. Alcohol-based hand rubs have been welcomed by staff because of their relative ease of use (e.g., shorter time to perform hand hygiene, more convenient location due to the small size, etc.). Many research studies have shown the effectiveness of introducing alcohol-based hand rubs, even though soap-water sinks are still essential for certain hand hygiene tasks, especially when there is visible soiling on hands (Cohen, Saiman, Cimiotti, & Larson, 2003). Other recent examples of facilitating the use of alcohol-based hand rubs included:

- Gel dispensers located where care is provided or hand hygiene is needed (e.g., mounted on patient bed-rails and anesthesia machines) (Giannitsioti et al., 2009; Munoz-Price et al., 2014);
- Wearable gel dispensers (Haas & Larson, 2008);
- Battery-operated touch-free dispensers (Larson, Albrecht, & O'Keefe, 2005); and
- Dispensers incorporated into door handle design (with sanitizer being sprayed automatically on hands when the handle was turned) (Babiarz, Savoie, McGuire, McConnell, & Nagy, 2014).

Another method of making hand hygiene easy to perform is increasing the availability of hand hygiene facilities at convenient locations. This method was utilized in a multifaceted hand hygiene initiative that successfully increased

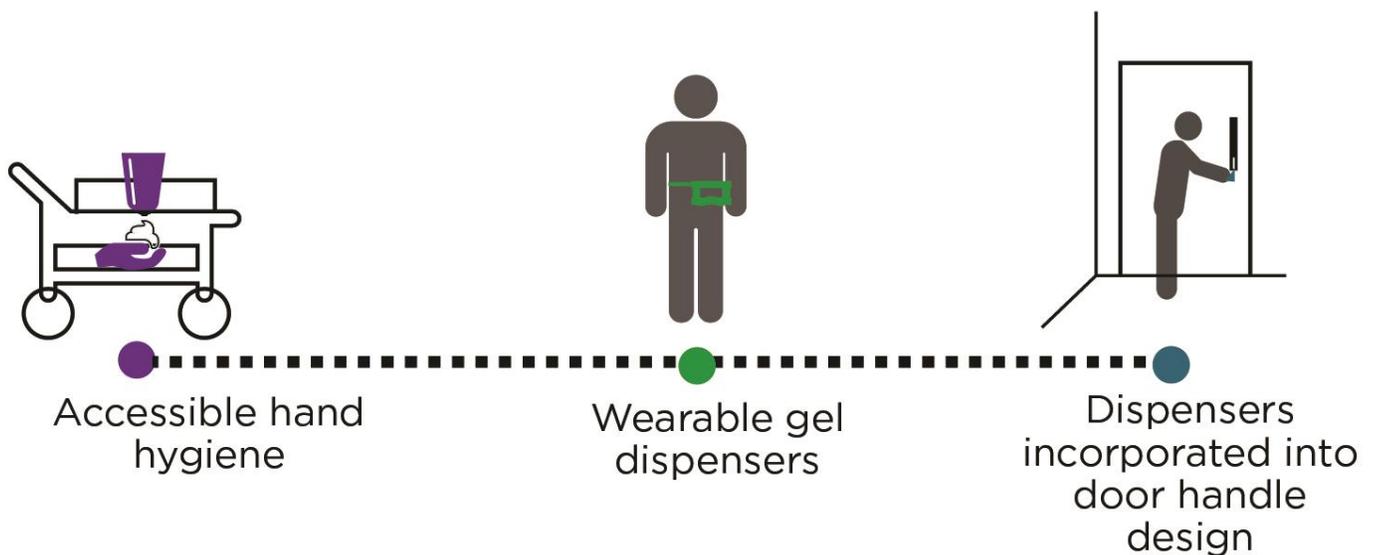


Public hand hygiene station post-SARs, Peter Munk Cardiac Centre, University Health Network Toronto (Image by 416style, used under <http://creativecommons.org/licenses/by/4.0/>)



hand hygiene compliance from 60% to 89%, and then to 96% (Kowitz, Jefferson, & Mermel, 2013) and in another initiative where compliance improved from 58% to 80.5% (Johnson et al., 2014). Similar results were found in other multifaceted programs (Lam, Lee, & Lau, 2004). However, research on the effects of increasing the number of hand hygiene facilities alone produced mixed results (Kaplan & McGuckin, 1986; Whitby & McLaws, 2004).

One barrier identified in hand hygiene compliance is the mismatch between healthcare operational procedures and hand hygiene. In many cases, workflow design does not efficiently incorporate hand hygiene as an integral step, such that hand hygiene may significantly increase the length of time for staff to perform care tasks (Chagpar et al., 2010). Because of the high workloads and multi-tasking demands of healthcare work, this process barrier leads to low hand hygiene compliance (Chagpar et al., 2010). This issue is also related to environmental design, which is not always fully compatible with processes (e.g., hand hygiene facilities located at the back of the room, far from where hand hygiene is often needed). Another related issue is the fact that a significant amount of staff time is spent on activities unrelated to direct patient care (Hendrich, Chow, Skierczynski, & Lu, 2008). Understanding and designing for the workflow of caregivers to increase staff time spent on direct patient care could contribute to the improvement of hand hygiene compliance by addressing the perceived ease of the task.



Strategy 3: Make It Easy to Clean Hands



Strategy #4: Improve Hand Cleanliness through Environmental Hygiene

As stated earlier, hand hygiene and environmental surface cleanliness are two interrelated and mutually influential components of the overall hygiene of healthcare settings. A cleaner environment may make it easier to maintain hand cleanliness. A recently published simulation study examined the effects of single- and four-bed patient rooms on hand contamination during six types of healthcare procedures. The study found that the physical barrier between single-bed rooms helped to limit the airborne dispersion of pathogens on environmental surfaces, improve environmental cleanliness, and subsequently improve hand sanitation levels (King, Noakes, & Sleight, 2015). Improved environmental cleanliness may somehow reduce the risk of hand contamination due to undesirable hand hygiene compliance (King et al., 2015). Details around the strategies of improving environmental cleanliness can be found in the Cleanliness issue brief.

Conclusion

Healthcare provider hand hygiene is widely recognized as the single most important method of infection prevention. Improving hand hygiene is a challenging but critically important effort. Effective strategies to improve hand cleanliness require a systems approach that includes the design of the environment to support educational activities, monitoring and feedback, and perceived ease of compliance:

- Reinforce and increase staff knowledge/awareness about hand hygiene through education programs tailored to particular staff, including clear guidance, social influence, and leadership support reinforced through signs, posters, and/or screen savers.
- Engage all stakeholders and provide real-time reminders, hand hygiene monitoring, and immediate feedback, supported by new technology (e.g., electronic monitoring systems, video surveillance, electronic hand hygiene counters, motion-sensor-activated audible hand hygiene reminders, RFID tracking systems). Use visual or other cues, such as color on floors and walls directing attention to hand hygiene devices.
- Make it easy to clean hands through conveniently located hand hygiene facilities (e.g., visible sinks and gel dispensers placed within workflows



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at ergonomically appropriate heights) and more efficient process design that incorporates hand hygiene as an important step in the workflow and maximizes staff time in direct patient care.

- Enhance environmental cleanliness to reduce the risk of cross-contamination potentially caused by low hand hygiene compliance.

For Additional Detail

For more detailed information on the classification systems referenced in Table 1, refer to the “Guideline for Disinfection and Sterilization in Healthcare Facilities” by the Centers for Disease Control and Prevention, authored by Rutala et al. (2008). The paper is available at www.cdc.gov/hicpac/pdf/guidelines/disinfection_nov_2008.pdf.



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