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Review

Approaches to hand hygiene monitoring: From low to high technology approaches

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ABSTRACT

Hand hygiene is a global and critical infection prevention practice across all healthcare settings. Approaches to monitoring hand hygiene compliance vary from simple methods such as direct observation and product usage to more advanced methods such as automated electronic monitoring systems. Current literature supports a multimodal approach, supplemented by education, to enhance hand hygiene performance.

Contents

Introduction

Hand hygiene is the foundation of infection prevention in the healthcare setting and one of the few interventions that has indisputable historical data to support its practice (Semmelweis, 1983; LaForce, 1997; Larson, 1995). Nevertheless, compliance with hand hygiene is suboptimal among healthcare providers (Boyce et al., 2002). Reasons for non-compliance with hand hygiene have been extensively evaluated and most commonly reflect busy workflows, lack of product availability, inadequate knowledge of indications, and skin irritation from repeated product use (Pittet, 2001). Thus, promotion of behavioral change for improved hand hygiene compliance remains an ongoing challenge for infection prevention programs globally.

Monitoring of healthcare worker hand hygiene performance is considered a standard in most acute care hospitals. Collection and feedback of compliance data is used to educate and engage healthcare providers in hand hygiene improvement campaigns. Data also allows Infection Preventionists to track the success of interventions or to identify areas of potential problems. Monitoring can be accomplished using several different methods, though the gold standard is direct observation of healthcare provider practices (Stewardson and Pittet, 2014) by a trained observer. This labor intensive method, however, does pose some limitations because it only captures a small fraction of total hand hygiene events. In addition, the data is prone to observer bias or Hawthorne Effect, in which providers change behavior when they are aware of the presence of an observer. Supplementing direct observation with other monitoring technologies may provide more comprehensive data, capturing much more data than a human observer. Automated or aggregated usage data is also arguably more objective than data from a human observer. Nonetheless, even monitoring technologies are fraught with limitations such as

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accuracy issues and poor healthcare worker acceptance. Thus if advanced technologies are employed for hand hygiene monitoring, direct observation may still remain an important component of the overall hand hygiene program. The variety of monitoring methods can be beneficial as it offers flexibility to infection prevention programs; each healthcare institution will need a unique hand hygiene monitoring strategy depending on local needs and resources.

Direct observation hand hygiene monitoring

The World Health Organization (WHO) recommends direct observation of hand hygiene practice as it is a simple yet inexpensive method for assessing compliance (Stewardson and Pittet, 2014; World Health Organization, 2009). To ensure consistency and standardization in observation measures, validated and trained observers should be well-versed in the institution's established methodology for evaluating hand hygiene compliance. It is critical that trained observers be unobtrusive in the fast paced healthcare setting; however, they must also tactically position themselves so that they can accurately observe hand hygiene practice. Observers should document both the number of hand hygiene events as well as hand hygiene opportunities in order to calculate compliance data. The WHO also provides a standardized tool to calculate hand hygiene opportunities, which has been effective in some institutions and reduces overestimation of opportunities (Steed et al., 2011). If employment of hand hygiene observers is a financial burden, utilizing healthcare provider volunteers may be an alternative method (Linam et al., 2016).

Hand hygiene events and opportunities can either be defined by the WHO's 5 Moments for Hand Hygiene, or by patient room entry and exit. The WHO's 5 Moments highlight the activities of patient care that are most likely to result in transmission of pathogens while in the patient environment. A recent study by Chang et al. indicates that entry and exit compliance may be the more feasible option for direct observation of hand hygiene performance (Chang et al., 2016). While the WHO's 5 Moments for Hand Hygiene approach encourages optimal hand hygiene during patient care activities, it requires direct line of sight visibility. Physical barriers arise when healthcare providers draw the curtain or close the door during patient care. Patient privacy concerns generally prevent observers from entering patient rooms or approaching the patient bedside. On the other hand, most healthcare facilities provide hand hygiene product outside of patient rooms, allowing for unobstructed monitoring of entry and exit hand hygiene compliance (Chang et al., 2016). In addition to hand hygiene events and opportunities, collecting date, time, location, and healthcare provider type for each event can provide additional information for targeted hand hygiene interventions. The WHO provides an observation form that can be printed and completed to document hand hygiene events and opportunities. Hand hygiene monitoring mobile apps, such as iScrub (iScrub Lite, n.d.), also exist, simplifying documentation process and data manipulation (Marra et al., 2013).

Adoption of direct observation hand hygiene monitoring has been successful in both middle and low income countries. Allegranzi et al. implemented the World Health Organization Hand Hygiene Improvement Strategy in Mali, Africa utilizing a 4-phase approach: preparedness, baseline evaluation, intervention, and follow-up evaluation (Allegranzi et al., 2010). Preparedness included ensuring adequate supplies of locally produced, alcohol-based hand rub that met standards of effectiveness. During the intervention, monitoring followed by data feedback and education increased hand hygiene compliance from a baseline of 8% (n = 1932) to 22% (n = 1639) (Allegranzi et al., 2010). The same hand hygiene program focusing on feedback of data and ongoing education was successful in a variety of international settings, and the components of the program remained consistent across all settings, regardless of existing resources (Tambyah, 2010).

Ongoing education combined with feedback of hand hygiene compliance data was also successful in a 17-month study conducted in China by Mu et al. (2016). In the first phase of the study, increased availability of hand hygiene dispensers and supplies was engineered into the clinical environment. In the second phase, an educational campaign armed with data from direct observations of hand hygiene compliance was implemented, targeting multidisciplinary healthcare workers. Hand hygiene compliance improved from 38% to 76% in response to the campaign coupled with a significant increase in product usage over the same time period (Mu et al., 2016).

There are several limitations to using direct observation for hand hygiene monitoring. Direct observation is time consuming, requiring formal training of dedicated observers to assess hand hygiene performance, and focused attention of human observers to collect each hand hygiene event (World Health Organization, 2009). Furthermore, compliance data reflects a small sample size of hand hygiene practice, which may not represent actual hand hygiene performance across a healthcare center. Compliance data may be influenced by the Hawthorne Effect/observation bias, observer bias, and even selection bias. To reduce these biases, the WHO recommends desensitizing healthcare providers to monitoring by frequently deploying observers on to the units, regularly validating observers' assessment methodology, and requiring observers to randomly select locations, time of day, and healthcare providers for monitoring (World Health Organization, 2009). Despite these limitations, direct observation is a low cost, sustainable method for observing hand hygiene practice. Most importantly, the data from direct observation is clearly able to influence positive changes in healthcare worker behaviors (Allegranzi et al., 2010; Tambyah, 2010; Mu et al., 2016).

Monitoring hand hygiene via product usage

Product usage is an indirect method for monitoring hand hygiene compliance. Consumption of paper towels, alcohol-based hand rub, and liquid soap can be tracked and translated into an estimation of hand hygiene events. The WHO recommends defining a hand hygiene event based on a specified amount of product usage (i.e. alcohol-based hand rub) (World Health Organization, 2009). Because establishing a denominator for hand hygiene opportunities is difficult, several healthcare facilities have opted to use patient days or workload indicators in order to calculate hand hygiene compliance (Colombo et al., 2002). Product consumption as a method of monitoring hand hygiene compliance has exhibited varied outcomes in literature. Bittner et al. assessed soap and paper towel usage to determine hand hygiene practice and noted no impact on behavior (Bittner et al., 2002). They found that feeding back compliance data based on product usage did not resonate with healthcare providers as effectively as direct observation. Yet, in various other studies, implementing a multimodal hand hygiene monitoring program consisting of direct observation and product consumption demonstrated increased hand hygiene practice amongst all healthcare providers (Mu et al., 2016; Bert et al., 2017; Pfäfflin et al., 2017).

Product consumption monitoring provides a broad view of hand hygiene practice without the labor-intensive efforts of direct observation. Because of its objective nature, product usage monitoring for hand hygiene evades selection, observer, and observation biases. In addition, depending on the methodology used to collect the data, it may be feasible to perform this monitoring at relatively low cost. However, determining hand hygiene performance via product consumption has many

limitations. This method cannot distinguish healthcare provider product usage versus patient and visitor usage; all hand hygiene events are grouped together. Also, this method does not determine if healthcare providers are appropriately performing hand hygiene in that it fails to match hand hygiene events with clinical indications. Unlike direct observation, product usage does not provide actual healthcare provider level compliance, making it difficult for targeted interventions. Thus product usage data may assist in administratively tracking changes in hand hygiene behaviors across a healthcare center, but the granularity of direct observation is likely necessary to motivate staff members to improve personal practice.

Automated hand hygiene monitoring systems

Electronic hand hygiene monitoring systems have been developed and are now implemented in healthcare facilities around the world (Dufour et al., 2017; Michael et al., 2017). Compliance monitoring capabilities range from entry and exit to the WHO's 5 Moments for Hand Hygiene. Systems can capture both hand soap and alcohol-based hand rub events. Although these electronic monitoring systems require a substantial financial and human resource investment, they claim to be able to assess all hand hygiene events and opportunities across a healthcare center, while maintaining the ability to provide granular data. In fact, individual healthcare workers are often tagged with a badge that records performance, and personal data is fed back to the worker. Several studies have indicated enhanced hand hygiene compliance data after implementing an electronic monitoring system (McCalla et al., 2017; Michael et al., 2017). Furthermore, one health system in the United States found that as staff hand hygiene compliance improved, the healthcare-associated methicillin-resistant *Staphylococcal aureus* infection rates decreased (Kelly et al., 2016).

Yet it is important to note that compatibility of these systems with busy clinical work flows may be imperfect. While the automated technology may perform well in a test environment, the network may fail to capture healthcare worker behavior during the flow of clinical care (Pineles et al., 2014). Furthermore, implementation of these systems is a formidable challenge, as healthcare workers may be resistant to wearing a tracking device, or fearful of individual level data and its intended use (Conway, 2016). Finally, unless the data capture accuracy very closely reflects actual practice, the data will be regarded as flawed and the ability to influence change is lost (Boyce et al., 2012). Nevertheless, there is a strong ongoing interest in refining and deploying these technologies in the healthcare setting. Infection prevention programs should not place too great an expectation in an automated solution to hand hygiene non-compliance. The success of these systems required careful implementation, ongoing education, and validation of data against the gold standard of direct observation of hand hygiene practices.

Conclusion

Hand hygiene practice continues to be a fundamental initiative in healthcare infection prevention programs throughout the world. Promoting education and behavior change can be supported by monitoring and feedback of hand hygiene performance. While several methods of monitoring exist, financial and human resources may dictate which approach is most feasible for each healthcare facility. Current literature indicates multimodal approaches to monitoring may increase the successes of hand hygiene programs, though the art of high quality direct observation remains an essential element.

Conflict of interest/funding statement

There were no sources of material or monetary support for this study. The authors have no conflicts of interest.

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