



State of the Science Review

Electronic monitoring in combination with direct observation as a means to significantly improve hand hygiene compliance



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Monitoring hand hygiene compliance among health care personnel (HCP) is an essential element of hand hygiene promotion programs. Observation by trained auditors is considered the gold standard method for establishing hand hygiene compliance rates. Advantages of observational surveys include the unique ability to establish compliance with all of the World Health Organization “My 5 Moments for Hand Hygiene” initiative Moments and to provide just-in-time coaching. Disadvantages include the resources required for observational surveys, insufficient sample sizes, and nonstandardized methods of conducting observations. Electronic and camera-based systems can monitor hand hygiene performance on all work shifts without a Hawthorne effect and provide significantly more data regarding hand hygiene performance. Disadvantages include the cost of installation, variable accuracy in estimating compliance rates, issues related to acceptance by HCP, insufficient data regarding their cost-effectiveness and influence on health care-related infection rates, and the ability of most systems to monitor only surrogates for Moments 1, 4, and 5. Increasing evidence suggests that monitoring only Moments 1, 4, and 5 provides reasonable estimates of compliance with all 5 Moments. With continued improvement of electronic monitoring systems, combining electronic monitoring with observational methods may provide the best information as part of a multimodal strategy to improve and sustain hand hygiene compliance rates among HCP.

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The World Health Organization (WHO) Guideline for Hand Hygiene in Health Care promotes the use of a multimodal hand hygiene improvement strategy.¹ One of the 5 core elements of the multimodal hand hygiene improvement strategy involves observation of hand hygiene practices and feedback of performance rates to health care personnel (HCP). Direct observation of HCP by trained observers, as outlined in the WHO Guideline, is currently considered the gold standard for monitoring compliance of HCP with recommended hand hygiene practices.^{1,2} Compliance rates are calculated by dividing the number of times that HCP perform hand hygiene, so-called hand hygiene events [HHEs], by the number of hand hygiene opportunities [HHOs], as outlined in the WHO Guideline.^{1,3} Although auditing of HCP hand hygiene performance by trained observers has several unique advantages, it also has several disadvantages. As a result, there is considerable interest in developing additional strategies that can serve as an alternative to,

or can be used in combination with, traditional observational methods. The purpose of this article is to review the advantages and disadvantages of 2 approaches to monitoring hand hygiene: observation by trained auditors versus the use of electronic systems for monitoring hand hygiene practices, and to explore how the 2 approaches can complement each other to benefit patient safety.

METHODS

A literature review of issues relating to monitoring hand hygiene compliance was conducted by performing an English-language PubMed search for the period January 2009–August 2016 using the following search terms: *hand hygiene electronic monitoring, hand hygiene automated monitoring, hand hygiene compliance, and hand hygiene 5 Moments*. Bibliographies of retrieved references were also reviewed for pertinent articles.

Direct observation—advantages

One of the unique advantages of assessing hand hygiene compliance using direct observations by trained auditors is the nearly universal applicability of this method. Observation of hand hygiene

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practices can be performed in virtually any health care facility, regardless of the size, complexity, and level of available resources. As a result, this method can be used in facilities located in countries with very limited resources as well and as in well-developed countries. Also, validated methods for observing hand hygiene by HCP have been described by the WHO.^{1,4} WHO methods are based on observing compliance of individuals with the most important opportunities for performing hand hygiene, as outlined in the “My 5 Moments for Hand Hygiene.”^{1,3} These include Moment 1 (before touching a patient), Moment 2 (before a clean or aseptic procedure), Moment 3 (after body fluid exposure risk), Moment 4 (after touching a patient), and Moment 5 (after touching patient surroundings). Moments 1, 4, and 5 are designed to reduce transmission of pathogens between patients, Moment 2 can prevent transmission of microorganisms to the patient during invasive procedures, and Moment 3 reduces the likelihood that HCP will acquire pathogens while caring for patients. In facilities where it is difficult to observe all 5 Moments, institutions can elect to observe and report only compliance with hand hygiene before and after touching a patient, or only before touching a patient.^{2,3}

Other unique features of direct observation include the ability of auditors to determine if HCP are cleaning their hands with good quality (ie, an acceptable dose and good technique to cover the whole hand), and to evaluate glove use.^{1,5–10} The results of such observations can be used to provide specific education and feedback to HCP on how to improve their hand hygiene technique and on appropriateness of glove use.^{11,12} Individuals involved in observing HCP can also identify causes of noncompliance and serve as real-time coaches, an approach that has been shown to be effective in improving hand hygiene adherence rates.¹³ Based on the above features, direct observation has been widely adopted and is currently considered the gold standard for measuring hand hygiene compliance.^{1,14,15}

Direct observation—disadvantages

Time and personnel required

For compliance rates determined by direct observation to be valid, hand hygiene observers require adequate training and periodic validation by experienced individuals,¹ which involves considerable personnel time and expense.^{16,17} To obtain reasonable estimates of hand hygiene compliance rates, auditors must devote hours of observation time in multiple clinical areas on a repeated basis. For example, a convenience sample of 23 studies^{7,10,18–38} that listed the time spent by observers, 9,020.27 hours were required to observe 111,886 HHOs (Table 1). The mean number of HHOs observed per hour was 18.8 (median, 18.3), with a range of 3.3–41.4 per hour. Yin et al³⁵ estimated that in a hospital with a 70% compliance rate, it would require at least 153 observations per nursing unit per time period (eg, month or quarter) to identify a 10% change in compliance with 80% power and 5% significance level. Many hospitals have had considerable difficulties in finding sufficient time and associated financial resources for auditors to perform an adequate number of observations, especially on night shifts and weekends.

Collation and analysis of data from direct observations can also be time-consuming, and challenging for personnel in some hospitals. The availability of software for handheld devices for recording and organization of data (eg, iScrub, Computational Epidemiology Research, University of Iowa, Iowa City, Iowa) and similar software developed by some academic institutions and industry can reduce the time required to collect and analyze the results of direct observations.^{39–44}

Insufficient sample size

Due to the time required for direct observations, it is feasible to observe only a very small fraction of all the HHOs and HHEs that

Table 1

Number of hand hygiene opportunities (HHOs) observed, time spent on observations, and number of HHOs per hour of observation in 23 published studies

Study authors	Publication year	Number of HHOs observed	Observation time (h)	No. of HHOs/h
Pittet et al ¹⁸	1999	2,834	105	27.0
Pittet et al ¹⁹	2000	20,082	833.9	24.1
Bischoff et al ²⁰	2000	1,575	120	13.1
Hugonnet et al ²¹	2002	2,743	84	32.7
Rosenthal et al ²²	2003	15,531	807	19.2
Pittet et al ²³	2004	887	125	7.1
Larson et al ²⁴	2005	5,586	306	18.3
Girou et al ²⁵	2006	952	38	25.1
Noritomi et al ²⁶	2007	727	32	22.7
Santana et al ²⁷	2007	3,476	120	29.0
Rupp et al ²⁸	2008	3,678	299.9	12.3
Scheithauer et al ²⁹	2009	1,897	288	6.6
Boscart et al ³⁰	2010	1,093	94	11.6
Edmond et al ³¹	2010	1,646	100	16.5
Allegranzi et al ³²	2010	3,571	93.6	38.2
Steed et al ³³	2011	6,640	436.7	15.2
Mestre et al ³⁴	2012	11,714	409.5	28.6
Lebovic et al ¹⁰	2013	7,364	393	18.7
Yin et al ³⁵	2014	11,444	3432	3.3
Goodliffe et al ³⁶	2014	1,605	267	6.0
Hagel et al ³⁷	2015	3,978	96	41.1
Tschudin-Sutter et al ⁷	2015	2,662	520	5.1
Sanchez-Carrillo et al ³⁸	2016	201	19.67	10.2

occur. In 1 study⁴⁵ that had HCP in an intensive care unit wear electronic badges to record HHOs, simulated observational models suggested that only 0.5%–1.7% of HHOs were detected by observational methods. Similarly, in a study⁴⁶ that compared direct observation to the volume of alcohol-based handrub (ABHR) used, it was estimated that only 0.4% of HHEs were detected by direct observation. In several studies^{42,47,48} that used electronic counting devices in dispensers or badges worn by HCP to record the number of HHEs performed, only 0.14%–2.5% of HHEs were captured by direct observation. The tremendous number of HHOs that can occur in a facility annually attests to the difficulty in obtaining accurate estimates of hand hygiene compliance using direct observation. For example, in an acute care hospital with 1,023 beds, it was estimated that 171,468,240 HHOs occurred per year in inpatient and emergency areas.⁴⁹

Lack of standardized observational practices

Although recommendations on how to observe hand hygiene compliance are available,^{1,50,51} many aspects of performing observations vary tremendously, making comparison of compliance rates between health care facilities problematic. For example, the methods used to train auditors and the degree to which their performance is validated vary substantially.^{13,16,18,33,37,41,52,53} The role of the individual conducting observations (eg, unit-based nurse, infection preventionist [IP], student, or volunteer) and the extent to which they are recognized as observers can clearly effect compliance rates.^{16,54,55} Unintentional observer bias, as well as the Hawthorne effect, is likely when observations on a nursing unit are made by nurses who routinely work on the unit, rather than by nonunit observers.^{16,56} The distance of the observer from the HCP being observed, the location of the observer on the unit, the level of activity on the unit, the duration of each observational session, and even the time of day when observations are made can influence compliance rates.^{35,41,45,57} Performance of observers who have received the same training may also vary.⁴¹ Identifying and maintaining an adequate number of trained personnel to perform observations can also represent a significant problem in some institutions.

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