ORIGINAL ARTICLE

Healthcare Personnel Perceptions of Hand Hygiene Monitoring Technology

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OBJECTIVE. To assess healthcare personnel (HCP) perceptions regarding implementation of sensor-based electronic systems for automated hand hygiene adherence monitoring.

DESIGN. Using a mixed-methods approach, structured focus groups were designed to elicit quantitative and qualitative responses on familiarity, comfort level, and perceived impact of sensor-based hand hygiene adherence monitoring

SETTING. A university hospital, a Veterans Affairs hospital, and a community hospital in the Midwest.

PARTICIPANTS. Focus groups were homogenous by HCP type, with separate groups held for leadership, midlevel management, and frontline personnel at each hospital.

RESULTS. Overall, 89 HCP participated in 10 focus groups. Levels of familiarity and comfort with electronic oversight technology varied by HCP type; when compared with frontline HCP, those in leadership positions were significantly more familiar with ($P < .01$) and more comfortable with ($P < .01$) the technology. The most common concerns cited by participants across groups included lack of accuracy in the data produced, such as the inability of the technology to assess the situational context of hand hygiene opportunities, and the potential punitive use of data produced. Across groups, HCP had decreased tolerance for electronic collection of spatial-temporal data, describing such oversight as Big Brother.

CONCLUSIONS. While substantial concerns were expressed by all types of HCP, participants' recommendations for effective implementation of electronic oversight technologies for hand hygiene monitoring included addressing accuracy issues before implementation and transparent communication with frontline HCP about the intended use of the data.

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Adherence to recommended hand hygiene practices is an essential component of patient safety. The Centers for Disease Control and Prevention (CDC) and the World Health Organization have published guidelines that specify appropriate hand hygiene practices in healthcare settings as a key component of healthcare-associated infection (HAI) prevention.[1,2] Despite broad dissemination of these guidelines and publication of numerous studies that demonstrate an association between hand hygiene adherence and decreasing HAI rates, reported adherence is low worldwide.[3-7] Commonly reported barriers include lack of time, unavailable or inconveniently located supplies, forgetfulness, and competing activities of perceived higher priority.[8,9] Recent evidence suggests that changing healthcare personnel (HCP) practices requires more than education alone and that performance feedback is a key to changing behaviors.[10,11]

Many healthcare facilities promote awareness and encourage prioritization of hand hygiene by conducting periodic audits of HCP adherence to recommended hand hygiene practices. Direct (human) observation is widely considered the gold standard for measuring adherence but is problematic because of its time intensity, Hawthorne effect, potential observer bias, sampling bias, and lack of standardized approach for observers.[12-15] Recently, a host of new technologies has emerged for automated oversight of hand hygiene adherence. These technologies—which include alcohol sensors, video surveillance, radio frequency identification, and wireless electronic sensing of hand hygiene events—are currently being

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Box 1

Imagine a small wearable device that can detect when a healthcare worker enters or exits a patient care area and whether that person performs hand hygiene while there. Information from this device could be analyzed to produce reports on hand hygiene compliance rates quickly (ie, immediately or at the end of a shift).

deployed in a growing number of hospitals.[16-19] Automated oversight technologies mitigate the behavioral biases inherent in direct observation, and they offer a source of constant oversight that is impossible to achieve with direct observation. There is little published data, however, on whether these technologies are valid and how these technologies are perceived, accepted, and used by HCP in US healthcare settings.[20]

The overall objective of this study was to understand how HCP currently perceive automated sensor-based hand hygiene oversight technologies by conducting focus groups at 3 hospitals. Results were intended to inform decisions about use of these technologies in healthcare settings and to optimize implementation strategies that evoke adoption and ownership of these technologies as a mechanism for improvement in hand hygiene practices.

METHODS

A convenience sample of 3 hospitals in Iowa City, Iowa, agreed to participate in a focus group assessment of hand hygiene oversight technology on a voluntary basis. Participating facilities included a university hospital with 680 beds, a Veterans Affairs hospital with 93 beds, and a community hospital with 218 beds. In tandem with CDC-supported efforts to develop, validate, and optimize a wireless sensor-based tool to measure hand hygiene adherence, HCP at the University of Iowa collaborated with CDC staff to coordinate focus groups. At the time focus groups were conducted, 1 ward in the university hospital was scheduled for a pilot of the wireless sensor devices, although none had been deployed at the time.

Following a trilogic evaluation model,[21] separate focus groups were held for each of the following types of HCP: leadership personnel (eg, chief executive officers, chief operations officers, chief medical officers, chief nursing officers, and leaders of various quality improvement departments or committees), midlevel management personnel (eg, infection preventionists and unit managers), and frontline care–providing personnel (eg, nurses and physicians).

Three to 4 focus groups were conducted at each hospital. All focus groups were facilitated by a CDC-employed behavioral scientist who was not affiliated with any of the hospitals. The facilitator followed a structured 10-question script, and each focus group discussion lasted no more than 45 minutes. The focus group script was divided into distinct content domains, including (1) awareness of hand hygiene oversight technologies, (2) comfort level with wearable devices to monitor hand hygiene practices, (3) situational thresholds for tolerance of monitoring (Boxes 1–3), (4) preferences for data feedback from automated hand hygiene oversight technologies, and (5) perceptions of impact and sustainability. Participants were informed that they were being tape-recorded and that their identities would be protected. Snacks and beverages were provided, but participants received no other form of compensation for their participation.

For several questions, every participant in the group was asked to respond individually; responses to these questions were analyzed quantitatively using SAS 9.2. Frequencies were calculated for the following quantitative responses: years employed at the hospital, awareness of automated hand hygiene oversight technology (yes/no), comfort level with proposed wearing of devices to monitor hand hygiene practices (scale, 1–5), and preferred format for feedback (periodic or real time). To assess significance of differences in quantitative variables by hospital, χ^2 and ANOVA tests were conducted. Differences in quantitative variables by HCP type, controlling for hospital affiliation, were assessed using logistic or linear regression models. Qualitative responses were transcribed and thematically coded. Subsequently, themes were summarized and their relative frequency assessed. This study was determined to be exempt from human subjects review by the institutional review board at the CDC in March 2010.

RESULTS

A total of 10 focus groups were conducted in spring of 2010 at hospital A ($n = 25$), hospital B ($n = 30$), and hospital C ($n = 34$). Three focus groups were conducted with leadership personnel ($n = 26$), 3 with midlevel HCP ($n = 30$), and 4 with frontline HCP ($n = 33$). On average, HCP had been employed at their respective hospitals for 15 years, with no statistical difference in years employed by hospital. There were statistical differences by hospital in awareness of automated oversight technology, comfort with the technology, and preference for periodic versus real-time feedback (Table 1).

Awareness of automated oversight technology for assessing hand hygiene practices varied by HCP type (Table 2). Eighty-one percent of personnel in leadership positions were aware of automated hand hygiene oversight technology, which was significantly higher than awareness in frontline and midlevel HCP groups (27% and 33%, respectively; $P < .01$). When asked to describe their comfort level with hypothetical wearable electronic devices that could measure entry and exit into patient rooms as well as hand hygiene activity (Box 1), lead-

Box 2

Now imagine that there is an outbreak in your hospital involving a significantly increased rate of an emerging hospital-associated infection. It is not clear why. During this kind of a situation, do you think healthcare staff should be willing to have their hand hygiene behaviors tracked using such a technology?

Box 3

What if this technology could also measure and record the interactions between healthcare staff and patients so as to assist in determining patterns of disease transmission—for example, it could detect that healthcare worker A was near patient B during the time of the outbreak at 12 noon on March 1 (time-stamped). Do you think healthcare staff should be willing to have their behaviors tracked (frequency, duration, etc) using such a technology?

ership personnel were significantly more comfortable compared with frontline and midlevel HCP ($P < .01$).

Across all focus groups, the most commonly cited factors influencing comfort were accuracy of data produced by the devices (including situational context that could not be accounted for by sensors), lack of information about the technology, and the potential use of the data for punitive purposes. Frontline HCP cited punitive use of the data as a concern more often than other HCP types and were concerned about the implications of accuracy on individual hand hygiene audits ("The scary part is, are they going to use it to fire you ... machines don't always work the way you want them to, and are there going to be false negatives, false positives?"). Midlevel HCP also emphasized accuracy issues as potentially problematic in defining the situational context for individual hand hygiene opportunities; for example, "If I walk in the door and say your CBC was okay, that would trigger that I walked in there but didn't wash my hands." Participants of all HCP types also said that their discomfort with the technology stemmed from not having enough information: "I need more details ... is the feedback just going to come to me personally, or does it go to someone in management?"

Across focus groups, the majority of HCP said they would be amenable to wearing devices for monitoring hand hygiene practices during an outbreak situation (Box 2) as long as the technology was used for identification of an outbreak source ("If it was simply for tracking the source of the outbreak, I can understand that"). There were participants across all HCP types, however, who said that the outbreak situation would not make them more comfortable with the electronic wearable devices because the intense focus on HCP hand hygiene during an outbreak might deemphasize other potentially relevant factors. Some felt the value of wearable devices would be in their sustained, rather than outbreak-specific, use ("I think that'd be missing the point, because most infections aren't outbreak associated ... I think if it was going to be done, it would have to be an all-the-time thing to really change what happens").

When asked how comfort levels would change if the devices could measure not only whether an HCP entered a room and used hand hygiene product but also interactions between HCP via location time stamps (Box 3), the most common response overall was concern about the Big Brother implications. One frontline HCP suggested that this type of monitoring was insulting ("Why do we need to be treated like kindergartners? I'm a professional"). In convergence with frontline and midlevel HCP, leadership also expressed that the time stamp and location data heightened their concern ("That seems a little creepy to me ... a little too much Big Brother").

Answers varied by HCP type when asked who should have access to the data generated by automated oversight technology. The majority of frontline respondents felt that frontline HCP should be the primary recipients of the data; the majority of midlevel respondents felt that unit managers should be the primary recipients of the data; and the majority of leadership respondents felt that all HCP, patients, and the public should have access to data.

In a quantitative assessment of how often HCP should receive feedback on their hand hygiene performance, only 19% of frontline HCP preferred real-time feedback to periodic feedback; 38% of midlevel HCP preferred real-time feedback, and 44% of leadership personnel preferred real-time feedback (0.0036 when compared with the frontline group; Table 2). Reasons for preferring real-time feedback included, for example, "It would only take me so many times a day that I was told, 'You forgot to wash your hands,' and then I would do it." Advocates for periodic reporting emphasized the annoyance and overwhelming nature of daily data feedback ("Daily is interrupting"; "I wouldn't have time to deal with it on a constant level").

When asked what advice focus group participants would give to hospitals considering implementation of automated hand hygiene oversight technology, the most common response overall was to address accuracy ("Leadership should have knowledge of studies that show that [the technology] is accurate"). When asked about sustainability of improved hand hygiene adherence from wearing the devices, a commonly cited theme was HCP ownership ("It could have an impact that could be sustainable, as long as it was done as part of a comprehensive program that the employees felt involved in ... if it was seen as something that helps us to manage our patient care better"). Frontline HCP in particular emphasized HCP transparency in the implementation phase ("If it was explained in the right way to employees, [you could] get individuals to actually want to do it").

DISCUSSION

Focus groups conducted at 3 Iowa City hospitals in March 2010 addressed perceptions of automated hand hygiene oversight technology among frontline HCP, midlevel HCP, and leadership personnel. The most commonly cited concern regarding a proposed sensor-based technology was difficulty in producing accurate data, specifically related to the valid identification of a hand hygiene opportunity. Concerns about accuracy were coupled with unease about the potential use of adherence data for punitive purposes. Findings suggest that administrators considering implementation of automated

TABLE 1. Focus Group Participant Characteristics and Preferences Stratified by Hospital

	Overall ($n = 89$)	Hospital A ($n = 25$)	Hospital B ($n = 30$)	Hospital C ($n = 34$)	*P* for difference
Professional category					
Frontline	37	28	37	44	.7
Midlevel	34	40	27	29	
Leadership	29	32	37	26	
Years at hospital, mean (SD)	15 (10)	15 (10)	17 (10)	11 (10)	.2
Awareness of oversight technology	45	20	67	44	.003
Comfort level with oversight technology, mean (SD)[a]	3.5 (1.2)	3.2 (0.9)	4.1 (1.1)	3.2 (1.3)	.002
Preference for feedback timing					
Periodic	67	78	52	74	.08
Real time	33	22	48	26	

NOTE. Data are percentage of participants, unless otherwise indicated.
[a] Scale, 1–5.

hand hygiene oversight technologies should carefully consider the intended use of the data and to communicate this intended use to HCP before implementation. While these technologies have tremendous potential to overcome statistical barriers to valid hand hygiene adherence auditing by reducing sampling and observation (ie, Hawthorne effect) biases, there are both real and perceived concerns about the ability of the technologies to accurately detect individual hand hygiene opportunities. Oversight technologies do, however, offer the potential of a statistical proxy for overall hand hygiene adherence. Communicating this message to HCP will be vital to the acceptance of these technologies. Such recommendations reflect qualities characteristic of organizations that successfully implement HAI prevention initiatives, including the ability to cultivate a culture that values and understands clinical excellence, to facilitate strategic local communication before implementation for maximum ownership, and to overcome barriers by dealing directly with resistant staff.[22]

A common theme throughout all focus groups and across multiple responses was that HCP did not know enough about automated oversight technologies to strongly endorse them. Several participants were anxious to see data suggesting that implementation of an automated hand hygiene system was effective, and they felt that that data would be important to present to HCP on implementation ("If somebody's implemented it, I'd like to know their outcome. Has it worked well, and how did they roll it out?"). Furthermore, responses to questions about impact and sustainability elicited similar responses among HCP groups. Most believed that the technology would raise awareness but that sustainability of impact would rely on larger organizational change ("I think you need to have this embedded into the culture so we don't have to remind people").

Differences in awareness of and comfort level with automated oversight technology varied by HCP type, as did preference for real-time feedback. The majority of participants in leadership positions had heard of such technology, while the majority of frontline and midlevel HCP had not heard of the technology. Leadership personnel also ranked themselves as more comfortable with the proposed wearable devices described in Box 1. The elevated comfort levels expressed by leadership might reflect enhanced awareness of the technology in general, the fact that the punitive implications would presumably most directly affect the frontline and midlevel HCP, or the fact that leadership would have less exposure to the nuisance of wearing or reacting to the devices on a daily basis.

Most HCP indicated a higher tolerance for technology that could measure hand hygiene activity and room entry/exit only; overall, HCP were far less tolerant of wearing a device that would collect the geographic and temporal locations of HCP. Measuring and tracking individual employee location, according to 1 frontline HCP, "pushes the limits and infringes on something. It just doesn't feel right." The universal unease with location tracking stemmed from broad concerns about Big Brother to specific concerns about how the data would be stored, protected, and used. Simultaneously, HCP had concerns about the use of entry/exit as an indication for hand hygiene. Hospitals considering implementation of automated hand hygiene oversight technology should consider carefully how much individual-level data are needed to estimate hand hygiene adherence.

This study was subject to several limitations. Participating hospitals represented a convenience sample of hospitals located in Iowa City, although the inclusion of 1 large academic center, 1 community hospital, and 1 Veterans Affairs hospital was intentional to maximize diversity in size and scope of the small sample of facilities. Individual participation was voluntary, although use of the trilogic model (recruitment of frontline, midlevel, and leadership personnel) ensured representation of different HCP types. Focus groups can induce response inhibitions based on hierarchal and other qualitative group dynamics, but this bias may have been minimized by making the groups homogenous by HCP type.

TABLE 2. Differences in Awareness, Comfort, and Preferred Feedback Level and Timing by Profession Type, Adjusted for Clustering by Hospital

					P for differences		
	Overall ($n = 89$)	Frontline ($n = 33$)	Midlevel ($n = 30$)	Leadership ($n = 26$)	Frontline vs leadership	Midlevel vs leadership	Frontline vs midlevel
Awareness of oversight technology	45	27	33	81	<.0001	.0005	.5
Comfort with oversight technology, mean (SD)[a]	3.5 (1.2)	3.6 (1.2)	3.3 (1.3)	4.0 (0.8)	.006	.006	.9
Preference for feedback timing							
Periodic	67	81	62	56	.04	.6	.1
Real time	33	19	38	44			

NOTE. Data are percentage of participants, unless otherwise indicated.
[a] Scale, 1–5.

As trends toward transparency and accountability continue with health reform and enhanced surveillance of HAIs, automated systems are likely to proliferate. All HCP types, but particularly frontline HCP, expressed concerns about privacy and punitive implications and suggested addressing these concerns with a clear communication strategy about the intended use of the data. Several participants advised that these automated oversight technologies be viewed as a mechanism for changing culture but cautioned hospitals to be cognizant of the perceived inaccuracies and the implications for punitive action against individuals ("If people trust in the data, they respond to data").

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