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Electronic hand hygiene monitoring systems can be well-tolerated by health workers: Findings of a qualitative study

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D Kelly[1], E Purssell[2], N Wigglesworth[3] and DJ Gould[2]

Abstract

Background: Electronic hand hygiene monitoring overcomes limitations associated with manual audit but acceptability to health workers varies and may depend on culture of the ward and the nature of the system.

Objectives: Evaluate the acceptability of a new fifth type electronic monitoring system to frontline health workers in a National Health Service trust in the UK.

Methods: Qualitative interviews with 11 informants following 12 months experience using an electronic monitoring system.

Results: Informants recognised the importance of hand hygiene and embraced technology to improve adherence. Barriers to hand hygiene adherence included heavy workload, dealing with emergencies and ergonomic factors related to placement of alcohol dispensers. Opinions about the validity of the automated readings were conflicting. Some health workers thought they were accurate. Others reported problems associated with differences in the intelligence of the system and their own clinical decisions. Opinions about feedback were diverse. Some health workers thought the system increased personal accountability for hand hygiene. Others ignored feedback on suboptimal performance or ignored the data altogether. It was hard for health workers to understand why the system registered some instances of poor performance because feedback did not allow omissions in hand hygiene to be related to the context of care.

Conclusion: Electronic monitoring can be very well tolerated despite some limitations. Further research needs to explore different reactions to feedback and how often clinical emergencies arise. Electronic and manual audit have complementary strengths.

Keywords

Hand hygiene, electronic hand hygiene monitoring, qualitative research

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Background

Hand hygiene is essential to avoid transmission of nosocomial pathogens and helps prevent spread of community-acquired infection in settings where health care is delivered (Pittet et al, 2006). It is audited in many countries, usually by observing practice (World Health Organization, 2009). Manual audit is regarded as the "gold standard": it allows hand hygiene adherence to be documented in the context of patient care and allows auditors to correct errors in "real time" (Haas and Larson, 2007). Manual audit has been criticised because audit periods are brief, give an over-view of hand hygiene behaviour at single points in time and the findings are subject to sampling and selection bias (Gould

[1]School of Healthcare Sciences, Cardiff University, UK
[2]School of Health Sciences, City, University of London, UK
[3]Directorate of Infection, Guy's and St Thomas' NHS Foundation Trust, UK

Corresponding author:
D Kelly, School of Healthcare Sciences, Cardiff University, Eastgate House, Newport Road, Cardiff, South Glamorgan, CF24 0AB, UK.
Email: kellydm@cardiff.ac.uk

et al 2011, Jeanes et al, 2019). Health workers are likely to undertake hand hygiene more often if they know that audit is in progress (Srigley et al, 2014), resulting in a transient Hawthorne (increased productivity) effect (McCambridge et al, 2014). They dislike being corrected in front of patients and colleagues (Fuller et al, 2012) and may delay complex procedures until audit is over, generating an avoidance effect (Gould et al, 2017). The data are often incomplete because vantage is poor and bedside curtains obscure clinical activities (Fitzgerald et al, 2013).

Electronic monitoring systems (EMSs) record hand hygiene adherence constantly in "real time", overcome the Hawthorne effect and other sources of bias (Srigley et al, 2014) and are more efficient because data are collected simultaneously for large numbers of staff (Allbright et al, 2018). Managers recognise these advantages (Ellingson et al, 2011**)** but the opinions of frontline health workers are mixed. While acceptance has been good in some studies (Storey et al, 2014) there have been concerns about who will have access to the data, how the information will be used (Benudis et al, 2019; Boscart et al, 2008; Ellingson et al, 2011) and accuracy (Dyson and Madeo, 2017; Levchenko et al, 2011). EMSs have inbuilt algorithms that do not always record hand hygiene opportunities and adherence in line with health workers' clinical decision-making (Dyson and Madeo, 2017; Levchenko et al, 2011). If they do not regard audit findings as a genuine indicator of practice, they are unlikely to strive to improve adherence based on their findings (Boyce, 2017).

A number of EMSs are available varying in design, the algorithms used to determine when hand hygiene is necessary and how feedback is delivered (Ward et al, 2014). Health workers' experiences of using EMSs are also likely to differ and the findings of user evaluation for one type of EMS cannot be generalised to others. Findings are likely to be affected by the culture of the ward and sampling bias but these factors have not been considered in existing evaluations.

Methods

The aim of this qualitative study was to evaluate the acceptability of a new fifth type EMS to frontline health workers in a National Health Service (NHS) trust in the UK.

The electronic system

The Tork Vision Hand Hygiene System (Essity AB, Sweden) incorporates antennae mounted in the ward ceiling. Tags are worn by health workers and there are internet-connected alcohol hand-rub dispensers at every bed space. The tags document health workers' movements with high (arm-length) precision in "real time" and register hand hygiene adherence to the World Health Organization's Moments 1, 4 and 5. A hand hygiene opportunity is registered whenever a tagged health worker occupies the patient zone for 10 s or longer. Visits under 10 s are filtered out. The EMS records a hand hygiene event when a health worker is within arm-length distance of an activated dispenser. An adherent hand hygiene event is recorded when hand hygiene is undertaken on entering the patient zone, moving between beds and leaving. Data are analysed and stored in a Cloud-based information technology infrastructure. It is possible to document adherence for individual health workers and aggregate data for clinical teams, wards or entire organisations. Individual health workers are identified by their tag but the data are anonymised and personal to the individual. The EMS does not incorporate alerts to indicate when hand hygiene is indicated. Instead, feedback is delivered in "real time" to a wall-mounted screen. Feedback can also be received on the individual's 'smart-phone' or tablet. The Tork Vision Hand Hygiene System can overcome the Hawthorne effect and is much more efficient than manual audit (Gould et al, 2020). The system is used in conjunction with a hand gel comprising 80% ethanol with emollients.

Study setting. The study was conducted in an acute NHS trust in London, UK serving a local population of *c.* 300,000. A wide range of secondary and tertiary care services are provided. According to the national body in the UK that oversees standards in healthcare premises (Care Quality Commission) infection prevention is "good". Data were collected in an acute 31 bed medical ward. Alcohol hand-rub is available at every bedside. There are 39 ward-based staff and 15 health workers also attached to the ward (doctors, pharmacist, housekeepers, allied health professionals). The ward was selected because it has been involved in a number of research and practice development initiatives. Staff are considered to have been receptive to innovation.

The infection prevention team and company engineers held discussions concerning the most effective way of introducing the EMS to the staff. As a result of these discussions the staff received presentations before the system "went live". These emphasised the importance of hand hygiene, health workers' responsibility to be accountable for their own hand hygiene standards, and the personal nature of the data in an effort to promote trust in the EMS. Most agreed to receive the results on their own electronic devices in addition to the anonymised data delivered to the ward. Once the EMS had been installed the ward manager provided feedback in daily ward handovers.

Acceptability of the EMS and feedback were assessed using qualitative interviews 12 months after the system had gone "live". The data collector was previously unknown to participants. The acceptability of the EMS was explored through semi-structured interviews. These were conducted in an office close to the clinical area at times convenient to participants and audio recorded with permission. Interviews

took place from June to July 2019. Ethical approval was given by the research ethics committee of the university leading the study. All participants gave informed consent.

Analysis. The data were transcribed verbatim and analysed thematically employing an inductive data-driven approach and subjected to thematic analysis (Braun and Clarke, 2006). Two members of the research team undertook analysis with third party arbitration in cases where interpretation was equivocal. By the end of interviewing, no new themes were identified.

Results

Eleven frontline health workers were interviewed (nine registered nurses and two healthcare assistants). Thematic analysis identified five themes:

(a) the importance of embracing change;
(b) hand hygiene as a marker of professional practice;
(c) factors influencing hand hygiene adherence;
(d) interpreting the findings of electronic audit;
(e) issues associated with feedback.

The importance of embracing change

Staff welcomed the opportunity to use the new technology:

> We're proud to be involved in this research - we're the first in the country. If it encourages us to be better at hand hygiene, I think it's a good thing. (Registered nurse)

Encouraging health workers to reflect on and enhance practice was viewed in a positive light. Continuous monitoring by the EMS was perceived to facilitate improvement. Visits from the company supplying the EMS were appreciated:

> The people who introduced it were here the other day. We've had a talk about how we're doing, where we are and how we fluctuate. (Registered nurse)

Hand hygiene as marker of professional practice

Informants were well-informed and positive about hand hygiene. It was considered important to protect patients and health workers:

> I think it's the gold standard for preventing infection. It's the number one way of preventing infection. (Registered nurse)

The reciprocal benefits of hand hygiene were also mentioned:

> It's important because you move from one patient to another – you have to protect yourself as well as the patients. (Healthcare assistant)

Factors influencing hand hygiene adherence

Pace of work on the ward was described as "frantic" and throughput was considered very high compared to other places where staff had worked. High levels of clinical activity and competing demands were perceived as the main obstacles confronting hand hygiene adherence:

> People are rushing in and out of bays, possibly they may not think (about hand hygiene) and you've got things blocking the dispensers, or you have to rush to a patient. (Registered nurse)

Nevertheless, some individuals were perceived to be more adherent than others irrespective of being exposed to the same pressures:

> *Interviewer*: Pace of work, does that impact on hand hygiene?
>
> *Registered nurse*: Yes I think so, on some and not others because the data we've had recently showed that some people are consistently doing well and some are consistently low and then there's others that just float in the middle, up and down.

Other barriers to adherence were dislike of the alcohol gel, lack of space at the bedside obstructing access to hand-rub dispensers, having to wait for the dispenser to deliver hand-rub when health workers were in a hurry and in emergencies:

> I was doing a blood sugar for one patient and then there was this other patient fainted and I rushed over, in that case I'm supposed to gel my hands but I just rushed to help her from falling. (Registered nurse)

Interpreting the findings of electronic audit

Opinions about the accuracy of the EMS were conflicting. Some health workers accepted the automated data as the "true" indicator of adherence:

> The tag works. It's a true-life indicator of what we're doing. . . and the data that's produced is the same, quite similar, virtually the same as what's done by the [manual] audit. (Registered nurse)

Others were aware that the EMS would register a hand hygiene opportunity to which they were unable to respond when entering or leaving the patient zone carrying equipment. They were also aware that the ceiling-attached sensors might falsely register a hand hygiene opportunity if they entered the periphery of the zone to talk to a patient without either touching or for some other plausible reason:

> Today I had a student with me so I haven't done any patient care at all, I haven't touched any patients but I have been in their bed space which says I should gel but I haven't touched anyone. (Registered nurse)

Not knowing how to interpret feedback in the context of the clinical activity undertaken was problematic:

> *Registered nurse*: I have two red emails and the rest are green. It says I could be better, but I don't know how better I can be.
>
> *Interviewer*: How did that make you feel?
>
> *Registered nurse*: I just asked myself where did I miss it? Why did I miss it? I get the red ones and I don't know the answer.

Feedback

Impact on hand hygiene behaviour was attributed to feedback of the data generated by the EMS, not the system itself:

> It monitors how effective we are but doesn't make us more effective. I still think person-to-person intervention and interaction make a difference. (Registered nurse)

Some informants suggested that if somebody had performed particularly well, their success should be acknowledged during ward meetings. The method of delivering feedback appeared satisfactory but reaction to it varied. Some participants reported that wearing a tag and being identifiable increased feelings of accountability towards hand hygiene while others selectively ignored poor results or paid no attention to hand hygiene data at all:

> It creates an awareness in me to. . . remember you have that tag and. . . comes down to you so that's brilliant, yeah. (Registered nurse)
>
> It's nice to see you've done really well but one week. . . they sent an email saying you haven't done very well and I was, well okay. (Registered nurse).
>
> *Interviewer*: Do you think people pay attention to that feedback?
>
> *Registered nurse*: Not at all. I have to be honest.

Receiving the data in "real time", graphical representation and receiving feedback on collective performance were considered beneficial, especially by those who felt highly accountable for their own hand hygiene practice because attention was drawn to those who were persistently under-performing. Leadership from the ward manager increased the attention given to feedback and the ward manager was regarded as an important champion of the EMS:

> When the ward manager is on the ward. . . she's here most days. . . she makes it part of our morning ward round. (Healthcare assistant)

Discussion

Informants in this study recognised the importance of hand hygiene, welcomed innovation to improve adherence and accepted the EMS very well. Earlier evaluations have demonstrated that health workers are concerned about being identified when automated systems are introduced (Benudis et al, 2019; Ellingston et al, 2011). Despite being positively received in some studies, concerns have been expressed about who would access the data and how the information might be used (Boscart et al, 2008; Dyson and Madeo, 2017). Contrary to these findings, health workers in our study were highly enthusiastic and not concerned about wearing a tag. They identified factors that could detract from adherence but recognised that despite facing the same obstacles, some individuals managed to perform consistently better than others supporting the findings of an earlier study which suggested that hand hygiene behaviour is personal to the individual (Dufour et al, 2017). There were negative comments in relation to the alcohol hand gel which was considered harsh by some informants. This is an important consideration as health workers' opinions about the acceptability of EMSs are shaped by many factors and dislike of harsh hand hygiene products is a well-known disincentive to use (Pessoa-Silva et al, 2005).

Opinions about the accuracy of the automated data were mixed. Some informants thought the automated data were at least as accurate as a manual audit. Others identified limitations: inability of the EMS to identify hand hygiene opportunities that could not be acted on because hands were full, not allowing for emergency situations and false hand hygiene opportunities registered by the EMS when the health worker moved at the periphery of the patient zone. They also reported occasions when the patient zone was occupied without direct contact, corroborating the findings of earlier evaluations in which health workers have suggested that the EMS sometimes prompted them to undertake hand hygiene when it was unnecessary and in emergency situations (Dyson and Madeo, 2017; Levchenko et al, 2011). Entering the patient zone to bring meal trays has been associated with poor adherence in other studies (Dufour et al, 2017). Manipulating the system ("gaming") to falsely register hand hygiene events has been reported (Dyson and Madeo, 2017) but there were no reports of gaming in our study.

Opinions about feedback were diverse even in our small sample. Some informants believed that no attention was paid to them, others admitted to ignoring unfavourable results and a third group took monitoring seriously and attempted to improve practice. Finally, our study provides some insights about the way that feedback of hand hygiene

data operates, filling an important gap in knowledge with messages for policy makers and infection prevention teams (Ivers et al, 2014). To be persuasive it appears that hand hygiene audit findings must be seen to be credible and fair: health workers in our study could identify plausible reasons for occasional lapses in the accuracy of the automated data and chose to ignore them in preference to their own clinical decision-making. As in other studies (Storey et al, 2014), the immediacy of the data probably increased acceptability and strong leadership from the ward manager which, was a positive influence (Drey et al, 2020).

As other studies evaluating EMSs (Ward et al, 2014), ours was small scale and took place in a single organisation, thus introducing the risk of bias. In other evaluations it is unclear how participating wards were selected. It is possible that managers directed research teams to wards where practice was known to be good to enable the organisation to emerge well from the investigation. Conversely, research teams might have directed their attention to wards where practice was suboptimal in the hope that innovation would stimulate improvement. Ward culture influences hand hygiene performance and the success of interventions intended to improve adherence (Drey et al, 2020), but ours appears to be the first evaluation of an EMS that is transparent about selection and to disclose information about ward culture. This information increased our ability to interpret the findings. The professional attitude of the health workers and their understanding of the importance of hand hygiene were undoubtedly important. Ward leadership, sound preparation by the infection prevention team and ongoing support from the company are also likely to have contributed. A limitation is that we only interviewed nursing and healthcare assistants, so missing others who might also be able to comment on the EMS (such as medical staff or allied health professionals who also spend time in this clinical setting routinely).

However, an additional strength of our study was the use of in-depth qualitative interviews to obtain data in relation to acceptability, conducted by a researcher independent of the core research team. In other evaluations data have been collected by questionnaire which does not allow for probing about potentially sensitive issues such as how health workers react to feedback on poor adherence. Response rates have been low in some studies (Benudis et al, 2019; Storey et al, 2014) resulting in superficial data that may reflect bias. In evaluations where focus groups (Boscart et al, 2008; Ellingson et al, 2011; Levchenko et al, 2011) and interviews (Dyson and Madeo, 2017) have been conducted data were obtained by members of the team conducting the study introducing the possibility of bias generated through social desirability.

Overall, the findings of this study demonstrate that if introduced sensitively with ongoing communication between ward and infection prevention teams, EMSs can be very well tolerated by frontline health workers. The study confirms that it is sometimes hard for health workers to understand omissions in hand hygiene when data are automated, confirming previously expressed opinions: the context in which hand hygiene takes place is important and the two approaches to monitoring are complementary (Gould et al, 2017; Masroor et al, 2017). The message for policy makers and infection preventionists is that EMSs provide constant, objective measurement and feedback which release managers from undertaking routine manual audit, allowing them to identify areas in need of improvement, focus on training and develop interventions to meet local need. Close observation of health workers with documentation of movements between patients and within the patient zone demonstrates that they frequently touch equipment and surfaces without undertaking hand hygiene. These brief contacts are sufficient to transfer nosocomial pathogens (Fitzgerald et al, 2013). The EMS in our study registered a hand hygiene opportunity whenever a health worker occupied the patient zone for 10 s or longer. It is possible that brief environmental contacts might have occurred during this time but were dismissed as unimportant by health workers or they were unaware of them. The significance of these brief contacts needs greater emphasis during hand hygiene training.

We identified a number of issues meriting further investigation. Studies repeatedly demonstrate that the pressure of clinical work and dealing with emergencies are major impediments to hand hygiene adherence (Smiddy et al, 2015). By identifying occasions when hand hygiene opportunities most frequently occur, EMS data allow us to determine times when clinical workload is high. Simultaneous manual observation could be used to indicate the number of interruptions and emergency situations taking place and the point at which pace of work and fragmentation of tasks impact on adherence. Finally, more research needs to be undertaken to explore reactions to feedback of hand hygiene adherence with a larger sample and in a range of settings. Even in this small-scale qualitative study the reactions of staff were diverse but suggest that the content of feedback and the manner in which it is delivered can influence health workers' intention to act on it.

Conclusion

Electronic hand hygiene monitoring can be very well tolerated despite limitations related to accuracy inherent in the system which health workers can identify. Further research needs to explore different reactions to feedback and how often clinical emergencies arise. Electronic and manual audit have complementary strengths. Development and design of EMSs should be led by clinical need and incorporate qualitative feedback to improve their effectiveness and acceptability in different healthcare settings.

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ORCID iD

N Wigglesworth https://orcid.org/0000-0002-0289-8200

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