

## HAND HYGIENE: MONITORING TECHNOLOGY

23/03/2020

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### Summary

#### Question

What is the best available evidence regarding the efficacy of hand hygiene monitoring technology in improving hand hygiene, or reducing the incidence of healthcare-associated infection?

#### Clinical Bottom Line

Healthcare worker compliance with hand hygiene is considered to be the primary measure to prevent transmission of healthcare-associated infection (HCAI).<sup>1-3</sup> Observation is considered to be the gold standard for assessing hand hygiene compliance; however, limitations exist (e.g. the Hawthorne effect).<sup>2</sup> Hand hygiene monitoring technology (HHMT), including electronic and video monitoring systems (EMS/VMS), have been developed as a potential solution to the problem of poor hand hygiene compliance among healthcare workers.<sup>1</sup> An HHMT includes simple systems that count hand hygiene events by alcohol-based hand rub or soap dispensing, and complex systems that provide estimates of compliance and/or real-time hand hygiene reminders,<sup>1</sup> or by giving prompts (e.g. a badge worn may change color or emit a sound).<sup>2</sup> However, HHMT may be expensive and may not be acceptable to healthcare workers due to concerns about privacy, accuracy, or the need to wear additional devices or modify workflow. HHMT uses different algorithms to define compliance or measurements of hand hygiene frequency instead of compliance, and it is not clear how these measures correlate with directly observed compliance.

- A systematic review evaluated the efficacy of HHMT for improving hand hygiene or reducing the incidence of healthcare associated infection (HCAI). The authors reported that the efficacy of HHMT in improving hand hygiene and/or reducing the incidence of HCAI should be confirmed in a variety of clinical settings before HHMT is adopted. HHMT may improve compliance through the provision of enhanced feedback, real-time reminders, or through an enhanced Hawthorne effect (a type of reactivity in which individuals improve an aspect of their behavior in response to their awareness of being observed), created by continuous monitoring. Specifically:<sup>1</sup> (Level 1)
  - A randomized controlled trial (RCT) at low risk of bias showed 6.8% higher study-defined compliance in the intervention arm by an EMS providing individual feedback and real-time reminders.
  - One non-RCT found that an EMS with aggregate feedback showed no difference in hand hygiene frequency but was at high risk of bias.
  - Two pre- and post-test studies, evaluating an EMS that provided voice prompts, showed increases of study-defined compliance, but risk of bias was high.
  - Two time series analyses of a VMS that provided aggregate feedback demonstrated a large, sustained improvement in study-defined compliance and were at moderate risk of bias.
- A mixed-methods study investigated the impact of hand hygiene prompt and monitoring systems on compliance, how the HHMT influenced behavior, and the experience and opinions of healthcare workers on the use of the HHMT. Hand hygiene compliance was monitored (before, during and after system installation) by observations and alcohol rub usage. The battery-operated system comprised of a small, light badge (approximately 50 g) clipped to the tunic breast pocket, room sensors and a plug-in base station. When the healthcare worker cleaned their hands with alcohol rub, they held a hand near the badge for it to detect clean hands. If the healthcare worker chose to clean their hands with soap and water, a ceiling sensor recognized this providing the healthcare worker was at the sink for two or more minutes. Hand hygiene compliance was recorded by the Infection Prevention and Control Team as increasing from a mean of 73% in the eight weeks before installation, to 83% during the ten-week intervention period, and returning to 73%, once the system was removed (measured over a period of four weeks) – the HHMT recorded compliance at 98% to 100% during the ten weeks. Additionally, the amount of alcohol rub ordered went from four liters (before) to 10L during, and 2.5L after, installation. Most of the healthcare workers reported being aware of the prompt when they entered or left a room (room entry and exit being proxy measures of the World Health Organization [WHO] hand hygiene moments 1 and 4/5). Both the awareness of patient comfort in the case of a green badge (indicating hand hygiene had been undertaken) and the risk of upsetting the patient with a red badge (failure to undertake hand hygiene) resulted in greater intentions to clean hands; although some healthcare workers had reported removing the badge to prevent patient anxiety. Authors concluded that hand hygiene prompt and monitoring systems seemed to improve compliance;

however, the inability to recognize context warrant improvements. HHMT systems may be undermined by healthcare worker irritation and cheating the system.<sup>2</sup> (Level 2)

- A systematic review examined hand hygiene interventions designed to improve hand hygiene compliance. The review reported that EMSs improved monitoring capabilities at reduced costs and resolved some of the reported monitoring problems; however, their widespread application remains limited. The authors concluded the following:<sup>3</sup> (Level 1)
  - An HHMT successful in one setting, may not produce the same positive effects when applied to other healthcare environments; however, the replication of successful HHMT implementation strategies are recommended.
  - Minimal benefit may result from HHMT education unless it is interactive and engaging. Such education should not be overly informative and cognitively demanding and must fit into the healthcare workers' schedules.
  - Organizations should examine the hand hygiene issues particular to their organization before deciding on which HHMT components to implement.
  - HHMT should incorporate hand hygiene opportunities as defined by the WHO/Healthcare Infection Control Practices Advisory Committee.
- A mixed-methods study assessed the effectiveness, user experiences, and costs of implementing a real-time hand hygiene notification machine learning system in pediatric outpatient clinics in a medical center. Real-time hand hygiene notification significantly increased hand hygiene compliance (34.6% increase), compared to baseline percentage. In terms of costs, the total materials cost for full implementation was \$12,613, and the total annual costs were estimated to be \$27,419 (46%) lower compared to observational auditing in the pediatric outpatient setting. Overall, clinicians' and physicians' experiences with the intervention were positive; however, there were concerns raised regarding the long-term sustainability, and clinician fatigue to repeated notifications.<sup>4</sup> (Level 2)
- An intervention study described the implementation of an electronic hand hygiene monitoring system in three community hospitals. It was reported that the implementation was a complicated and lengthy process. However, the median compliance rate improved significantly (> 85%) with the use of this technology. However, the authors reported that the implementation of an electronic hand hygiene monitoring system required an investment of capital, resources, and time.<sup>5</sup> (Level 2)
- An observational study assessed the hand hygiene compliance of physicians for three months during outpatient examinations, using remotely monitored electronic counting devices. The authors reported significant improvement in hand hygiene compliance and concluded that auditing and feedback of adherence data to physicians may have a positive impact on their hand hygiene practice.<sup>6</sup> (Level 3)
- An observational study undertaken in a hospital where an EMS had been installed on most wards (87% of hospital beds) to monitor the WHO five moments of hand hygiene, found that electronic HHMT significantly improved hand hygiene compliance and significantly lowered rates of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. Authors reported that HHMT aided nursing leadership's ability to drive change and improve staff performance, by providing real-time reliable hand hygiene compliance data, concluding that this may lead to clinically important organizational change and, most importantly, improved patient safety.<sup>7</sup> (Level 3)
- A literature review investigated whether HHMT can be used to assess all WHO five moments of hand hygiene, as is the desired patient safety standard. Nineteen HHMT were found in the review including: radio-frequency identification; infrared detection; wireless networks; and VMS. Reviewers found that no available system was able to measure the WHO moments of hand hygiene two and three (before and after a procedure), finding coverage was largely restricted to moments one and four (before and after touching a patient). Authors concluded that understanding HHMT and appraising them at a systems level may help further develop this area of monitoring.<sup>8</sup> (Level 5)

## Characteristics Of The Evidence

This evidence summary is based on a structured search of the literature and selected evidence-based health care databases. The evidence in this summary comes from:

- A systematic review of seven studies (one RCT, one non-RCT, three uncontrolled pre-test post-test studies, and two uncontrolled time-series analyses).<sup>1</sup>
- A mixed methods study consisting of an observational component (n=15-20 observations per week for ten weeks) and semi-structured interviews with four staff nurses, three charge nurses, two doctors and three nursing assistants.<sup>2</sup>
- A systematic review of 73 interventional studies (six RCTs and 67 non-RCTs).<sup>3</sup>
- A mixed-methods study including a pre- and post-intervention phase, observational audits, a cost-effectiveness component and interviews.<sup>4</sup>
- A pre- and post-intervention study conducted in three community hospitals.<sup>5</sup>
- An observational study involving 280 physicians.<sup>6</sup>
- An observational study involving 23 inpatient units.<sup>7</sup>
- A literature review.<sup>8</sup>

## Best Practice Recommendations

- There is emerging evidence to support the use of HHMT to increase hand hygiene compliance and reduce the incidence of HCAI; however, at this time no one type of HHMT can be recommended. It is however, recommended that organizations consider the context in which an HHMT will be used, and conditions unique to their setting, before installing any HHMT. (Grade B)

## References

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The author declares no conflicts of interest in accordance with International Committee of Medical Journal Editors (ICMJE) standards.

**How to cite:** Marin, T. Evidence Summary. Hand Hygiene Monitoring Technology. The Joanna Briggs Institute EBP Database, JBI@Ovid. 2020; JBI23915.

For details on the method for development see Munn Z, Lockwood C, Moola S. The development and use of evidence summaries for point of care information systems: A streamlined rapid review approach. *Worldviews Evid Based Nurs.* 2015;12(3):131-8.

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