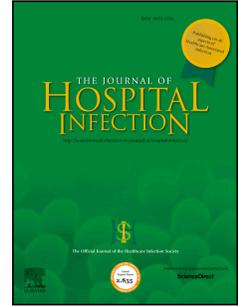


# Journal Pre-proof

Innovative technologies for hand hygiene monitoring are urgently needed in the fight against COVID-19

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**Title:** New innovative technologies for hand hygiene monitoring urgently needed in the fight against COVID-19

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Sir,

The editorial “Washing our hands of the problem” celebrated this journal’s commitment to publishing on hand hygiene, which is now particularly relevant in the advent of the COVID-19 pandemic [1]. Though the challenge of measuring hand hygiene (HH) events and compliance was rightly highlighted, it is well recognised that the ‘gold standard’ methodology of direct observation (DO) does not produce accurate data [1]. The only alternative option given in the editorial was using data derived from the consumption of alcohol based handrub (ABHR), based on purchase orders, as a proxy measurement for HH events. As alluded to in the editorial, use of ABHR purchase order data per se can be problematic. A study by Lee et al. [2] demonstrated that fluctuations in HH events as shown in DO are not reflected in ABHR purchase order data. ABHR data only provides an organisational, or at best, a departmental picture of HH events [3]. Furthermore, even with such data, it is unlikely that this type of feedback on staff HH performance will provide the motivational behaviour change needed to see a sustained improvement in rates of HH compliance. To achieve this goal, staff need access to their own personal HH data so that they can make individual decisions to improve their own HH compliance [4].

The editorial does, however, provide the opportunity to highlight the importance of new innovative technologies to improve HH monitoring. Though the optimal method for improving compliance has yet to be found, automated HH monitoring systems (AHHMS)

do allow for far more accurate data collection, which is capable of encouraging real behaviour change. A recent review identified fifteen such commercial AHHMS. Unfortunately, the majority of these only provide performance feedback to staff at group but not individual level [5]. Thirteen also had a significant impact on staff workflow (e.g. staff needing to wear additional sensor equipment or change behaviour due to battery life) [5]. “One size does not fit all” is an important lesson with regards to improving HH standards, as noted in the editorial, recognising that staff need access to their own personal HH data [4]. The disparity between what staff need from an AHHMS and what is currently available in the commercial marketplace might indicate why uptake of this type of technology has been so poor both in the NHS and other healthcare systems worldwide.

A closer look at AHHMS shows that there are three types of technology on offer; door monitoring systems, badge trackers worn by healthcare workers, and camera-based systems [6]. Door monitoring systems assume that a person entering a room equates to a HH event. However, this fails to recognise differences between staff groups - for example it may be necessary for a nurse to perform HH more times than a consultant in a given patient encounter. Additionally, these systems are not necessarily appropriate in hospitals with limited single room capacity. AHHMS which measure HH compliance rates based on individual staff entry into a single room, regardless of contact with the patient or their surroundings, could give misleading information. Use of badge trackers may also require staff to attach an additional badge and they may be asked to charge it

at the end of their shift. This impracticability creates an additional step in staff workflow, which is unlikely to be adhered to. RFID technology incorporated into the badges also requires staff to stand at a specific location relative to ABHR dispensers, otherwise the HH event will not be logged. Camera-based systems produce data free of the Hawthorne effect, however this is at the expense of the time taken to observe large volumes of footage [6]. Clearly, despite the many limitations of current AHHMS, an optimal system putting the clinical user at the centre of the innovation should be possible. The key features for such innovative technology should include personal HH performance goals showing where and how to improve, no added workload for staff, robust high volume data that gives a true picture of reality and the capture of data from all staff groups regardless of role or location, plus ABHR /liquid soap consumption data.

Such an AHHMS solution could prove vital in the current COVID-19 crisis as HH is the first line of defence in the control of the pandemic [7]. Under ordinary circumstances, HH compliance rates disappointingly have remained at best 50% [8]. However, we are currently in extraordinary times. We know that DO is labour intensive, and therefore unlikely to be prioritised due to severe staff pressures. If infection prevention and control teams are to get a sense of HH compliance during this pandemic, it is essential that we look to innovative HH technologies for support.

## **References**

1. Lynch C, Mahida N, Oppenheim B, Gray J. Washing our hands of the problem. *Journal of Hospital Infection* 2020. In Press.  
<https://doi.org/10.1016/j.jhin.2020.03.010>.
2. Lee YF, Merican H, Nallusamy R, et al. Hand hygiene compliance in Penang, Malaysia: Human audits versus product usage. *American Journal of Infection Control* 2016;44(6):e95–7. <https://doi.org/10.1016/j.ajic.2015.12.031>.
3. Dalziel C, McIntyre J, Chand AG, McWilliam S, Ritchie L. Validation of a national hand hygiene proxy measure in NHS Scotland. *J Hosp Infect* 2018;98:375–7. <https://doi.org/10.1016/j.jhin.2017.10.001>.
4. Tartari E., Pires D., Pittet D. ‘One size does not fit all’ – customizing hand hygiene agents, messages, and interventions. *Journal of Hospital Infection* 2018;98(4):324–7. <https://doi.org/10.1016/j.jhin.2018.02.020>.
5. Cooke R, Corke C. A review of automated hand hygiene monitoring systems-why is uptake so poor? *J Infect Prev* 2019;20:32.
6. Boyce JM. Electronic monitoring in combination with direct observation as a means to significantly improve hand hygiene compliance. *Am J Infect Control* 2017;45:528-535. <https://doi.org/10.1016/j.ajic.2016.11.029>
7. Adhikari SP., Meng S., Wu Y-J., et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infectious Diseases of Poverty* 2020;9(1). <https://doi.org/10.1186/s40249-020-00646-x>.

8. Pan SC, Tien KL, Hung, IC, Lin, YJ, Sheng, WH, Wang MJ, et al. Compliance of Healthcare Workers with Hand Hygiene Practices: Independent Advantages of Overt and Covert Observers. PLoS ONE 2013;8(1):e53746.

<https://doi.org/10.1371/journal.pone.0053746>