

3D ambient perception-action AI system with real-time nudges and dashboard increased hand hygiene compliance (HHC) in a Canadian hospital setting: a mixed methods study

Jeremy Grimshaw¹ on behalf of The Ottawa Hospital/Lumenix Working Group (Sybille Delice-Charlemagne², Alison Jennings², Kara Kitts², Claire Ludwig², Jaimie Delaney¹, Gregory Loan¹, Paul Elder¹, Scott D. Delaney¹)

1 Lumenix, Ottawa, Canada

2 The Ottawa Hospital, Ottawa, Canada

HIGHLIGHTS

A 3D ambient perception-action AI system with real-time nudges and dashboard, called the **Artificially Intelligent Monitoring System (AIMS)**, was introduced on a 36-bed transitional care ward. We conducted a mixed method evaluation of AIMS on hand hygiene compliance (HHC), the most important infection prevention and control measure.^{1,2}

Sustained hand hygiene compliance improvements

- Implementation of AIMS led to an **immediate 10.8% absolute increase** in the moment 1 HHC rate ($p < 0.001$), which **increased to an 18.7% absolute increase** by 15 months ($p < 0.001$).
- AIMS was accepted and valued by unit staff.
- Patients and carers reported no problems with AIMS and did not request that AIMS be disabled in the 15 months following implementation.

Comprehensive and granular HHC data

- Routine human observation-based hospital hand hygiene audits reported higher rates than AIMS; likely due to the Hawthorne effect.^{3,4}
- AIMS generates comprehensive and granular data on both HHO and HHC that have never previously been available. During the follow-up period, AIMS identified 936 moment 1 hand hygiene opportunities per day, equivalent to 66,857 total hand hygiene opportunities a month in 36-bed transitional care unit (extrapolated based on Nayyar).⁵

BACKGROUND

- HHC is the most important infection prevention and control measure.^{1,2} Yet globally, HHC remains low. Advances in technology and artificial intelligence offer new opportunities to address this problem.
- AIMS** is a ceiling-mounted, platform technology that uses cutting-edge 3D perceptual sensors and state-of-the-art neural networks to anonymously monitor clinical environments and prompt healthcare professionals (HCP) to undertake appropriate actions to improve staff and patient safety and quality, including HHC, environmental hygiene, fall detection and patient wandering (**Figure 1**).
- The AIMS Smart Hand Hygiene Support app** monitors a clinical environment continually (30/s, 24/7, 365/yr) and can identify when an individual enters the environment and whether they perform hand hygiene (HH). If not, AIMS provides an audio and visual alert to encourage the HCP to perform HH before touching the patient. AIMS routinely captures data on all hand hygiene opportunities (HHOs) and HHC — data provided to a real-time dashboard detailing HHC — which can be used by organizations to actively monitor their own performance and inform local quality improvement interventions.



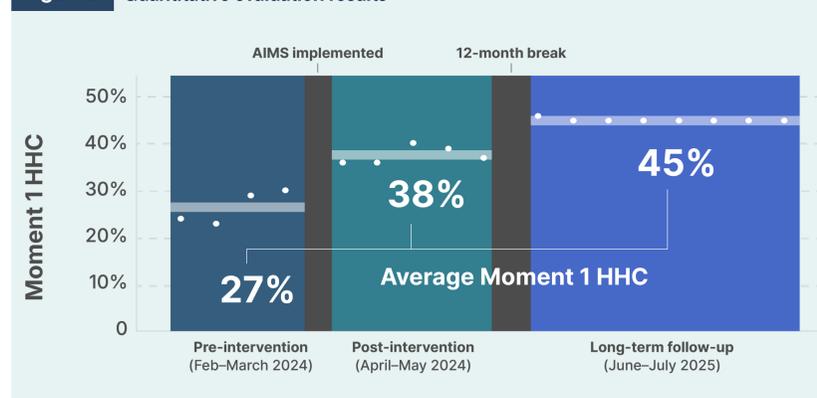
Ceiling-mounted AIMS node in patient room

METHODS

- Mixed method evaluation:** Uncontrolled before and after quantitative study evaluating moment 1 HHC and qualitative study with staff about their experiences of and perceptions about AIMS.
- Setting:** 36-bed transitional care unit in a Canadian teaching hospital.
- Qualitative study:** Semi-structured interviews based upon the Theoretical Framework for Acceptability with 11 staff including nurses, the Unit nurse manager, physicians, allied HCPs and support staff. Interviews were double coded and analysed thematically.
- Quantitative study:** Moment 1 HHC was measured four weeks before and five weeks after the implementation of AIMS. AIMS nodes captured HHC data. T-tests comparing HHC rates pre- and post-AIMS implementation and at long-term follow-up 15 months following implementation.
- Ongoing monitoring** of patients' and carers' requests to disable the AIMS nodes alerts due to patient concern or distress.
- Comparison** with routine human observation-based hospital hand hygiene audits (based on Ontario guidance⁶ requiring up to 25 human observations of any HHOs per month).

RESULTS

Figure 2 Quantitative evaluation results



- HHC detection:** AIMS detected an average of 936 moment 1 HHOs per day during the post-implementation period. HHOs were lower during weekends and overnight.
- Qualitative study:** Staff valued AIMS technology and the support it gave them to improve HHC. The AIMS dashboard supported the Unit nursing management to work with staff to improve Unit-level hand hygiene performance (**Box 1**).
- Quantitative study:** The absolute HHC rates were 26.7% pre-implementation and 37.6% post-implementation (absolute difference = +10.8% (95% CI +9.1%, +12.5%); t-test $p < 0.001$) (**Figure 2**).
- Long-term follow-up: 15 months after the implementation, HHC rates were 45.0% (difference 18.7%, 95% CI +17.2%, +20.2%; t-test $p < 0.001$) (**Figure 2**).
- No patients or carers requested the AIMS nodes or alerts be disabled in the first 15 months following AIMS implementation.
- 15 months after the implementation, the routine human observation-based hospital hand hygiene audits reported HHC rates of 80.6% (based on 31 observations during June-July 2025).

Staff members' perspectives of and experiences with AIMS and related training activities:

- Staff valued AIMS and the support it gave** them to improve HHC.
- AIMS was positively embraced by patients, their family members, and staff.** Feedback interviews with staff pointed to a high degree of comfort and confidence with AIMS, its role and function.
- The AIMS dashboard was a helpful tool** that supported Unit nursing management to work with and encourage staff to improve Unit-level hand hygiene performance.
- The training and education provided was valued** (especially when this was done in-person with a live demonstration).
- Staff were excited by the prospect of further AIMS applications** to support their work and help improve care.

TAKEAWAY

A 3D ambient perception-action AI system with real-time nudges led to a sustained 18.7% increase in moment 1 HHC and generated comprehensive (24/7) and granular data on both HHO and HHC that have never been previously available.

REFERENCES

- Pittet D. *Journal of Hospital Infection* 2004;58(1): 1-13.
- WHO. www.who.int/gpsc/5may/tools/9789241597906/en/ 2009 (accessed 19th Aug 2025)
- Chen LF et al. *Infect Control & Hosp Epidemiol* 2015; 36(12): 1444-1450.
- Vaisman A et al. *BMJ Qual Saf* 2020; 29: 932-938.
- Nayyar et al. *Infect Control & Hosp Epidemiol* 2018; 39: 1378-1380.
- Public Health Ontario <https://www.publichealthontario.ca/en/Health-Topics/Infection-Prevention-Control/Hand-Hygiene/JCYH> (accessed 19th August 2025)



Contact Information

Dr. Jeremy Grimshaw
 Medical Director and Senior Scientist,
 Implementation and Behavioural Science
 dr.jeremy.grimshaw@lumenix.com
 +1 613 878 3843