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Major Article

Automated hand hygiene auditing with and without an intervention

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Background: Daily feedback from continuous automated auditing with a peer reminder intervention was used to improve compliance. Compliance rates from covert and overt automated auditing phases with and without intervention were compared with human mandatory audits.

Methods: An automated system was installed to covertly detect hand hygiene events with each depression of the alcohol-based handrub dispenser for 5 months. The overt phase included key clinicians trained to share daily rates with clinicians, set compliance goals, and nudge each other to comply for 6 months. During a further 6 months, the intervention continued without being refreshed. Hand Hygiene Australia (HHA) human audits were performed quarterly during the intervention in accordance with the World Health Organization guidelines. Percentage point (PP) differences between compliance rates were used to determine change.

Results: HHA rates for June 2014 were 85% and 87% on the medical and surgical wards, respectively. These rates were 55 PPs and 38 PPs higher than covert automation rates for June 2014 on the medical and surgical ward at 30% and 49%, respectively. During the intervention phase, average compliance did not change on the medical ward from their covert rate, whereas the surgical ward improved compared with the covert phase by 11 PPs to 60%. On average, compliance during the intervention without being refreshed did not change on the medical ward, whereas the average rate on the surgical ward declined by 9 PPs.

Conclusions: Automation provided a unique opportunity to respond to daily rates, but compliance will return to preintervention levels once active intervention ceases or human auditors leave the ward, unless clinicians are committed to change.

BACKGROUND

Establishing an accurate measurement of hand hygiene compliance is central to any local and national patient safety infection control program.[1,2] In 2010, hand hygiene compliance audits became mandatory for all Australia public hospitals. They are performed in accordance with the methodology required by Hand Hygiene Australia (HHA)[3] and aligned with the World Health Organization (WHO) guidelines.[4] The WHO guidelines recommend auditing the My 5 Moments for Hand Hygiene: moment 1 (before touching a patient), moment 2 (before aseptic-clean procedure), moment 3 (after body fluid exposure risk), moment 4 (after touching a patient), and moment 5 (after touching patient surroundings). Currently, the compliance threshold required for accreditation is 70%,[3,5] and quarterly rates are posted on the MyHospitals Web site[6] for public scrutiny. Auditors trained by HHA use a standardized hand hygiene compliance audit tool[3] to overtly document the My 5 Moments for Hand Hygiene[7] a minimum of 350 overt hand hygiene opportunities (HHOs) for health care workers' (HCWs) that are collected sporadically over 3 months to provide a quarterly rate.[3] Purposeful overt audits may result in rates that do not reflect routine practice.[8-13] Infection control has been slow to champion automated surveillance systems,[10,14] arguing that the scarcity of evidence and experience

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with any of these systems inhibit greater support of the method.[11] However, electronic surveillance has been shown to be valid[15,16] and useful in effecting change.[17] One strategy to achieve changes has been the use of immediate personalized performance feedback to target clinician practices.[18] We advocated that peer support could improve performance by having peers act as a cue to memory by nudging each other with "take a moment" prior to entering a patient's room.[19] The Ministry of Health responded to this call with the launch of the Clean In, Clean Out campaign in 2015[20] in a valiant effort to refresh the national hand hygiene initiative.[5] For concerns that rates established from human audits would not reflect improved compliance in response to the refreshed campaign, we installed an automated system[21,22] to mirror the compellingly validated methodology of the Hospital Hand Hygiene Opportunities: Where and When (HOW2) The HOW2 Benchmark Study.[23] The automated surveillance system registers a complied event each time the hand hygiene solution dispensers are accessed, and all complied events are sent using low radio frequency signals to a central database. The system does not distinguish compliance by each of the My 5 Moments for Hand Hygiene,[7] rather the central database establishes an aggregated rate for all 5 moments. This single rate is calculated from a denominator of the average daily HHOs identified from the 24 h/d, 7 d/wk audit of each ward, adjusted daily for bed occupancy.[21] This methodology is in accordance with the HOW2 benchmark study that was validated by a videotaped recording.[23] This system allowed us to establish daily compliance for 18 months with and without nudging.

MATERIALS AND METHODS

The study was conducted on a medical and surgical ward in a university tertiary teaching hospital in Sydney, New South Wales, from October 2013-November 2015. The automated system was installed with a denominator adjusted daily for occupied bed days. Detailed methodology has been previously reported.[3,21,22]

We excluded student nurses and medical students from our aim of improving compliance in nurses and physicians because students are permanently rotated around the hospital. Nursing students do not attend the daily clinician hand over meetings, and medical students infrequently attend; therefore, students would not receive all elements of the intervention. The denominator was adjusted for nurses and physicians to reflect their HHOs established from the 24 h/d, 7 d/wk audit.[21,22] The 24-bed medical ward was classified as a high-dependency coronary care unit, and the 20-bed surgical ward was a high- to medium-dependency cardiothoracic unit. The average lengths of stay were 3.49 and 4.27 days for the medical and surgical wards, respectively. There were 23 nurses and 9 physicians on the medical ward and 15 nurses and 9 physicians on the surgical ward from Monday to Friday. On the weekend there were 21 nurses and 2 physicians on the medical ward and 14 nurses and 2 physicians on the surgical ward. The data and the phases for data collection are as follows.

Mandatory HHA audits

The hospital provided the authors, at the completion of the trial, the HHA rates for each reporting quarter for nurses and physicians for the 2 trial wards from the second quarter of 2014 to the third quarter of 2015.

Phase 1

The automated system was installed in June 2014 and ran covertly for 1 month (for details see Azim et al[21]). At the beginning of July 2014, staff was informed that automated surveillance would commence, and this passive surveillance period ran for 5 months until November 2014.

The supplier routinely maintained equipment throughout the trial and checked that each dispenser was capable of sending data to the central database. Each dispenser had a built-in system that alerted the supplier of a software failure that may prevent data being transferred.

Phase 2

The intervention commenced in December 2014 and ran until June 2015. The intervention included training nurse unit managers from both wards to access the previous 24-hour compliance rate, to share rates with clinicians at the morning clinical hand over meetings, to set future compliance goals, and to nudge each other with a reminder to hand hygiene, with a friendly "take a moment" as they entered a patient's room. The intervention was refreshed with reminders at the hand over meetings and seminars throughout this phase to nudge.

Phase 3

From July 2015 and October 2015, staff were not reminded to nudge or access the previous daily rates.

Phase 4

Clinicians were warned that an overt 8-hour (7:00 a.m. to 3:00 p.m.) human audit was scheduled on November 6, 2015.

Data analysis

During phases 1-4, complied event data were aggregated as the numerator and divided by daily sanitizer HHOs adjusted for occupied bed days (for full details see Azim et al[21]). Handwash solution dispensers were connected in July 2015, and the denominator was adjusted to include all HHOs. Data were entered and analyzed by Excel version 14 (Microsoft, Redmond, WA) and SPSS version 21 (SPSS, Chicago, IL). The subtraction of one percentage from another, such as between phases, provides a percentage point (PP) difference. We report PP differences between compliance rates because the data follow a binomial distribution with multiple Bernoulli events (HHOs) where there were only 2 distinct outcomes (compliance or no compliance). Poisson distribution would be appropriate only where there is a mismatch between the numerator and the denominator (ie, if we could not measure individual Bernoulli events). Statistical significance can be inappropriate with large samples,[24] and we expected a large monthly sample of 45,000 HHOs based on our 24 h/d, 7 d/wk observations of the average daily number of HHOs unadjusted for bed occupancy.[21] Therefore, we performed an a priori calculation using Stata SE version 14 (StataCorp, College Station, TX) to identify delta, also known as the significant detectable effect (ie, the size of the difference between 2 proportions that would be found to be significant), with alpha set at 0.05, a conservative expected compliance rate of 50%, and power at 90% for a conservative sample size of 30,000. Our calculation identified that the detectable significant difference between 2 proportions was just 1.3 PP. This difference was so small that we determined it would not represent a clinical or behaviorally important improvement. Large monthly samples with high power to detect a significant effect as small as 1.3 PP would make hypothesis testing redundant. As a result, we made an a priori decision that a behaviorally important improvement would need to be ≥5 PPs. The sample size precluded the need for confidence intervals to illustrate precision of estimates. All of the rates were rounded up at 0.6, and we took the conservative statistical approach of rounding down at 0.5. The compliance rates established by the automated surveillance system during the 8-hour human audits were obtained from the daily graph generated by the system for this 8-hour period. Average monthly rates and minimum