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Major Article

Hand hygiene compliance rates: Fact or fiction?

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Background: The mandatory national hand hygiene program requires Australian public hospitals to use direct human auditing to establish compliance rates. To establish the magnitude of the Hawthorne effect, we compared direct human audit rates with concurrent automated surveillance rates.

Methods: A large tertiary Australian teaching hospital previously trialed automated surveillance while simultaneously performing mandatory human audits for 20 minutes daily on a medical and a surgical ward. Subtracting automated surveillance rates from human audit rates provided differences in percentage points (PPs) for each of the 3 quarterly reporting periods for 2014 and 2015.

Results: Direct human audit rates for the medical ward were inflated by an average of 55 PPs in 2014 and 64 PPs in 2015, 2.8-3.1 times higher than automated surveillance rates. The rates for the surgical ward were inflated by an average of 32 PPs in 2014 and 31 PPs in 2015, 1.6 times higher than automated surveillance rates. Over the 6 mandatory reporting quarters, human audits collected an average of 255 opportunities, whereas automation collected 578 times more data, averaging 147,308 opportunities per quarter. The magnitude of the Hawthorne effect on direct human auditing was not trivial and produced highly inflated compliance rates.

Conclusions: Mandatory compliance necessitates accuracy that only automated surveillance can achieve, whereas daily hand hygiene ambassadors or reminder technology could harness clinicians' ability to hyperrespond to produce habitual compliance.

Direct observation of health care workers (HCWs) using human auditors has long been the gold standard for auditing hand hygiene compliance before the development of the World Health Organization hand hygiene guidelines.[1] Perceptively, the guidelines[1] and a follow-up publication[2] came with a caveat about the potential epidemiologic pitfalls of this methodology: statistically underpowered samples, selection bias (eg, specific shifts, wards, and days), and human errors such as measurement bias and Hawthorne effect.[3] Human auditors collect data for the Australian National Hand Hygiene Initiative that is a mandatory surveillance program implemented by Hand Hygiene Australia (HHA).[4] Hospital-wide compliance rates for each of the 3 mandatory quarterly periods per year are published on the MyHospitals Australia Web site for public scrutiny against a required preset threshold, currently at 70%, for accreditation.[5] Attempts to address epidemiologic pitfalls associated with human audits include training auditors to reduce observation bias and improving reliability by aggregating daily 20-minute samples to produce a quarterly rate. However, improving validity has not been addressed and would require auditing all shifts and days[6] and reducing the distorting influence of the Hawthorne effect from direct observations.

Since 2009, several attempts have been made to examine the epidemiologic errors associated with direct, also referred to as overt, human auditing and to quantify the Hawthorne effect or correct the Hawthorne effect with automation and technology.[7-13] Rates produced from direct observations made by infection control practitioners and unit hand hygiene ambassadors were 30-50 additional percentage points (PPs) higher than rates produced from trained covert medical student auditors.[7] When rates established from unit-based auditors were compared with undercover auditors at 2 hospitals, the average magnitude of the difference was 20 PPs.[8] This difference was concluded to be because of the unit-based auditor having allegiance with the staff, but the difference may

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also have been because of the Hawthorne effect.[8] When the external validation method used technology as the undercover auditor, such as videotape recording, electronic dispensers, and badges, the magnitudes of the Hawthorne effect were also reported to be high.[9-13] Videotape recording of compliance with performance feedback to HCWs identified a difference of 53 PPs in rates when compared with recording without feedback of performance.[9] When rates from videotape recording were compared with direct human auditor rates, the magnitude of the difference across the 3 surveillance periods ranged from 23-36 PPs.[10] Rates from human daily 20-minute audits for a week were 57 PPs higher than rates established from badges for the same duration.[11] Rates established from direct human auditing for an average of 9 minutes daily over 5 months were 2.5 times higher when compared with rates established from dispenser technology.[12] Others have established that the Hawthorne effect from direct human auditing was 1.6 times higher than automation.[13] The conclusion would be that the Hawthorne effect is pervasive globally during direct human audits, and although the magnitudes differ, it is never trivial.

Public Australian hospitals have audited hand hygiene compliance in accordance with the mandatory requirements since 2010.[4] However, since the data became publicly accessible in October 2011,[5] rates have been presented as valid, or factual, whereas the influence of the Hawthorne effect on these rates has yet to be estimated. We report 2 reporting years of automated surveillance data from 2 wards at a university teaching hospital collated to produce 3 mandatory quarterly rates per year and compared these with the same quarterly rates collected by direct human auditors for HHA.[14,15]

METHODS

Setting

The automated hand hygiene compliance surveillance system collected data on 2 wards in a tertiary teaching hospital in Sydney, New South Wales, Australia, for 6 mandatory quarterly reporting periods between 2014 and 2015 (for full details see Azim et al[14] and Kwok et al[15]). 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.

Direct human audits

In accordance with the mandatory HHA program, a minimum of 350 hand hygiene opportunities (HHOs) were collected per ward to produce a rate for each of the mandatory 3 quarterly reporting periods.[4] Gold standard auditors were trained in direct observation of a ward for approximately 20 min/d over 3 months, collecting on average 9-10 HHOs daily that were collated to produce quarterly ward and hospital-wide rates. Ward-based quarterly rates, aggregated by the My 5 Moments for Hand Hygiene, for 2014 and 2015 were not publicly available at the time of the study and were provided to us by the hospital management.

Automated hand hygiene compliance

During the same mandatory direct human audits for the HHA surveillance periods, the automated surveillance system continuously collected compliance data (for full methodology and evaluation see Azim et al[14] and Kwok et al[15]). In brief, the automated system provided daily 24-hour ward compliance rates using a denominator of total daily HHOs for each ward previously identified from 24-hour audits for 7 days. The average ward-specific denominator was adjusted contemporaneously for daily bed occupancy. The numerator (complied hand hygiene events) was the aggregation of daily access to alcohol-based handrub and handwashing solution dispensers. A low voltage signal from the dispenser was sent to a central Internet hub with each depression of the dispenser. Each dispenser was adjusted to register only 1 moment when >1 depression was made within 5 seconds. Validation of the automated surveillance system has been reported by others using videotape recording.[16,17] To reassure our HCWs and validate the automated surveillance accuracy, we announced an 8-hour period where data from direct human audits would be compared with automated surveillance data for accuracy; the automated rate was 3 PPs higher than the human auditors on the medical ward and 17 PPs higher on the surgical ward.[15]

Statistics

Rates produced from routine direct human auditing for HHA were compared with rates produced by continuous automated surveillance for each of the same 3 mandatory quarterly periods per year for 2014 and 2015. No statistical tests for significance were used because the size of the 24-hour automated surveillance datasets would have resulted in a 3-PP difference between the automated and human rates reaching significance. Therefore, the magnitude of the Hawthorne effect was examined only by calculating the PP difference: subtracting the percentage rate collected by human auditors from the automated rates for each of the 3 reporting quarters in each year and each ward. The PP differences were plotted on a graph. The HHA rate was divided by the automated rate to establish how many times higher the human audit rate was relative to the corresponding automated rate.

RESULTS

The PP differences between direct human and automated surveillance rates were consistently high on the medical ward across each quarter in 2014 and 2015 (Fig 1). The total average HHA rate for 2014 was 55 PPs (2.8 times) higher than the automated rates on the medical ward and remained high (64 PPs, 3.1 times) in 2015 (Table 1). The magnitude of the Hawthorne effect on the direct human audit rates for the surgical ward was consistently lower across all quarters (Fig 1), with an average annual magnitude of effect of 32 PPs, 1.6 times higher than automation, in 2014 and 31 PPs, 1.6 times higher than automation, in 2015 (Table 1).

DISCUSSION

Since the introduction of My 5 Moments for Hand Hygiene,[1] the possible magnitude of the Hawthorne effect on compliance rates established from direct human audits may range from 20-50 PPs or 1.3-2.1 times higher than undercover human audit rates.[7,8] Similarly, the Hawthorne effect inflated direct human rates by 1.5-2.9 times or 23-57 PPs when compared with technology and automated surveillance.[9-13] We found the Hawthorne effect in 6 HHA mandatory quarterly reports for 2014-2015 for our 2 study wards was inflated by 31-64 PPs, 1.6-3.1 times higher, than our automated rates. The size of the Hawthorne effect is similar to international estimates since 2009, regardless of which external validation method was used.[7-13] When estimates of compliance rates were tested using product usage, dispenser events, and human auditors, Marra and Edmond were in no doubt that direct human audits should not be used to establish compliance.[18]

Our data illustrate that the average quarterly sample is as large as 147,308 HHOs, 578 times more HHOs than human audits collected. Other automation and technology studies validated their denominator and numerator from video recording[15] and dispenser counters.[18] Our daily denominator was based on continuous 24-