An alternative methodology for interpretation and reporting of hand hygiene compliance data

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**Background:** Since 2009, all hospitals in Ontario have been mandated to publicly report health care provider compliance with hand hygiene opportunities (http://www.health.gov.on.ca/patient_safety/index.html). Hand hygiene compliance (HHC) is reported for 2 of the 4 moments during the health care provider-patient encounter. This study analyzes the HHC data by using an alternative methodology for interpretation and reporting.

**Methods:** Annualized HHC data were available for fiscal years 2009 and 2010 for each of the 5 hospital corporations (6 sites) in the North Simcoe Muskoka Local Health Integration Network. The weighted average for HHC was used to estimate the overall observed rate for HHC for each hospital and reporting period. Using Bayes’ probability theorem, this estimate was used to predict the probability that any patient would experience HHC for at least 75% of hand hygiene moments. This probability was categorized as excellent (>75%), above average (50%-74%), below average (25%-49%), or poor (<25%). The results were reported using a balanced scorecard display.

**Results:** The overall observed rates for HHC ranged from 50% to 87% (mean, 75% ± 11%, P = .079). Using the alternative methodology for reporting, 6 of the 12 reporting periods would be categorized as excellent, 2 as above average, 2 as below average, and 3 as poor.

**Conclusion:** Population-level HHC data can be converted to patient-level risk information. Reporting this information to the public may increase the value and understandability of this patient safety indicator.

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Health care-associated infections (HAI) are adverse events associated with significant morbidity, mortality, and excess costs. The unwashed hands of health care providers are believed to be the most important vector for HAI. Whereas the attributable benefit of hand hygiene interventions on reducing HAI has not been definitively demonstrated, the preponderance of evidence along with the simplicity and minimal cost of hand hygiene interventions has resulted in commitments by governments and health care organizations to promote improved hand hygiene practices among health care providers.

The government of Ontario has recently launched a “Just Clean Your Hands” patient safety initiative. The goal is to improve compliance with hand hygiene opportunities among health care providers. The method for collecting hand hygiene compliance (HHC) data in Ontario is consistent with the recommendations of the World Health Organization (WHO), with the exception that the 5 moments for hand hygiene described by the WHO have been condensed into 4 moments in the “Just Clean Your Hands” campaign. The Ontario Provincial Infectious Diseases Advisory Committee, an expert panel of infectious diseases specialists and infection control professionals, recommended this simplification to facilitate health care provider hand hygiene training. Whereas direct observation occurs for all 4 moments, mandated reporting is limited to only 2 hand hygiene moments: before initial contact with the patient/environment and after patient/environment contact. The program requires public reporting of HHC rates for every hospital in the province. The HHC rates for both the before and after moments can be found on the government’s patient safety indicator Web site.

HHC rates are calculated from quasi-random observations of unpaired hand hygiene opportunities. (“Unpaired” implies that auditors are not recording the before and after HHC of the same health care provider but rather record before and after HHC of different health care providers.) This methodology has been
demonstrated to overestimate overall compliance rates. The only requirement that must be met by each hospital is related to sample size; each hospital must submit data from at least 200 hand hygiene observations for a hospital with at least 100 patient beds or 100 observations for a hospital with less than 100 patient beds. The current reporting methodology for HHC is flawed for several reasons. First, the public policy decision to report only 2 of the 4 moments compromises the validity of this indicator to estimate the true risk of disease transmission to the public. Second, hand hygiene is a “bundled” patient safety indicator meaning the outcome is dichotomous: either a patient has or has not received the appropriate hand hygiene intervention. For example, if a health care provider consistently forgets to clean their hands prior to patient contact but is compliant with all other hand hygiene opportunities, then the health care providers HHC should be reported as 0% compliance and not as 75% compliance (using the 4 moments of hand hygiene employed in Ontario as the denominator). This approach is consistent with the recommended reporting methodology for other patient safety indicators such as the ventilator-associated pneumonia and central-line infection prevention bundle checklists, and the WHO surgical checklist. Third, the sampling methodology of observing random moments among many patients as opposed to observing all the moments for randomly selected patients results in a nonlinear relationship between observed HHC rates and the likelihood of individual patients receiving appropriate HHC. To convert the current data into patient-level data, Bayes’ probability theorem can be employed to calculate the conditional probability of any patient receiving indicated hand hygiene given the reported HHC rates. By using this strategy, the validity and utility of publicly reported HHC rates can be improved.

METHODS

The North Simcoe Muskoka Local Health Integration Network is located in the province of Ontario, Canada. It comprises 1 of 14 provincial regional health authorities responsible for the fiscal management of Ontario’s publicly funded health care system. Within the North Simcoe Muskoka Local Health Integration Network, there are 5 acute care hospitals (6 sites) that service a population of approximately 450,000, or 3.45% of Ontario’s population. HHC data for fiscal years 2009 and 2010 were obtained from each hospital. The raw data were used to calculate an overall weighted average for HHC (Table 1).

The outcome measure was defined as the “probability of any patient receiving at least 75% compliance for all hand hygiene opportunities during a 24-hour period.” The estimated probabilities were categorized as excellent (≥75%), above average (50%-74%), below average (25%-49%), and poor (<25%). These categories were chosen because they represent both ordinality and cardinality at a grade 5 level, making them ideal for public reporting. The categories were also color coded to facilitate a balanced scorecard report (Table 2).

Conditional probability curves for estimating the outcome were generated using Bayes’ probability theorem. Probability curves were generated for patients in different hospital areas that included rehabilitation, general ward, and intensive care (Fig 1). The estimated average number of daily hand hygiene opportunities for patients in these areas was 20, 72, and 144, respectively. The overall HHC rates (weighted HHC rates) were plotted onto the conditional probability curves to estimate each hospital’s performance according to the proposed scoring system (Fig 2). For patients located in rehabilitation areas, 3 reporting periods would be categorized as below average or poor, 3 as above average, and 6 as excellent. For patients located in either the general ward or intensive care areas, 5 reporting periods would be categorized as below average or poor, 1 as above average, and 6 as excellent.

Estimated probabilities for defined outcome

The overall HHC rates (weighted HHC rates) were plotted onto the conditional probability curves to estimate each hospital’s performance according to the proposed scoring system (Fig 2). For patients located in rehabilitation areas, 3 reporting periods would be categorized as below average or poor, 3 as above average, and 6 as excellent. For patients located in either the general ward or intensive care areas, 5 reporting periods would be categorized as below average or poor, 1 as above average, and 6 as excellent.

Balanced scorecard reporting methodology

A comparison between the current and proposed reporting methodology is presented in Figure 3.

DISCUSSION

Compliance with hand hygiene opportunities is a commonly reported patient safety indicator. Most health care organizations...
employ the methodology recommended by the WHO to collect HHC rates. Although this method permits easy and reliable collection of data, it requires the conversion of observed HHC rates into conditional probabilities to determine HHC at the patient level. This conversion reveals that a nonlinear relationship exists between reported HHC rates and the likelihood that any patient will experience an expected level of HHC. As a result, patients in organizations that report observed HHC rates below 70% will have a very low likelihood of consistently experiencing indicated hand hygiene interventions. However, even small improvements in observed HHC rates from 70% to 75% can substantially increase the probability of patients in general wards or intensive care units of receiving consistent HHC. The converse for health care organizations is that attempting to achieve observed HHC rates beyond 80% to 85% contributes very little to overall patient safety regardless of patient care needs.

The outcome measure used in this study was chosen arbitrarily. However, given the low compliance demonstrated by health care providers for best practice guidelines, establishing an “excellent” rating for those sites that demonstrate at least 75% compliance with hand hygiene indications is acceptable (face validity established by a survey questionnaire [30 respondents]). By using this methodology, there is considerable flexibility for governments and organizations to establish different benchmarks. For example, by using a > 90% compliance benchmark to create a different conditional probability curve, organizations would need to improve their observed HHC rates by at least 15% just to maintain their same ranking.

Guidelines for the presentation of health-related information exist. In summary, presenting information in percentage form is discouraged because it represents the least understood form of numerical display. By employing a balanced scorecard reporting system with easy to understand terminology and color coding, a larger proportion of the public should be able to access, understand, and use the patient safety data. The superiority of the recommended display system needs to be validated in a clinical trial.

This study has several limitations. First, hand hygiene moments for different patients across institutions is highly variable, and the use of an average number of hand hygiene moments per patient per day depending on their hospital location (a surrogate marker for severity of illness and intensity of medical care) to calculate the conditional probability curves limits the accuracy of the derived individual HHC data. Second, the estimated conditional probabilities represent the daily exposure risk and are assumed to remain relatively constant throughout the patient’s length of stay as long as the intensity of their medical care does not change. Third, the data used to calculate the weighted HHC for each corporation are based on only 2 of the 4 hand hygiene moments. This most likely represents an underestimation of health care provider HHC with high-risk opportunities (before aseptic procedures and after exposure to body fluids). (Observational data from each participating site revealed near 100% HHC among health care providers before aseptic procedures and after body fluid exposure.)
CONCLUSION

The current methodology to measure and report HHC in Ontario depends on observing 2 of the 4 hand hygiene moments. This paper used Bayes’ conditional probability theorem to convert institutional estimates for HHC into individual patient estimates. An alternative methodology for reporting this data using a balanced scorecard display was developed.

References