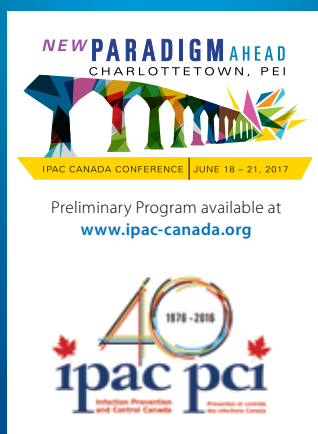
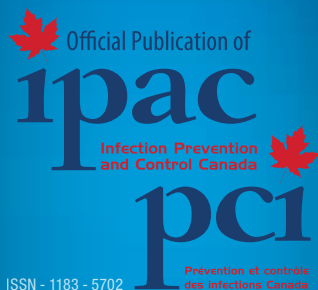


# CJIC

The Canadian Journal of Infection Control  
Revue canadienne de prévention des infections

VOLUME  
31  
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2



## IPAC CANADA NEWS:

New Board  
Members Elected

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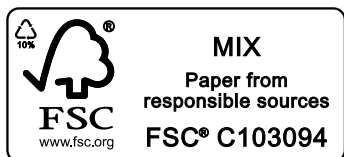
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## REVIEW ARTICLE

# Microbiological culture surveillance of flexible endoscopes: A systematic review

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## ABSTRACT

**Purpose:** The purpose of this systematic review is to provide a discussion of the evidence supporting and negating the need for routine microbiological culture surveillance of flexible endoscopes.

**Methods:** A medical librarian conducted a systematic search of the Ovid MEDLINE, EBSCO CINAHL, and Scopus databases as well as the Ovid Cochrane Database of Systematic Reviews for a national guideline on flexible endoscope processing to be developed by the Association of periOperative Registered Nurses (AORN). Search results were limited to literature published in English from 1994 through 2014. The author and the librarian also identified relevant guidelines and guidance from government agencies, professional organizations, and standards-setting bodies.

**Results:** Routine microbiological surveillance culturing is supported in the literature as an effective method for monitoring the effectiveness and quality of processing, reinforcing best practices, evaluating the effectiveness of corrective interventions, and detecting endoscopes requiring service.<sup>1-13</sup>; however, there is also evidence to show that surveillance cultures may be ineffective as a method for preventing transmission of infection from flexible endoscopes.<sup>13-18</sup>

**Conclusions:** A multidisciplinary team that includes infection preventionists, endoscopists, laboratory personnel, risk managers, and other involved individuals should evaluate the need for implementing a program of regular microbiological culture surveillance, establishing the methods and frequencies for culturing, and determining the benchmarks for microbial levels in flexible endoscope cultures.

## KEY WORDS

Surveillance cultures; flexible endoscopes; false-positive; false-negative; swab culturing

## INTRODUCTION

The purpose of this systematic review is to provide a discussion of the evidence supporting and negating the need for routine microbiological culture surveillance of flexible endoscopes. The collective evidence seems to indicate there may be a need for routine microbiological culture surveillance procedures as a mechanism for preventing transmission of infection from flexible endoscopes (1-13); however, there is also evidence to show that surveillance cultures may be ineffective as a method for preventing transmission of infection from flexible endoscopes (13-18). Developing effective standardized procedures for obtaining the cultures, as well as the actions to be implemented based on the results of the cultures, including patient notification when a positive culture is found, is extremely challenging. The Centers for Disease Control and Prevention (CDC) has provided interim guidance for performing culture surveillance (19-21); however, a protocol for culturing and a sampling method has not yet been validated. Notably, surveillance cultures are performed routinely in some other countries (22-25), but there are variances among the international guidelines.

## METHODS

### Search strategy

A medical librarian conducted a systematic search of the Ovid MEDLINE®, EBSCO CINAHL®, and Scopus® databases as well

as the Ovid Cochrane Database of Systematic Reviews for a national guideline on flexible endoscope processing being developed by the Association of periOperative Registered Nurses (AORN). The guideline was published in February 2016, and is available for purchase at <http://www.aorn.org/guidelines/purchase-guidelines/print-edition>. Search results were limited to literature published in English from 1994 through 2014. At the time of the initial search, the librarian established weekly alerts on the search topics and until October 2015, presented relevant results to the lead author of the guideline. The author and the librarian also identified relevant guidelines and guidance from government agencies, professional organizations, and standards-setting bodies. During the development of the guideline the author requested supplementary searches for topics not included in the original search request as well as articles and other sources that were discovered during the evidence-appraisal process.

Search terms included the subject headings *endoscopes*, *disinfection*, *decontamination*, *sterilization*, *disinfectants*, *detergents*, *biofilms*, *infection control*, *cross-infection*, *equipment contamination*, *occupational exposure*, *protective clothing*, and *hypersensitivity*. Subject headings and key words for specific types of endoscopes, bacteria, disinfectants, and protective devices also were included, as were headings and terms related to the concepts of endoscope storage, methods of

reprocessing, disinfection monitoring, infection transmission, disposable and reusable equipment, occupational allergies and injuries, and air pollution and ventilation.

### Selecting studies

Excluded were non-peer-reviewed or retracted publications and evidence specific to the mechanism of action or health hazards associated with specific high-level disinfectants or liquid chemical sterilants, rigid endoscopic instrumentation, endoscopic medical treatment protocols, techniques, patient management, or functional design of flexible endoscopes. In total, 1,257 research and non-research sources of evidence were identified for possible inclusion, and of these, 418 were cited in the AORN guidance document. Of the 418 articles accepted for the guideline, 40 were identified as being relevant to the topic of microbiological culture surveillance of flexible endoscopes, and these sources were included in this systematic review (Figure 1).

### Strength and quality of studies

Articles identified by the search were provided to the lead author and a doctorally prepared evidence appraiser. The lead author and evidence appraiser reviewed and critically appraised each article for its level of strength and quality using the AORN Research or Non-Research Evidence Appraisal Tools as appropriate. These tools are available at <http://www.aorn.org/guidelines/about-aorn-guidelines/evidence-rating>. Each article was then assigned an appraisal score. The lead author and the reviewer participated in conference calls to discuss their individual appraisal scores and to establish consensus. See Table 1 for a listing of the evidence and appraisal scores for the literature included in this review ([http://www.ipac-canada.org/cjic/vol31no2\\_Table-1.pdf](http://www.ipac-canada.org/cjic/vol31no2_Table-1.pdf)).

## RESULTS

### Monitoring effectiveness and quality

Chiu et al (26) assessed the effectiveness of mechanical processing of double-balloon enteroscopes by collecting and analyzing samples before and after processing of oral and anal route enteroscopes. The researchers concluded that surveillance culture monitoring was an effective method for assessing the effectiveness of high-level disinfection (HLD) of double-balloon enteroscopes. In a study to evaluate the quality of gastrointestinal endoscope processing and the advantages of microbiological culture surveillance of flexible endoscopes, Saviuc et al (4) concluded that microbiological surveillance was indispensable for monitoring processing, reinforcing good practices, and detecting endoscopes in need of service. Bisset et al (27) monitored patient-ready endoscopes to determine the efficacy of decontamination procedures in a busy endoscopy center. After a change in the procedure for processing endoscopes resulted in a cluster of culture-positive results. The researchers concluded that cultures after changes in protocols were necessary to confirm that the change in protocol did not alter processing effectiveness.

### Preventing transmission of infection

Routine microbiological surveillance may help to identify the source of endoscope contamination and rectify processing methods to prevent transmission of infection (5,9,10,12). Tunuguntla and Sullivan (5) performed 300 cultures on 12 flexible endoscopes and found that all but two endoscopes were culture-positive with *Pseudomonas* species. The culture-positive endoscopes were reprocessed and recultured, but again were culture-positive for *Pseudomonas*. The authors then investigated the water source and mechanical processors and found that one of the processors was culture-positive for *Pseudomonas* due to a contaminated water source. The authors theorized that these deficiencies in processing might have led to patient infection and would not have been detected except for routine culture surveillance.

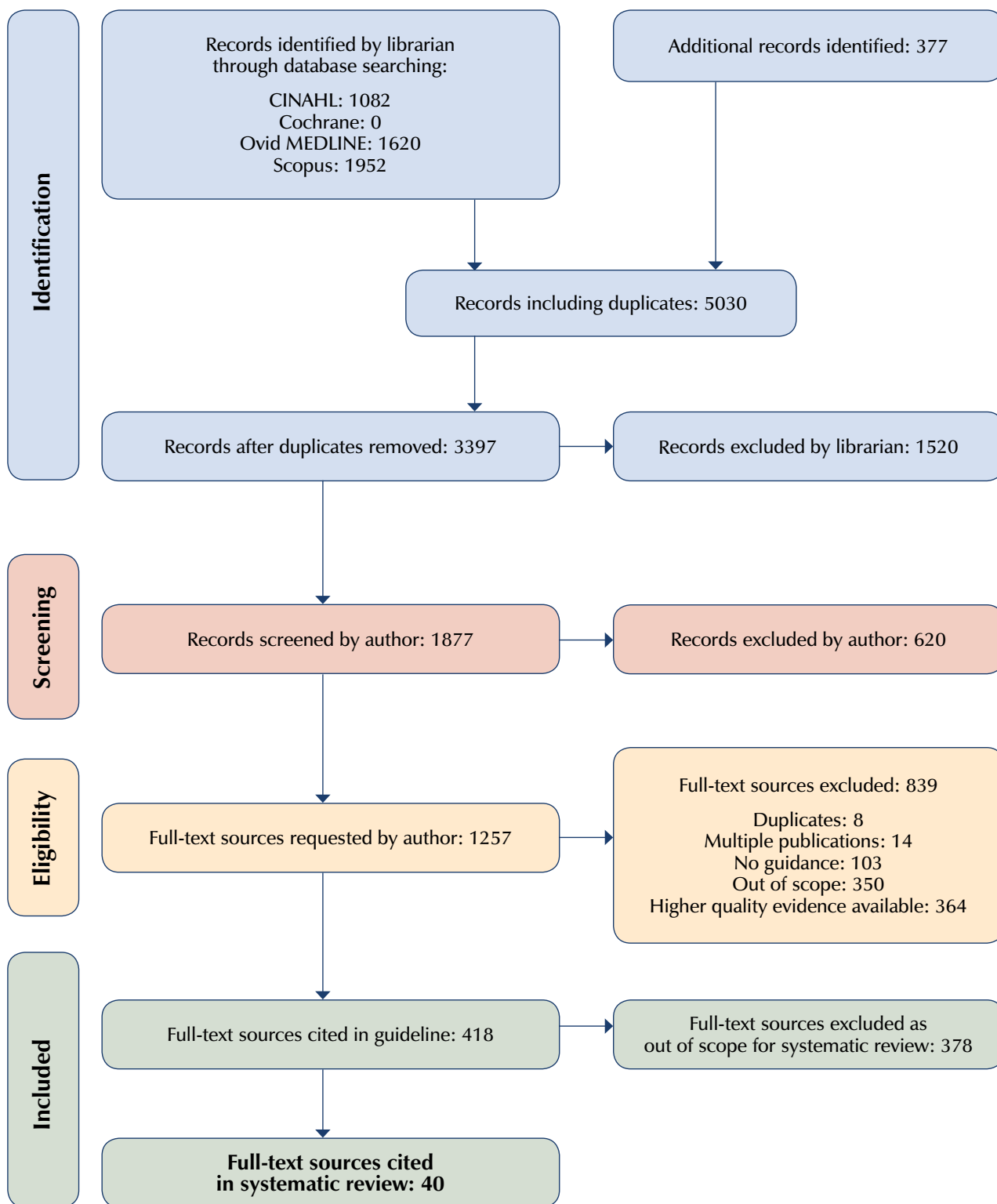
Microbiological sampling of rinse water used during mechanical processing of flexible endoscopes may reduce the risk of patient infection or pseudo-infection from waterborne bacteria (28). In a literature review to determine the need for microbiological culturing of rinse water used in mechanical processors, Muscarella (28) discussed the regulatory requirement (29,30) and recommendations (31-33) for validating the sterilization process using biological indicators to ensure that conditions for sterilization have been achieved and the similar need for verifying that utility water passed through water filtration systems such as those connected to mechanical processors used for flexible endoscopes is cultured. The filtered water used to rinse the endoscope may be labeled “sterile” or “bacteria-free”; however, there is no way to know whether the rinse water actually meets this claim if it is not routinely sampled. Routine sampling of the rinse water may also provide information about the effectiveness of the water filtration system.

### Issues with culture surveillance

Endoscopes are complex devices. There may be debris and bacterial growth in inaccessible portions of the endoscope. Between May and November 2013, three patients at a Wisconsin medical center were identified as having New Delhi Metallo-beta ( $\beta$ )-lactamase-1 (NDM-1) carbapenem-resistant *Escherichia coli* after undergoing endoscopic retrograde cholangiopancreatography (ERCP) procedures with the same duodenoscope. Smith et al (14) observed the endoscope processing procedures and found no lapses. The investigators obtained three cultures from the duodenoscope. Results showed the duodenoscope was culture-negative; however, the evidence was sufficiently strong to implicate the duodenoscope as the mode of transmission. The investigators concluded that it was questionable whether routine surveillance cultures would have led to an earlier identification of endoscope colonization since the NDM-1-producing *E coli* was not able to be isolated from the implicated duodenoscope.

An outbreak of carbapenem-resistant *Klebsiella pneumoniae* (CRKP) in a German university hospital associated with a contaminated duodenoscope was reported by Kola et al (15). Culturing the duodenoscope did not

**FIGURE 1: Flow diagram of literature search results**



From: Moher D, Liberati A, Tetzlaff J, Atman DG. The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097. Reprinted and adapted with permission from *Guidelines for Perioperative Practice*. Copyright © 2016, AORN, Inc, 2170 S. Parker Road, Suite 400, Denver, CO 80231. All rights reserved.

recover CRKP. The investigators reviewed processing procedures for the duodenoscope and could find no deviations from the manufacturer's instructions; however, they did obtain positive cultures for *Enterococci*, which they suggested was indicative of insufficient cleaning. The investigators concluded that although culturing of the duodenoscope did not recover CRKP, it did not exclude it as the vehicle of transmission.

Fraser et al (16) conducted a case-control study following an outbreak of multidrug-resistant *Pseudomonas aeruginosa* sepsis in five patients who underwent ERCP procedures with the same loaned duodenoscope. The investigators concluded that the organism that caused the outbreak had most likely been transmitted from patient to patient by the loaned endoscope. In an attempt to prevent such an outbreak, endoscopes at the facility had been cultured quarterly before the outbreak; however, the outbreak occurred despite a negative surveillance culture of the implicated endoscope. The investigators suggested that routine cultures were not helpful in preventing the outbreak and were therefore of no benefit.

Because of a severe outbreak of *K pneumoniae* producing extended-spectrum  $\beta$ -lactamase that occurred in 16 patients undergoing ERCP procedures, Aumeran et al (34) observed duodenoscope processing procedures. They found that the duodenoscopes were not fully dried before they were stored. Surveillance cultures of the endoscopes were repeatedly negative during the outbreak, but the epidemic strain was finally isolated by flushing and brushing the duodenoscope channels. In an expert opinion piece, Muscarella (35) discussed the limitations of surveillance culturing demonstrated by the Aumeran report (34) and the false-negative result that erroneously confirmed the endoscope was safe for patient use. Only when the sampling technique was modified to include brushing of the endoscope's suction channel in addition to flushing it was the effectiveness of sampling sufficient to culture the outbreak strain. Recovery of bacteria from a sampled channel confirms that the sampling technique effectively recovered microorganisms from the endoscope (i.e., a true positive result), whereas non-recovery does not necessarily confirm effective processing.

Correlations with patients' clinical outcomes is preferred; however, this type of validation is difficult to perform. The introduction of low-virulence microorganisms to the gastrointestinal tract does not necessarily mean that the patient will have clinical symptoms or develop an infection. In a nonexperimental study to define a realistic benchmark for residual microbial levels in a routine clinical setting, Alfa et al (36) tested all channels from 20 flexible gastrointestinal endoscopes used at an endoscopy clinic. The researchers recommended that < 100 CFU/mL be used as a clinically relevant benchmark for the number of bacteria detected from processed endoscopes.

### **Culturing techniques**

Different techniques may be required for different portions of the endoscope. For example, a swab-rinse technique may be

recommended for sampling exterior surfaces and the distal opening of the suction/biopsy channel port (13). A flush/brush/flush technique with rinsing through the channels using a sterile fluid and sterile cleaning brush to obtain samples through the biopsy port may be recommended for sampling the interior surface of the endoscope channels (13). A flush technique may be recommended when brushing the channel lumens is not possible (13). Anterograde sampling, where the last-rinse water from the endoscope is collected inside the mechanical processor at the distal end of the endoscope, or retrograde sampling, where the suction/biopsy channel and the air/water channel are each manually flushed with sterile fluid from the distal to the proximal end, may be recommended (13). In a prospective study to assess the effectiveness of HLD by comparing cultured samples from biopsy channels of gastrointestinal endoscopes and the internal surfaces of mechanical processors, Chiu et al (3) collected rinse samples from 420 biopsy channels and swab samples from mechanical processors and examined them for the presence of aerobic and anaerobic bacteria and mycobacteria. The researchers concluded that culturing rinse samples from biopsy channels provided a better indication of the effectiveness of HLD of gastrointestinal endoscopes than culturing swab samples from the inner surfaces of mechanical processors. Lu et al (37) described the same study but concluded that swab culturing was also a useful method for monitoring the contamination level of the mechanical processor and the effectiveness of the HLD process. Collection of microbiological samples requires the use of sterile technique and this may be difficult when culturing a long, flexible instrument (38). It may be necessary to have more than one person perform the collection to prevent contamination of the sample.

### **Cost**

Gillespie et al (38) conducted a review of the costs of microbiological testing at two health campuses in Southern Australia. Bronchoscopes, duodenoscopes, and mechanical processors were microbiologically sampled every four weeks. Gastrosopes and colonoscopes were cultured every three months. Positive cultures were investigated and followed up by the endoscopy and infection prevention teams. Costs for processing team members to sample the endoscopes were calculated at weekend pay rates because the samples were obtained outside of normal operating hours. Time to sample was calculated at 22 minutes per sample and \$10.54 (\$AUD 15) per hour. The total cost of testing over five years was \$70,547.75 (\$AUD 100,400). In 2015, this would equate to \$419,427.75 (\$AUD 596,845.70).

### **Culturing of duodenoscopes**

Routine or periodic surveillance culturing may help to assess the adequacy of duodenoscope processing and identify duodenoscopes with persistent contamination despite processing in accordance with the manufacturer's instructions (18-19). The ECRI recommends performing



baseline cultures on all duodenoscope channels and elevator mechanisms using a media specific for carbapenem-resistant *Enterobacteriaceae* as well as quarantining cultured duodenoscopes until negative results are received. If cultures are positive, the ECRI recommends reprocessing and repeat culturing, and if the repeat culture is positive, permanently removing the endoscope from service or sending it back to the manufacturer for additional assessment (39).

The CDC has provided detailed interim guidance for performing culture surveillance for bacterial contamination of duodenoscopes or other endoscopes that have an elevator mechanism after processing (19-21). The CDC guidance is intended to supplement and not replace or modify manufacturer recommended processing procedures (19-21).

## DISCUSSION

The collective evidence regarding the need for routine microbiological surveillance cultures is inconclusive. There are some advantages to culturing. A program of regular microbiological surveillance culturing of flexible endoscopes and mechanical flexible endoscope processors is advised in the processing guidelines of several international organizations (22,23,25). However, there are variances among the guideline recommendations, indicating that further research is warranted. Routine microbiological surveillance culturing is supported in the literature as an effective method for monitoring the effectiveness and quality of processing, reinforcing best practices, evaluating the effectiveness of corrective interventions, and detecting endoscopes requiring service (1-13).

Conversely, there are some disadvantages to culturing. Routine microbiological surveillance culturing of flexible endoscopes has not been advised in current US guidelines. Standards for performing microbiological cultures, including the frequency of testing and the interpretation of results have not been determined (1,10,11,13,17,31). A protocol for culturing and a sampling method has not yet been validated (11,13). Viruses such as hepatitis B and C and human immunodeficiency virus (HIV) cannot be cultured using standard methods (18). Disinfectants that are commonly used to process flexible endoscopes may inhibit cultures. There may be false-positive results from contaminated equipment or skin. A negative culture does not guarantee that the scope has been adequately processed. Surveillance cultures of processed endoscopes have not been validated by correlating viable counts on an endoscope to infection after an endoscopic procedure (17,31). Notably, the false-positive rate, the false-negative rate, and the limits of detection have also not been established (18). The sensitivity of routine cultures may be unreliable for detecting the organisms associated with outbreaks (18).

The use of surveillance cultures is confounded by the delay in feedback and the frequent isolation of nonpathogenic organisms resulting from environmental

contamination (13,17). Recommendations regarding the frequency of surveillance conflict (17,22,23,25). The need to quarantine flexible endoscopes until the culture results have been obtained may not allow for rapid reuse of the tested endoscope and could also lead to delays in patient care (18).

Microbiological culturing is resource-intensive, and requires additional expenditures for microbiological testing and time for personnel to collect and process samples (10,18,40). Culturing for bacterial load is impractical for many endoscopy centers that may not have access to microbiology laboratories (18). Implementing routine surveillance cultures may require that some facilities outsource culture testing to qualified microbiologists. This could be quite costly, and it might also be difficult for facilities to find a laboratory that is willing to perform the necessary culture testing. Outsourcing surveillance culturing to environmental or contract laboratories may also lead to uncertainty in interpretation of results (18).

## CONCLUSION

Developing effective standardized procedures for obtaining the cultures, as well as the actions to be implemented based on the results of the cultures, including patient notification when a positive culture is found, is extremely challenging. The evidence supporting routine microbiological culture surveillance of flexible endoscopes is inconclusive and further research is warranted. For this reason, a multidisciplinary team that includes infection preventionists, endoscopists, laboratory personnel, risk managers, and other involved individuals should evaluate the need for implementing a program of regular microbiological culture surveillance, establishing the methods and frequencies for culturing, and determining the benchmarks for microbial levels in flexible endoscope cultures.

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## REVIEW ARTICLE

# Best practices for flexible endoscope hang time: An integrative review

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## ABSTRACT

**Background:** This integrative review seeks to identify the maximum allowable hang time of an endoscope following high-level disinfection; that is, how long an endoscope may hang, unused, before needing to be either used on a patient or reprocessed. Many different associations, agencies, and governing bodies differ in their recommendations for the acceptable length of time, leading to confusion and inconsistency in identifying a standard of care.

**Methods:** A literature search was conducted using the databases PubMed/MEDLINE and CINAHL. A total of eight articles and three guidelines were included in the review. Manufacturers' recommendations tended not to address specific hang times due to the liability they may confer, given the lack of confirmed studies.

**Results:** Numerous studies have tested endoscope contamination as a function of hang time, and have found safe hang times ranging from 3 to 56 days. Although the appraisal of the literature revealed significant variation, 5-7 days is the most frequently recommended acceptable hang time. Nonetheless, there is yet to be a universally recommended length of time.

**Conclusion:** The highest quality articles, Levels IIIA and IIIB, suggested an optimal hang time of 5-7 days, though reliable evidence suggests a longer hang time may be acceptable. Determining a safe time frame is critical for patient safety, manpower, resources, and equipment longevity and maintenance.

## KEY WORDS:

Endoscope, hang time, storage, shelf life

## INTRODUCTION

The comprehensive process of decontamination, high-level disinfection (HLD), and storage, to include an appropriate amount of hang time for flexible endoscopes, is an emerging healthcare concern. This detailed and sensitive process is often guided by inconsistent policies and procedures and, as a result, some patients have suffered (1). One part of this process that remains unclear is the maximum allowable hang time for endoscopes; that is, how long an endoscope may be stored, unused, before needing to be either used on a patient or reprocessed via HLD. While some patient care areas boast such a high rate of endoscope usage as to render this point moot, others may have an endoscope hanging for weeks to months before its next use (2).

Although pathogen transmission from contaminated endoscopes is rare, 1 in 1.8 million procedures, the result can be as detrimental as death (3,4). The principal factor to ensuring use of maximum hang time lies in the effectiveness of the HLD process. Numerous studies allude to the prevalent reason of transmission being improper reprocessing through cleaning and/or decontamination (5-9).

Though the risk of disease transmission is low with endoscope use, contaminated equipment has been linked in the transmission of hepatitis B and C viruses, salmonella, and pseudomonas (10). Furthermore, transmission can go unacknowledged due to inadequate or no surveillance, low incidence, or the absence of overt clinical symptoms (11).

Even though a specific rate of transmission may be difficult to obtain, understanding the factors associated with it can assist healthcare personnel in prevention. These sources include inadequate cleaning, inappropriate use of high-level disinfectant, contaminated endoscope water bottles and water supply, and improper drying of endoscope channels (11).

The literature has shown that the most significant factor in disease transmission by endoscopes was inadequate reprocessing by healthcare personnel. In a study from Ofstead et al (12), trained personnel were observed in order to monitor their effectiveness in reprocessing endoscopes. Even with specific policies and procedures in place, observers noted proper reprocessing in only 86 of 114 endoscopes using an AER, and in only 1 of 69 endoscopes using manual reprocessing.

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In a more recent report, the Food and Drug Administration (FDA) met in a panel to discuss the current generation of gastroenterology devices, particularly endoscopic retrograde cholangiopancreatography (ERCP) duodenoscopes (1). This meeting followed prompts from recent patient deaths, at noted medical centers, related to bacterial transmission from contaminated endoscopes. The panel resolved that the most recent devices (duodenoscopes) do not offer “reasonable assurance of safety and efficacy” (1). They did note that the endoscopes in question were nevertheless essential to the treatment of certain conditions. The panel did offer recommendations to reduce the risk of infection: appropriate patient use, standardized reprocessing, assessment following disinfection, proper HLD or sterilization, attentiveness to drying and storage, and pathogen surveillance following reprocessing. In the end, the panel decided to require the development of new manufacturer protocols (more rigorous cleaning and disinfection) for reliably sterile reprocessing.

An integrative review of the literature is necessary to develop a comprehensive recommendation for an evidence-based supported hang time of endoscopes. The aim of this project is to perform an integrative review of the literature to identify the maximum allowable hang time of an endoscope following HLD before pathogenic contamination is found.

## METHODS

### Literature review

A literature search was conducted using the databases PubMed/MEDLINE® and CINAHL® (Cumulative Index to Nursing and Allied Health Literature). The keywords *endoscope*, *hang time*, *storage*, and *shelf life* resulted in over 42 articles found. This search was refined using the Boolean connector *and*. Limits

applied included *humans* and *English*. Only articles published within the last five years were used, with the exception of landmark studies specifically culturing endoscopes for contamination within a given timeframe. The limit of five years was applied to include articles with the most current high-level disinfection practices and excludes those that could have outdated practices. A total of 26 articles met inclusion criteria (see Appendix A for the search strategy). Inclusion criteria included those studies that contained the identified (a) keywords, (b) limits, (c) date range, (d) tested contamination of endoscopes at specified time intervals, and (e) performed HLD on designated endoscopes. Guidelines and recommendations from governing bodies were also included in the review. The 26 articles were filtered through a rapid critical appraisal checklist based on the type of study, evidence, trial, or guideline (13). The rapid critical appraisal checklist (13) examined, through nine yes, no, or unknown questions, the validity of the results (how cases obtained, appropriate controls, and data collection methods consistent), the results (estimate of effect given, comparisons of data, bias), and the results related to patient care (patients similar, results to previous studies, expectations for the outcomes). An article was required to score a yes of all nine questions in the checklist in order to be included in the review (13). After the completion of the checklist, a total of eight studies and five guidelines were retained for integrative review. The studies and guidelines were synthesized utilizing an evidence synthesis table adapted from a critical appraisal guide (13). The evidence level and quality guides were used to grade each article in determination of an endoscope hang time recommendation (Figure 1 & 2) (13,14).

A table of evidence for literature review was utilized to appraise and compare the eight selected studies (Figure 3).

FIGURE 1: Evidence Synthesis Table Template

Citation	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables Studied and Their Definitions	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Author, Year, Title	Theoretical basis for study	Indicate design & briefly describe what was done in the study	Number, Characteristics, Attrition rate & why?	Independent variables (e.g., IV1 = IV2 =) Dependent variables (e.g., DV =)	What scales were used to measure the outcome variables (e.g., name of scale, author, reliability info [e.g., Cronbach alphas])	What stats were used to answer the clinical question (i.e., all stats do not need to be put into the table)	Statistical findings or qualitative findings (i.e., for every statistical test you have in the data analysis column, you should have a finding)	<ul style="list-style-type: none"> <li>• strengths and limitations of the study</li> <li>• Risk or harm if study intervention or findings implemented</li> <li>• Feasibility of use in your practice</li> <li>• Remember: level of evidence + quality of evidence = strength of evidence &amp; confidence to act</li> </ul>

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(Melnik & Fineout-Overholt, 2011)

FIGURE 2: Hierarchy of Evidence Scale

### Hierarchy of Evidence for Intervention Studies

Type of evidence	Level of evidence	Description
Systematic review or meta-analysis	I	A synthesis of evidence from all relevant randomized controlled trials.
Randomized controlled trial	II	An experiment in which subjects are randomized to a treatment group or control group.
Controlled trial without randomization	III	An experiment in which subjects are nonrandomly assigned to a treatment group or control group.
Case-control or cohort study	IV	Case-control study: a comparison of subjects with a condition (case) with those who don't have the condition (control) to determine characteristics that might predict the condition.  Cohort study: an observation of a group(s) (cohort[s]) to determine the development of an outcome(s) such as a disease.
Systematic review of qualitative or descriptive studies	V	A synthesis of evidence from qualitative or descriptive studies to answer a clinical question.
Qualitative or descriptive study	VI	Qualitative study: gathers data on human behavior to understand <i>why</i> and <i>how</i> decisions are made.  Descriptive study: provides background information on the <i>what</i> , <i>where</i> , and <i>when</i> of a topic of interest.
Expert opinion or consensus	VII	Authoritative opinion of expert committee.

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(Melnyk & Fineout-Overholt, 2011)

FIGURE 3: Quality of Evidence Scale

### Quality of Evidence (Scientific Evidence)

- A High:** consistent results, sufficient sample size, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific evidence
- B Good:** reasonably consistent results, sufficient sample size, some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence
- C Low/Major flaw:** little evidence with inconsistent results, insufficient sample size, conclusions cannot be drawn

(Newhouse, Dearholt, Poe, Pugh, & White, 2007)

**TABLE 1: Evidence Synthesis of Studies**

Author	Design	Sample	Major Variables
Riley et al., 2001	Control trial with incubation testing.	2 groups, Testing at 24 hr & 168 hr, 5 times each.	Research assistants validating testing, 1 endoscope reprocessor, bacterial broth suspension, stored ventilated cabinet, Steris system 1, 1 endoscope used in study.
Rejchrt et al., 2004	Observational study.	135 assays of 3 different endoscopes.	Personnel performing HLD, dust-proof cabinet for storage and conditions, duodenoscope elevator channel not cultured, precision of sample collection from endoscope.
Osborne et al., 2007	Prospective, observational study.	23 endoscopes in active service, microbiologically cultured for 3 weeks, 200 hundred cultures, 6 excluded.	2 personnel performing HLD, culture status after reprocessing defined as positive or negative, type of organism cultured whether pathogenic or nonpathogenic, shelf life measured in hours.
Vergis et al., 2007	3 Phase control testing, semi-blinded trial.	4 endoscopes. Phase 1- cultured at 24 hours and every workday for 2 weeks. Phase 2- repeat phase 1 for 2 weeks. Phase 3- at 24 hours then left 7 days till tested.	Institutional protocol for HLD, Aerobic dustproof cabinet, personnel collecting/ plating/interpreting assay results.
Pineau et al., 2008	Observational study.	3 endoscopes contaminated to test efficacy of drying/storage cabinet @ 12,24,48,72 hours.	Storage cabinet, HLD process, Scopes, Storage room.
Grandval et al., 2013	Observational study.	41 endoscopes (3 groups) incubated and cultured after 72 hours of storage.	Storage in SCHE, group 1, Storage in cupboard without disinfection, Storage with disinfection, Endoscopes, Reprocessing protocol.
Ingram et al., 2013	Prospective longitudinal, one-group, multiple posttest only.	4 endoscopes, culture matrix designed into 2 phases. Phase 1- 8 weeks (control). Phase 2- experimental shelf life at increment testing.	Cultures- anaerobic, aerobic, during procedure protocol. 4 cultures, 1 from each scopes at designated time periods from culture matrix.
Brock et al., 2014	Prospective, observational study.	10 endoscopes cultured at day 0, 7, 14, 21 for 96 samples collected.	Endoscope reprocessing, Sample collectors, Days after reprocessing, Scope storage, Adherence to standards of reprocessing, Bacterial growth.

Measurement	Data Analysis	Outcome	Evidence Level & Quality
Organisms: Staphylococcus aureus, pseudomonas aeruginosa, bacillus subtilis in trypticase soy broth cultured into Oxoid PP 2001.	Quantifications of bacterial growth no growth= 0 cfu, sparse growth= <5 cfu/ml, moderate growth= 5-20 cfu/ml, heavy growth= >20 cfu/ml.	No growth of bacteria in internal channels after 1 week processing.	Level III Grade B
Isolated colonies identified by bacterial identification system, Aerobic & anaerobic bacteria, bacterial spores, and candida species, 5 different methods to culture.	Isolated colonies identified by CRYSTAL bacterial identification system, 95% confidence intervals for positive culture were 0.0081, 0.0741 (relative frequency 0.0296).	0 bacteria growth immediately after HLD, 4 positive at day 5. All positive grew skin bacteria from handling.	Level III Grade A
Coagulase-negative staphylococcus, micrococcus, bacillus, corynebacterium fungus, Streptomyces, yeast; significant growth was identified to genus level, colony count or colony forming units (cfu), positive cultures was retested for result validation.	Descriptive statistics w/ frequency & distribution tables, $\chi^2$ statistic compare types of organisms grown, student's t-test compare between reprocessing & organisms grown, ANOVA statistics compare time between reprocessing & types of scopes & organisms grown.	37.5% environmental contamination rate and 0% pathogenic at 168 hours in 8 scopes.	Level III Grade A
Standard nonselective medium, Staphylococcus epidermidis, environmental and skin organism, fecal flora apart from anaerobes, parallel anaerobic cultures NOT performed.	Serial 10-fold ( $10^0$ , $10^{-1}$ , $10^{-2}$ ) dilution of endoscope washings and platings 100 $\mu$ L of each dilution onto SBAP, Colony counts recorded and isolates identified with routine diagnostic microbiology procedures (article does not define this).	Reprocessing unnecessary for 7 days, possibly 2 weeks. Phase 3 produced most favorably results due to lack of personnel handling/environmental contaminates.	Level III Grade A
Pseudomonas aeruginosa CIP 103467 test suspension with recovery solution. Incubated with TSA. Ratio calculation to determine performance of contamination method.	Mean performance values of contaminated method. Mean numbers of micro introduced to scope. Results with ration calculation. No statistical measurements notes.	Stored inside cabinet were lower in number of bacteria cultured. Outside were stable or even increased in bacteria count.	Level III Grade C
Endoscope contamination levels analyzed by guidelines by the National Technical Committee on Nosocomial Infection in 2007.	Results of sampling analyzed according to three levels (target, alert, action levels) defined by National Technical Committee on Nosocomial Infection guideline. Statistical analysis with Kruskal-Wallis test, P=0.829.	All groups identified environmental contaminates. Found storage cabinet for heat-sensitive provided target level for bacterial count.	Level III Grade A
Culture collection protocol, 2 investigators with IRR established. 2 trained decon techs, AER system-83 plus 2 custom ultrasonics with 2.6% glut.	Means & SDs of storage room characteristics, T-test for differences in mean temp & humidity, Bacterial growth in medical sig or med. insig growth and time.	No control scope had growth after 8 weeks. Phase 2 had 0 scopes with growth at 8 weeks, 1 scope with growth at day 14 & day 42.	Level III Grade A
Cultures: Nonpathogens & Potential pathogens incubated and identified using standard microbiological techniques, results reported in colony-forming units per milliliter.	Numbers and percentages of positive cultures were calculated in total and by type of endoscope, organism, channel, and day.	29.2% overall contamination rate. 29/33 were skin or environmental contaminants. 21 days storage is likely safe.	Level III Grade A

The design/method, sample/setting, major variables, measurement, data analysis, findings, and appraisal/worth to practice were evaluated for each article (13). The findings of these 8 studies were then summarized and presented via evidence synthesis (Table 1). Finally, each article was graded based on their level of evidence and quality guide in order to formulate a recommendation for endoscope hang time. The author was the sole investigator for conducting the search, screening, and quality appraisals of the literature.

### Critical appraisal of the literature

Riley et al (9) tested two groups of artificially contaminated colonoscopes, reprocessing each group and then sampling at either 24 hours or seven days. Significant contamination was not found in culturing the internal channels of the colonoscopes after either hang time duration. As such, the study concluded with a recommendation of no more than seven days of hang time before reprocessing. Storage after seven days was not recommended, though this represented more the opinion of the authors than an evidence-based recommendation. Grade: IIIB.

Rejchrt et al (15) tested three different types of endoscopes following endoscopic procedures, both immediately after HLD and again in five days. The endoscopes were stored vertically in a dust-proof cabinet, as recommended by numerous professional organizations to prevent the pooling of fluids (16,18). No cultures taken immediately after HLD were positive for bacterial growth; 2 of 135 taken at day 2 were positive, as well as another 2 of 135 taken at day 3. However, these contaminants were identified as skin flora, likely related to their handling during reprocessing (15). The authors proposed a maximum of five days hang time before reprocessing. Grade: IIIA.

In another study from Osborne et al (19), 23 flexible endoscopes in clinical use were cultured, over a three-

week period, when not physically being used on patients. Hang times following reprocessing ranged from 24 to a maximum of 200 hours, or just over eight days. The samples consisted of 194 cultures looking for both pathogenic and nonpathogenic organisms. The overall contamination rate was found to be 15.5%. The only pathogenic organism, a yeast, was found in one endoscope after 5-6 days of hang time, resulting in a 0.5% contamination rate for this time period. All other organisms identified were nonpathogenic environmental contaminants. Because these endoscopes were not set aside solely for this study, and due to the facility's high usage rate, only four reached the maximum hang time. This marks a limitation of the study regarding long-term hang time. Nonetheless, all four of these cultures were negative. Although findings revealed no pathogenic contamination at eight days hang time, the final recommendation made by the authors supported a five-day hang time. Grade IIIA.

Vergis et al (3) tested four endoscopes in three phases following their initial procedure use. In phases 1 and 2, endoscopes were cultured 24 hours after reprocessing, and again each workday for two weeks. In phase 3, however, they were cultured only at 24 hours and again at seven days. The authors noted growth of skin contaminants in phases 1 and 2, but no such growth in phase 3, suggesting that the contaminants in phases 1 and 2 were due only to the more frequent handling of the endoscopes. The authors recommended a seven-day hang time with proper storage to prevent environmental contamination. Grade IIIA.

To test the efficacy of a drying and storage cabinet, Pineau et al (20) tested three types of endoscopes which were artificially contaminated with *Pseudomonas aeruginosa*, stored in a drying and storage cabinet, and cultured at 12, 24, 36, 48, and 72 hours; cultures of the same endoscopes were repeated at the same hang times, this time while being stored outside the cabinet. The study found that, for all three endoscopes, cell counts at all times were lower than

**TABLE 2: Evidence Synthesis of Guidelines and Organizations**

Organization	Recommendation	Supporting Evidence
SGNA (2012)	Hang time has limited investigations; necessitates further data and research	ASGE Quality Assurance in Endoscopy Committee et al., 2011
ASGE/SHEA (2011)	No recommendation	References studies of 10-14 days and organizations (AORN, APIC) of 5-7 days
AORN	5 days hang time	4 studies, all included in this review
VA	12 days hang time	EBP literature review
APIC	No recommendation	Alvarado and Reichelderfer <sup>27</sup>



baseline when stored in the drying and storage cabinet. All three endoscopes stored outside the cabinet showed initial decreases in cell counts, but one increased to baseline by 36 hours and above it at 48 and 72 hours, while another increased to baseline by 48 hours and remained there at 72 hours. The impact of hang time on these results is unclear for those endoscopes stored in the cabinet, though those stored outside it did show increased growth as early as 36 hours post-contamination. It must also be noted that the authors listed a funding source that manufactured the storage cabinet tested. Grade IIIC.

Grandval et al (21) tested 41 endoscopes in three groups. Each endoscope was used on a patient, reprocessed, and then cultured after 72 hours of hang time. Group 1 consisted of endoscopes stored in a cabinet for heat-sensitive endoscopes; Group 2 of endoscopes stored for 72 hours in a clean, dry, standard storage cabinet without a disinfectant; and Group 3 of endoscopes stored in the same type of cabinet as Group 2, but with a disinfectant cycle immediately before culturing. Three types of endoscopes were used in each group: colonoscopes, gastroscopes, and duodenoscopes. Group 1 yielded the lowest rate of contaminants at 43.9% overall. No pathogens were found among these, only normal skin and environmental flora. Group 2's contamination rate was higher, at 58.9%, and included similar flora, but also some waterborne and enteric bacteria. Group 3 had the lowest rate of contamination at 39%, and like Group 2 included normal flora, as well as waterborne and enteric bacteria. While this study was not designed to illustrate differences in contamination rates as a function of hang time, it at least provides data for one time point, namely, 72 hours after reprocessing. Grade IIIA.

More recently, Ingram et al (22) cultured four endoscopes for anaerobic and aerobic microbes, taking samples at 3, 5, 7, 14, 21, 28, 42, and 56 days following reprocessing after use on patients. The authors found no bacterial growth from any endoscope at each of the different hang times, with the exception of two of them. Medically insignificant bacteria were cultured from 2 of the endoscopes, one at day 14 and the other at day 42. Although no definitive time recommendation was given, the authors did conclude that sufficient prevention of bacterial growth can be shown up to 56 days. This study differed from most by using open-air storage rather than closed cabinets. Grade IIIA.

The most current study, by Brock et al (6), cultured a total of 96 samples from the channels of 10 endoscopes over a three-month period. Each endoscope was first used on a patient, then removed from service for the duration of the study. The overall contamination rate for all timeframes was 29.2%, or 33 out of 96 samples. Of these 33 positive cultures, 29 were identified as either skin or environmental contaminants. The remaining four were pathogenic microbes, and were sampled at days 0, 7, 14, and 21. These microbes were found in low concentrations,

and only at 1 site on the biopsy channel. The hang time with the most frequent positive cultures was 21 days, at which time 12 of the 96 samples were found to have contaminants, and of which one was pathogenic. The authors concluded from their results that endoscopes are likely safe to be stored up to 21 days with a low risk of pathogenic microbial colonization if reprocessed and stored properly. Grade IIIA.

The guidelines and recommendations of relevant professional organizations were also reviewed and synthesized (Table 2). The Society of Gastroenterology Nurses and Associates, Inc. (SGNA), easily one of the most influential organizations in endoscope reprocessing, states only that hang time has limited investigations and necessitates additional data and research (18).

The American Society for Gastrointestinal Endoscopy (ASGE) and the Society for Healthcare Epidemiology of America (SHEA) also acknowledge that research on endoscope hang time is limited and more is warranted (23). However, both organizations go on to reference studies supporting the safety of a 10-14 day hang time, yet also reference other organizations that recommend shorter timeframes (23). Ultimately, neither the ASGE nor the SHEA makes a formal recommendation for hang time.

The Association for Professionals in Infection Control and Epidemiology (APIC) hang time recommendation has been cited in numerous publications and studies (18,23,24). Alvarado and Reichelderfer (24) authored the APIC guidelines (25) related to endoscope reprocessing, but no official timeframe is recommended for endoscope hanging. Upon scouring the APIC's website for the most current guidelines, noting that Alvarado and Reichelderfer were published in 2000, a link for the *Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008* from the CDC was found (25). The website also states they are actively assisting in the review of the *Multi-Society Guideline for Reprocessing Flexible Gastrointestinal Endoscopes, 2011* (16).

Nor does the CDC seem to arrive at a consistent recommendation. It cites one other guideline, an outdated one from the Association of periOperative Registered Nurses (AORN), recommending reprocessing immediately before use, as well as several other guidelines that do not (26). The most recent AORN recommendation is now a five-day hang time (17). They cite four articles (3,9,15,19), which are included in this review, as their supporting evidence. In discussing another prominent healthcare organization, the Veterans Health Administration (VA) has instituted a policy of 12 days hang time before reprocessing unused endoscopes, as mentioned previously in the article from (27).

## DISCUSSION

Although this appraisal of the literature revealed significant variation, 5-7 days is the most frequently recommended acceptable hang time. All studies were determined to yield

Level III evidence using well-designed, quasi-experimental controlled trials without randomization. Six of the articles graded an A, one graded a B, and the remaining article graded a C. The articles with the highest grading, IIIA, recommended ranges of three days (21), five days (15,19), seven days (3), 21 days (6), and 56 days (22). The remaining two articles recommended seven days (9) and 1.5 days (20). No studies offered a high level of evidence through randomized controlled trials.

There are two studies that warrant further discussion, Brock et al (6) with a recommendation of 21 days, and Ingram et al (22) with a recommendation of 56 days. Although these hang times appear as outliers compared to the frequently cited 5-7 day recommendation, it is important to note that these are the two most recent studies in this review, and that they are some of the first to extend the study duration this far (6,22). These findings indicate that perhaps longer hang times should be more frequently studied.

The absence of studies testing endoscopes for use in otolaryngology, pulmonology, and urology must be considered a limitation in the existing research. However, it is reasonable to extrapolate recommendations for gastrointestinal endoscopes to those of these other specialties, given that gastrointestinal endoscopes are typically more complex. Furthermore, only bacterial colonization has been extensively studied, leaving fungal and viral contamination relatively unaddressed. Perhaps the most important limitation is that no studies have examined the effect of extended endoscope hang time on patient outcomes. In any case, it is clear that this topic has been too seldom studied. The healthcare community is in greater need of a larger body of research to support findings in formulating a recommendation for safe endoscope hang time.

Professional organizations vary their hang times widely, reflecting a lack of consensus on the issue, and causing confusion over how to define the standard of care.

Determining a standard timeframe for endoscope hang time is essential for several reasons. One important factor in setting a timeframe is the financial impact that constant reprocessing has on an organization and indirectly on the cost of healthcare. In countries where the recommendation is to reprocess endoscopes before the first case of each day, the financial impact could be pronounced (19). When considering all the financial components, one must understand the steps involved. In performing manual reprocessing, the steps include bedside point of use precleaning, transportation of the endoscope to the reprocessing area, leak testing (if indicated), disassembly and decontamination with manual brushing; rinsing, high-level disinfection with final rinsing (either manual or with an automated endoscope reprocessor, (AER)), forced drying with air and/or alcohol, and storage (16). Whether reprocessing manually or with the use of an AER, the organization must factor in the cost of manpower,

time, equipment, supplies, maintenance, repairs, capital investment, and operating costs into each one of the steps listed above (28).

Another reason to set a timeline is that the lifespan, durability, and functionality of endoscopes can be decreased by repetitive, unwarranted reprocessing. Endoscopes are fragile medical devices with delicate components. Reprocessing entails rigorous cleaning, handling, and potentially caustic chemicals, all of which can easily cause damage (29).

Lastly, there are many factors relating to the trained personnel performing the HLD that are critical in establishing a timeframe and not needlessly reprocessing. One of those factors involves the occupational safety of the reprocessor. In a study from Ofstead et al (12). Employees reported health problems related to reprocessing endoscopes, which included respiratory ailments and physical discomfort. There are even reports of disinfectants not rinsing away or evaporating completely after successive exposures in reprocessing (30). Another personnel factor is the effect of a lack of standard, consistent guidelines for the endoscope hang time. According to Muscarella (31, p.2147) "inconsistent guidelines can confuse reprocessing staff members and result in noncompliance, variations in the standard of care, and ineffective reprocessing."

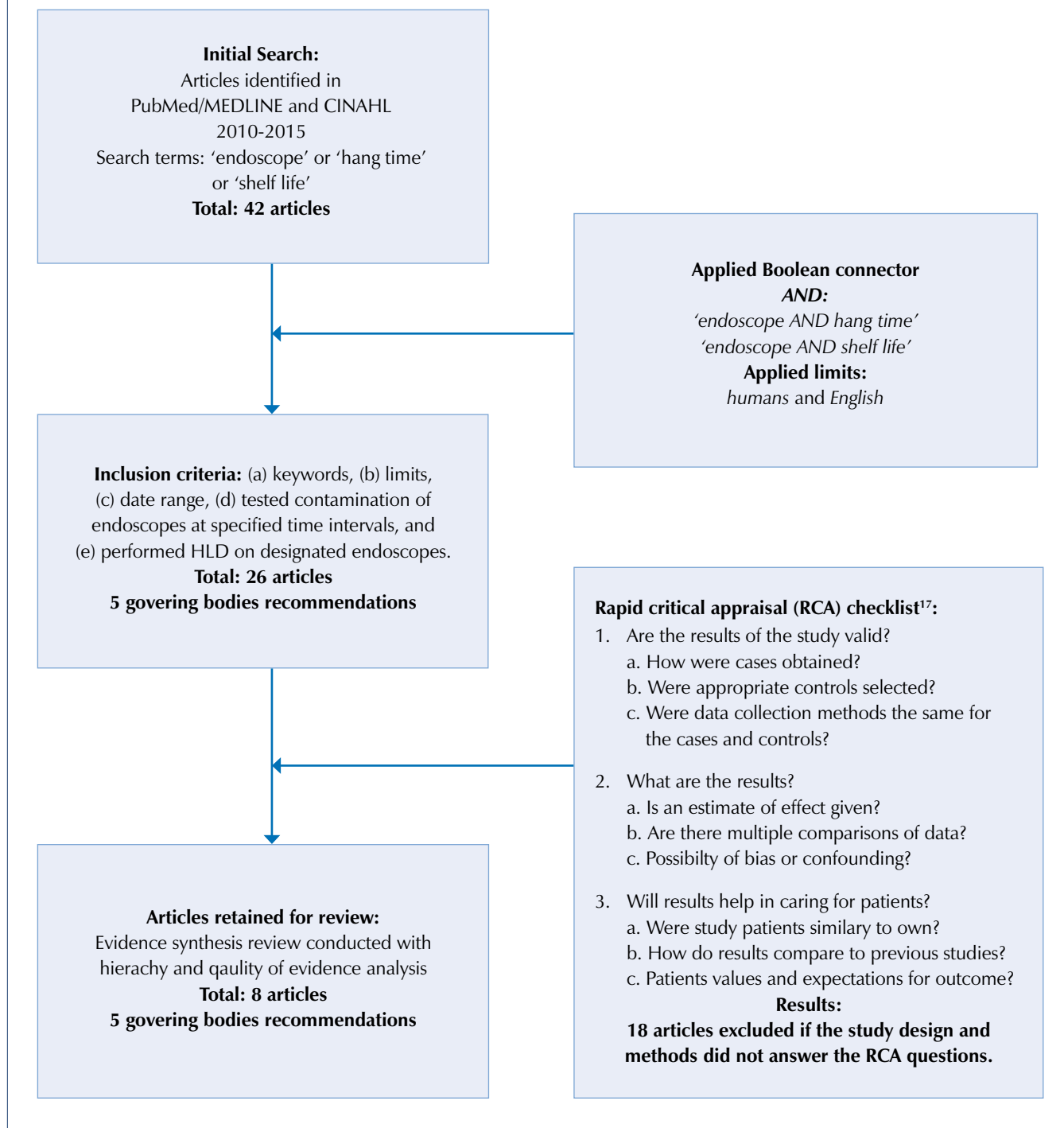
#### IMPLICATIONS FOR PRACTICE

The implications for practice are vast, and fall into three definable categories – the patient, the reprocessing personnel, and the organization. Patients place their trust in the healthcare industry to deliver quality care during everything from the routine to the most high-risk, complex cases. To fail to pursue the most scientifically sound practices in maintaining endoscopes is to fail the patient, with potentially morbid or mortal consequences.

Firth (1) stated that many reprocessing personnel are in a low pay, high turnover bracket, which can present challenges to retaining the more highly competent personnel on staff. These personnel are critical to the success of reprocessing endoscopes and minimizing the risk of disease transmission. Their training must be thorough, and should be monitored to ensure its effectiveness.

Lastly, healthcare facilities need unified standards to ensure that they can draft appropriate policies. The search for the optimal endoscope hang time continues, and has now spanned over a decade. At any duration of hang time, one cannot overstate the importance of the quality of the high-level disinfection process. Determining a safe timeframe is critical for patient safety, manpower, resources, and equipment longevity/maintenance. From the published studies and professional guidelines, 5-7 days appears to be the average acceptable time. The safety of patient care depends upon evidence-based practice in which research is the foundation of clinical decisions and care.

## APPENDIX A: Search Strategy



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# Measuring the performance of a surveillance system: validation of antimicrobial resistant organism incident infection cases in a complete infection prevention and control surveillance network

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## ABSTRACT

**Background:** Infection Prevention and Control in Alberta Health Services and Covenant Health conducts provincial surveillance for healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) infections for individuals admitted to every Alberta acute care facility. System-wide performance measurement is an important function of a comprehensive surveillance network.

**Methods:** Surveillance cases from urine, respiratory, and wound specimens recorded in the provincial data entry surveillance platform between April 2014 and March 2015 were considered for data quality review by infection control professionals or physicians (reviewers). Each reviewer was assigned a maximum of five cases for re-abstracting: to perform chart review and to determine cases as infection or colonization according to the National Healthcare Safety Network definitions. Sensitivity, positive predictive value, and a kappa statistic were calculated for analysis.

**Results:** Eighty-five reviewers from 54 facilities collectively re-abstracted 357 surveillance cases: 82% of cases were MRSA (293/357) and the remaining 18% were VRE (64/357). Provincially, 93 re-abstracted case infection or colonization decision differed from the original decisions (26.1%) for a sensitivity of 81.8% and a positive predictive value of 74.8%; and the kappa statistic was 0.46. Sensitivity, positive predictive value, and kappa were lower for VRE compared to MRSA and for urine specimens compared to respiratory and wound specimens.

**Conclusions:** The review findings highlight strengths and weaknesses in the IPC staff's understanding of the infection definitions. Continued education and discussion on healthcare-associated infection definitions, especially for urine and VRE cases, is important for maintaining and improving data quality.

## KEY WORDS

Surveillance, data quality, performance measurement, MRSA, VRE, healthcare-associated infection definitions, infection, colonization

## INTRODUCTION

Antibiotic resistant organisms (AROs) are a significant and on-going threat to patients in healthcare facilities and in the community and are associated with increased recovery time, length of stay, morbidity, and mortality (1). These infections are difficult to treat, often resulting in the use of second or third-line antibiotics that may be more costly, less effective, and toxic. In 2013, the Centers for Disease Control (CDC)

estimated antibiotic resistance in the United States resulted in approximately two million illnesses and 23,000 deaths (1). Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) are rated by the CDC as serious threats and are organisms under national surveillance in Canada (2,3).

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3,105,951 hospital patient-days across 101 acute care facilities in five geographic zones in Alberta, Canada. AHS/COV Infection Prevention and Control (IPC) staff perform MRSA and VRE surveillance in every acute care facility using standardized protocol definitions based on those of the Canadian Nosocomial Infection Surveillance Program (CNISP); and use healthcare-associated infection (HAI) definitions provided by the National Healthcare Safety Network (NHSN) (4). An incident case is defined as the first time a patient has a confirmed positive MRSA or VRE culture from a screening or clinical specimen while admitted to an AHS/COV acute care facility. The provincial IPC surveillance network centres on a secure web-based data entry platform at a patient-specific level, as has been previously described (5). In 2013 and 2014, CNISP reported national healthcare-associated MRSA and VRE infection rates of 1.8 and 0.5 per 10,000 patient days, respectively (6). The 2014/15 Alberta hospital-acquired MRSA and VRE infection rates were below those of CNISP, at 0.5 and 0.2 per 10,000 patient-days respectively.

While ARO infection surveillance in Alberta is a mandated IPC program activity (7), it is also an essential component of all effective IPC programs. Surveillance is the systematic, ongoing collection, collation, and analysis of data with timely dissemination of information to those who require this information for action to improve patient safety (8). However, surveillance data are only meaningful when collected in an efficient and effective surveillance system. Surveillance systems have been described using specific attributes including simplicity, flexibility, acceptability, representativeness, timeliness, and stability (9). Another attribute, data quality, reflects the completeness, consistency, and validity of the data recorded in the surveillance system; including ensuring data entry of mandatory elements and such simple checks as accurate data entry and no duplicate records (10). A more complete assessment of data quality can be conducted through measurement of sensitivity and positive predictive value (PPV) of the surveillance system (Appendix). While sensitivity and PPV are terms usually associated with diagnostic testing, these concepts have also been expanded to the evaluation of surveillance systems (9,11).

Determining the incidence of infection is a stated objective for provincial HAI-ARO surveillance and is regularly reported to all clinical stakeholders as a patient safety quality metric. Therefore, ensuring consistent and accurate classification of a case as infected or colonized by IPC staff is important for data quality assurance, a vital element of surveillance. The Data Quality Working Group, an internal consensus group with membership including the provincial IPC surveillance team, infection control professionals (ICPs) and an IPC physician, creates provincial protocols, standardizes protocol interpretations, and conducts data checks in the system to promote excellence in data quality. In interpretation of protocol definitions, variability in assigning surveillance cases as infection can

occur, resulting in errors affecting the reliability and accuracy of the surveillance data (12).

A review of AHS/COV MRSA and VRE data was conducted to compare the original case infection/colonization decision recorded in the provincial data entry system and the re-abstraction case infection/colonization decision determined by an assigned reviewer. The primary objective of this project was to assess the accuracy of the original infection or colonization decisions for surveillance cases and to correct the data in cases of discordance. Secondary objectives were to describe potential factors affecting the accuracy of the infection decision and to promote education and consultation support amongst IPC staff performing surveillance activities.

## METHODS

### *Sampling strategy/assignment*

IPC MRSA and VRE surveillance cases at any AHS/COV acute care facility in the province from urine, respiratory, and wound specimens with a laboratory collection date between April 1, 2014 and March 31, 2015 were eligible for review. Each ICP and participating IPC physician was assigned a maximum of five cases from the acute care facility closest to their office location. Each reviewer was provided a spreadsheet file (Excel 2010, Microsoft Inc. Redmond, WA) with assigned cases; the original case severity decision was not provided and the reviewers were asked to ignore the decision recorded in the online surveillance system when reviewing.

### *Case review*

Reviewers were asked to investigate patients' paper and electronic healthcare records to determine infection or colonization using NHSN HAI definitions (4) and to return their decision to the provincial IPC surveillance team. All reviewers were instructed to review assigned cases independently but were encouraged to bring any challenging cases forward for discussion and consensus with their IPC colleagues. The provincial surveillance database was updated to reflect the re-abstraction cases' infection or colonization decision based on the consensus nature of the re-abstraction decision.

### *Analysis*

Sensitivity and PPV were used to assess the accuracy of the infection decisions, using the re-abstracted infection or colonization decision as the referent "gold-standard" (see Appendix Table 2). A kappa statistic was calculated to measure inter-rater reliability with a test considering two outcomes by multiple raters, where the raters' identities vary: i.e., two raters were used but they were not the same raters throughout the whole review (13). All statistical tests were performed in STATA 10 (StataCorp, College Station Texas).

### *Ethics statement*

The project was conducted under the IPC mandate for quality improvement and therefore approved to meet ethical standards; written consent was not required for this analysis. The project data were collected in the provincial

IPC surveillance database in patient-identified form under a provincial privacy impact agreement, however, for analysis all data were de-identified and project results are presented in aggregate format.

## RESULTS

Incident MRSA or VRE surveillance cases in a urine, respiratory, or wound specimen were available from 53.5% (54/101) of the acute care facilities in the province. Eighty-five reviewers representing 76.6% of eligible staff participated in the review, with staff in smaller facilities having fewer than the re-abstraction maximum of five cases. In total, 357 cases were selected for re-abstraction: 82.1% of cases were MRSA (293/357) and the remaining 17.9% were VRE. Provincially, 26.1% (93/357) of the re-abstracted decisions differed from

the original decisions. Of these, 60.2% (56/93) of cases were changed from infection to colonization and the remainder (39.8%, 37/93) were changed from colonization to infection (Table 1).

The provincial sensitivity was 81.8%; i.e., approximately 82% of the cases classified as infection in the re-abstraction review were originally classified as an infection, while nearly 18% of the re-abstracted infections were originally classified as colonization (Table 1). The provincial PPV was 74.8%; i.e., approximately 75% of those originally classified as infection remained an infection in the re-abstraction review; thus, nearly 25% of those originally classified as infections were changed to colonization with the re-abstraction review. The sensitivity, PPV, and kappa were lower for VRE than for MRSA. Considering specimen type, sensitivity and PPV was low for urine specimens and relatively

**TABLE 1: Results of AHS/COV IPC surveillance case review**

Original	Re-abstraction			Analysis		
	Infection	Colonization	Total	Sensitivity	PPV	Kappa
<b>Provincial</b>						
Infection	166	56	222	81.8%	74.8%	0.46
Colonization	37	98	135			
Total	203	154	357			
<b>MRSA</b>						
Infection	155	38	193	83.3%	80.3%	0.48
Colonization	31	69	100			
Total	186	107	293			
<b>VRE</b>						
Infection	11	18	29	64.7%	42.5%	0.19
Colonization	6	29	35			
Total	17	47	64			
<b>Urine specimen</b>						
Infection	17	23	40	63.0%	42.5%	0.21
Colonization	10	39	49			
Total	27	62	89			
<b>Respiratory specimen</b>						
Infection	34	12	46	81.0%	73.9%	0.50
Colonization	8	27	35			
Total	42	39	81			
<b>Wound specimen</b>						
Infection	115	21	136	85.8%	84.6%	0.48
Colonization	19	32	51			
Total	134	53	187			

higher for both respiratory and wound specimens (Table 1). The kappa statistic was 0.46 overall, indicating a weak level of agreement between the original and the re-abstracted decisions (Table 1).

## DISCUSSION

The focus of this review was to measure the performance of the provincial surveillance system for reporting MRSA and VRE HAI. At the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system (9). In this study, sensitivity measures how correct the original IPC decision on infection had been, given that the re-abstracted decision is infection. If the sensitivity is high, the original reviewers correctly submitted an infection decision. The usual definition of PPV is the proportion of reported cases that actually have the health-related event under surveillance (9). In this analysis, it is the proportion of cases that were deemed to meet NHSN infection definition in the re-abstracted compared to those cases reported with infection in the original submission. PPV reflects the prevalence of the “truth” under consideration: a high PPV means that it is unlikely there was an infection in the original decision when the re-abstracted decision was colonization. For MRSA, since the greater pathogenicity of the organism leads to a higher prevalence of infections than with VRE (14) it is more likely that when IPC reviewers determined infection in their original decision, that decision was correct. For VRE, because there is lower infection prevalence due to the lower pathogenicity of the organism (15), if reviewers determined a VRE infection in the original decision it was more likely to be incorrect.

The sensitivities and PPVs for MRSA cases and for respiratory and wound specimens in the AHS/COV surveillance system range from 81.0% to 85.8% sensitivity and 73.9% to 84.6% PPV (Table 1). The low sensitivities, PPVs, and kappa values for VRE cases (0.19) and for urine specimens (0.21) identify these as areas potentially requiring more attention than the other categories. A recent comparison of two physician reviewers for urinary tract infections occurring more than 48 hours after admission noted that applying the NHSN definitions for urinary tract infections was challenging and time-intensive, and resulted in only moderate inter-rater reliability (kappa = 0.62) (16). It was unsurprising that VRE sensitivity and PPV were lower than for MRSA, as two potential factors contribute to the low percentages: small case counts (only 64 VRE cases were reviewed compared to 293 MRSA cases); and the low prevalence of VRE infections in Alberta acute care facilities and in general.

Most literature on performance measurement in this context occur for central vascular catheter associated bloodstream infection (CVC-BSI) surveillance using physicians’ review of cases submitted as the referent decision, with reported sensitivities ranging from approximately 66%-88% and PPVs of 85-97% (17-19). Another approach used a capture/recapture method. In that review, clinical records submitted to the Swedish statutory surveillance

system for communicable diseases were compared to parallel mandatory notification from laboratory records. The sensitivity of surveillance from clinical and laboratory records alone was 91.6% and 95.9%, respectively (20). Another review used a collaborative consensus decision as referent where CVC-BSI cases submitted to a statewide surveillance system were reviewed by external experts, and discordant cases adjudicated through a formal discussion with hospital staff (21). This resulted in a sensitivity of approximately 72% after discussion and agreement, and participant comments indicated the process was a valuable training tool for both the hospital staff and for the state’s public health reviewers.

This provincial data quality review for the accuracy of infection decisions used a simple re-abstracted approach for the referent decision, as both a methodology and as an education intervention. The IPC reviewers were encouraged to discuss difficult cases with their colleagues and to come to a consensus decision to maximize awareness of the NHSN definitions and to engage in group learning. This re-abstracted methodology was also used in a review of coronary artery bypass graft surgical site infection surveillance, and has been used to check data reliability in the CNISP MRSA and VRE surveillance systems (22-24). The CNISP audits showed only 1-2% discordant results with the infection/colonization field, but did not check the methodology used by reviewers for the re-abstracted decision. The low agreement seen in this review between the original and re-abstracted decisions (kappa = 0.46) may be reflective of the original decision process. Factors which may have affected accuracy of the original decision included 1) the health record information available for the re-abstracted review may have been more extensive when compared to the original review; 2) the information accessed for original review may have differed from the re-abstracted review (electronic vs. paper patient record) or was lost as undocumented information; 3) the NHSN definitions were used incompletely or not at all in the original decision; and 4) ICPs may have been more comfortable using the definitions following a series of pre-study education sessions which reviewed the NHSN definitions and provided specific case examples. A validity assessment of NHSN definitions also found a low kappa (0.32) with reviewers from facilities across 28 states, pointing to additional work to improve accuracy and reliability in applying NHSN definitions (25).

There were limitations in the review methodology. The review’s sampling strategy selected only urine, respiratory, and wound specimens, since those NHSN HAI definitions were deemed to be more open to reviewer interpretation than those of other specimen types such as blood cultures or sterile tissue. Therefore, there may be infection misclassification with other specimen types which were not assessed. The analysis assumed that for the re-abstracted decision 1) the NHSN definitions were used to determine case as infected or colonized; 2) the version of NHSN definitions used corresponded to the year of the specimen collection; 3) all available health record information was reviewed; 4) reviewers had the opportunity



to discuss challenging cases with their IPC colleagues. Although education sessions and written information on the re-abstraction process were provided, there was no check to ensure that these assumptions were correct. Overall, a convenience sample of approximately half of all available cases was reviewed with nearly all cases from smaller facilities included. However, the larger facilities in the province reviewed a smaller proportion of their available cases because of the limit placed on re-abstracted cases per reviewer (a maximum of five). Although the cases reviewed at larger facilities were selected arbitrarily, there may have been differences between the cases chosen for re-abstraction and those not chosen. Wherever possible, the original reviewer's cases were assigned to a different reviewer; however, in small acute care facilities with a single ICP this was not always feasible. Although there may have been some recall bias in these smaller settings, ICPs in larger settings may have been involved in discussions on cases they had previously reviewed and may have also recalled specific cases and their original decision.

This is one of the first Canadian attempts at performance measurement in a complete surveillance network with wide variation in facilities and in patient acuity. Overall, both the process and the findings of this provincial review led to increased surveillance case discussion by the IPC program leadership and staff participants; with zone leadership implementation of regularly scheduled surveillance case discussions. The outcome metrics will serve as an internal baseline for future performance measurement cycles, since there are no published acceptable standards. The re-abstraction process helped identify local improvements for provincial surveillance reporting requirements, including the standardizing of sources for patient record review (e.g., using the electronic medical record for specific clinical information that may not be available on paper records). The review findings highlight strengths and weaknesses in the IPC staff's understanding of NHSN HAI definitions for specific specimen types, including interpretation of urine colony counts from local laboratory reporting relative to the NHSN urinary tract infection definition criteria, and have helped identify new initiatives for the Data Quality Working Group. Future work, through education, discussion forums, and case study examples, is necessary to maintain and improve application and interpretation of the NHSN HAI definitions and provincial ARO protocols. The system-wide focus on excellence in IPC surveillance data quality will support targeted actions to improve patient safety across all facilities.

## APPENDIX

The purpose of evaluating surveillance systems is to ensure that problems of importance are being monitored efficiently and effectively. Along with ongoing data checks, a more complete assessment of data quality can be conducted through measurement of sensitivity and positive predictive value (PPV) of the surveillance system (9). In a traditional 2x2 table used for calculating these metrics (Table 2), the referent "gold-standard" (*truth*) is compared to the *test*. In this review,

APPENDIX TABLE 2: 2x2 Table for case review analysis

Original decision	Re-abstracted decision (referent point)		
	Infection	Colonization	
Infection	a	b	a+b
Colonization	c	d	c+d
	a+c	b+d	

Cell "a" are those cases where the re-abstracted decision for infection **agrees** with the original response of infection  
 Cell "b" are those cases where the re-abstracted decision for colonization **disagrees** with the original response (infection)  
 Cell "c" are those cases where the re-abstracted decision for infection **disagrees** with the original response (colonization)  
 Cell "d" are those cases where the re-abstracted decision for colonization **agrees** with the original response of colonization

the referent point is the *re-abstracted* infection decision based on chart review and use of the NHSN definitions, while the "test" is the *original* IPC case decision, based on chart review and NHSN definitions at the time of culture positive results.

At the level of case reporting, **sensitivity** refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system (9). The sensitivity measures how correct the original decision on infection had been, given that the re-abstraction decision is infection. In the table, this is calculated as  $a/a+c$ .

- If the *sensitivity* is high, the reviewers were correctly submitting a decision for *infection* in their original decision.

At the level of case reporting, **specificity** refers to the proportion of "disease-free" detected by the surveillance system (9). The specificity measures how correct the original decision on colonization had been, given that the re-abstraction decision is colonization. In the table, this is calculated as  $d/b+d$ .

- If the *specificity* is high, the reviewers were also correctly submitting a decision of *colonization* in their original decision.

The usual definition of **positive predictive value** (PPV) is the proportion of reported cases that actually have the health-related event under surveillance (9). In this analysis, it is the proportion of cases that reviewers decide meet NHSN infection definition in the re-abstraction review compared to those cases reported with infection in the original submission. In the table, this is calculated as  $a/a+b$ .

On the other hand, **negative predictive value** (NPV) in this analysis, is the proportion of cases that reviewers decide do NOT meet NHSN infection definition in the re-abstraction review (i.e., are colonizations) compared to those cases reported with colonization in the original submission (9). In the table, this is calculated as  $d/c+d$ .

PPV and NPV reflect the prevalence of the "truth" under consideration. A high PPV means that it is unlikely there was

an infection in the original decision when the re-abstracted decision was colonization. For MRSA, because there are more infections in the population (14) (i.e., a high prevalence of infections due to the pathogenicity of the organism), it is more likely that when reviewers determined infection in their original decision, that decision was correct. For VRE, because there is lower infection prevalence due to the lower pathogenicity of the organism (15), if reviewers determined a VRE infection it was more likely to be incorrect.

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# Implementation of sodium hypochlorite wipes for post discharge hospital cleaning and evaluation of cleaning efficacy using adenosine triphosphate monitoring

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## Disclaimer

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## ABSTRACT

**Objective:** To evaluate the implementation of new processes to improve hospital cleaning.

**Design:** Retrospective cohort study.

**Setting:** Urban community hospital with 515 beds located in Toronto, Ontario, Canada.

**Participants:** Environmental Services staff.

**Intervention(s):** Creation of inter-professional Process Improvement Working Group (PIWG) responsible for improving hospital cleaning. The PIWG directed the hospital wide implementation of Sodium Hypochlorite (SH) wipes to replace Accelerated Hydrogen Peroxide (AHP) and use of Adenosine Triphosphate (ATP) bioluminescence monitoring of cleaning quality.

**Results:** The PIWG was able to identify numerous improvement opportunities and was able to implement the use of SH wipes and ATP assessment over a 10-month period. A total of 1558 ATP swabs were taken after patient rooms were cleaned. Multivariable modeling demonstrated that surfaces cleaned with AHP (OR 4.85 [95% CI, 6.64-6.47];  $P < 0.0001$ ) and surfaces closest to the patient (OR 2.34 [95% CI, 1.87-2.93];  $P < 0.0001$ ) had an increased risk of failing ATP assessment.

**Discussion:** Our evaluation demonstrates that the use of a PIWG involving EVS staff is an important strategy to introduce new processes to improve hospital cleaning. Engaging point-of-care staff allowed us to identify novel improvements to simplify the approach to appropriate environmental cleaning. ATP environmental assessments demonstrated that surfaces furthest from the patient and SH wipes were associated with a lower risk of cleaning failure.

## INTRODUCTION

Hospital-acquired *Clostridium difficile* infections (HACDI) lead to significant patient morbidity, mortality and increase health care associated costs (1,2). Current guidelines for the prevention of HACDI recommend a multi-modal approach for pathogen eradication, including environmental cleaning, early identification and isolation, hand hygiene and antimicrobial stewardship. Despite these recommendations HACDI continues to be a major cause of excess morbidity and mortality (3,4).

It is important to consider the "triad of infection" encompassing agent, host and environment in analyzing the potential efficacy of any suggested multi-modal approach.

The common recommendation to HACDI management suggests the use of a sporicidal agent in limited conditions, i.e., in rooms of suspected or known cases and in outbreak situations. This prevention strategy assumes a predictable transmission pathway from symptomatic patient to universally susceptible host. It does not account for asymptomatic carriage, variability in host susceptibility related to antibiotic exposures and the complex nature of HACDI transmission. Recent studies have demonstrated that hospital-acquired HACDI transmission is infrequently related to a symptomatic patient recently on the same ward as a potential host (5,6,7,8).

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**Conflict of interest:** Barley Chironda, one of the authors previously had no conflict at the time of the study but is now currently an employee of Clorox Canada (maker of Sodium Hypochlorite used in this study). All other authors report no conflicts of interest relevant to this article.

**Authorship and manuscript preparation:** Gurvinder Bhatra (TEGH Librarian) provided assistance in literature searches.

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Based on the complexity of HACDI transmission, Toronto East General Hospital (TEGH), a 515-bed community hospital in Ontario, Canada, was interested in initiating a process to optimize cleaning throughout the facility. Reducing the complexity of the cleaning process and providing immediate, quantitative feedback on cleaning efficacy has been demonstrated as important strategies to improve cleaning efficacy (14). Our study evaluates implementation of Sodium Hypochlorite (SH) wipes for environmental cleaning, and use of Adenosine Triphosphate (ATP) Bioluminescence as a cleaning efficacy auditing tool. We also evaluated factors associated with failure of environmental cleaning, as assessed by ATP after SH wipe implementation.

## METHODS

### Setting

The TEGH is an urban community hospital with 515 beds located in Toronto, Ontario, Canada. Environmental services (EVS) are provided by a hospital-based housekeeping personnel.

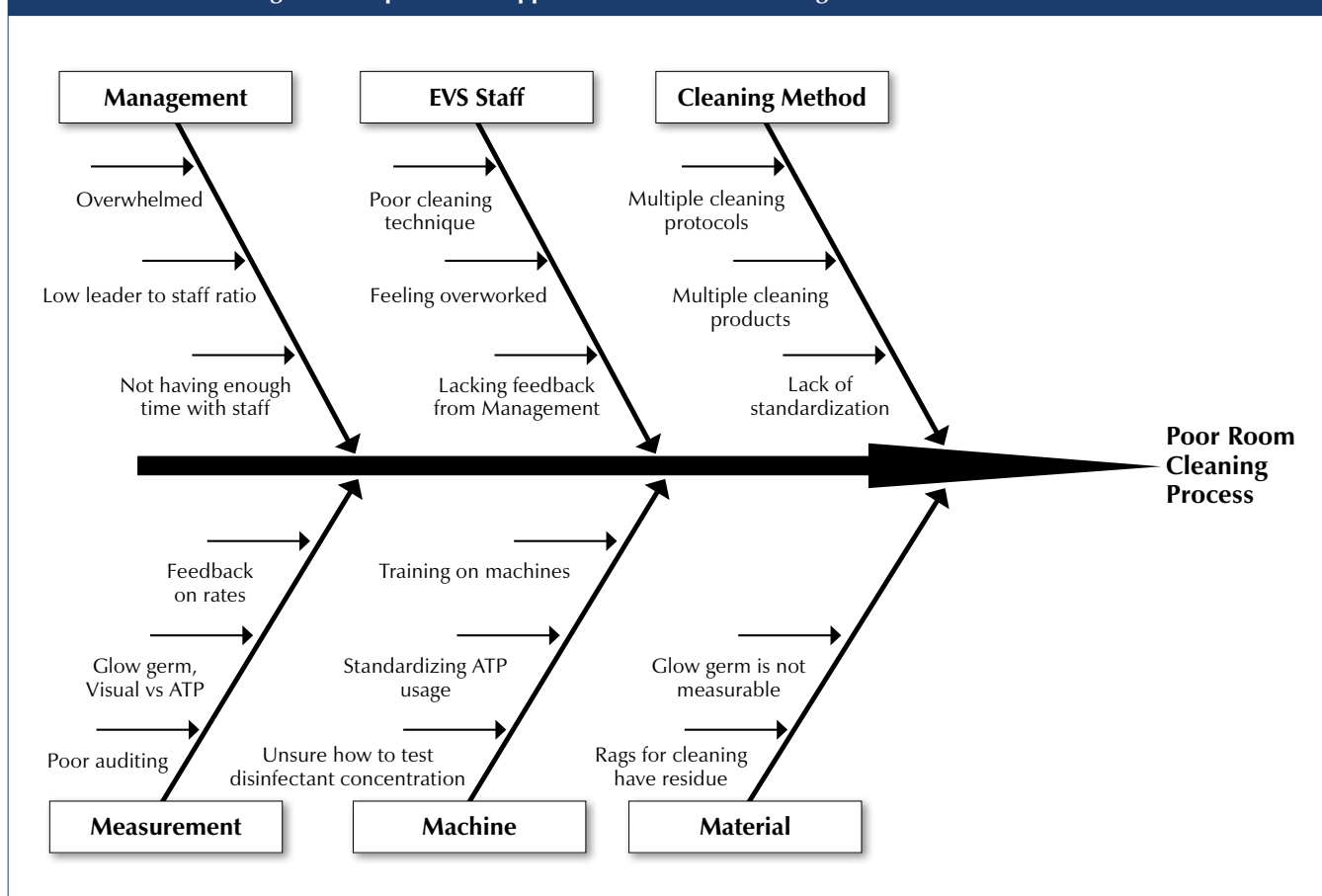
### Assessment

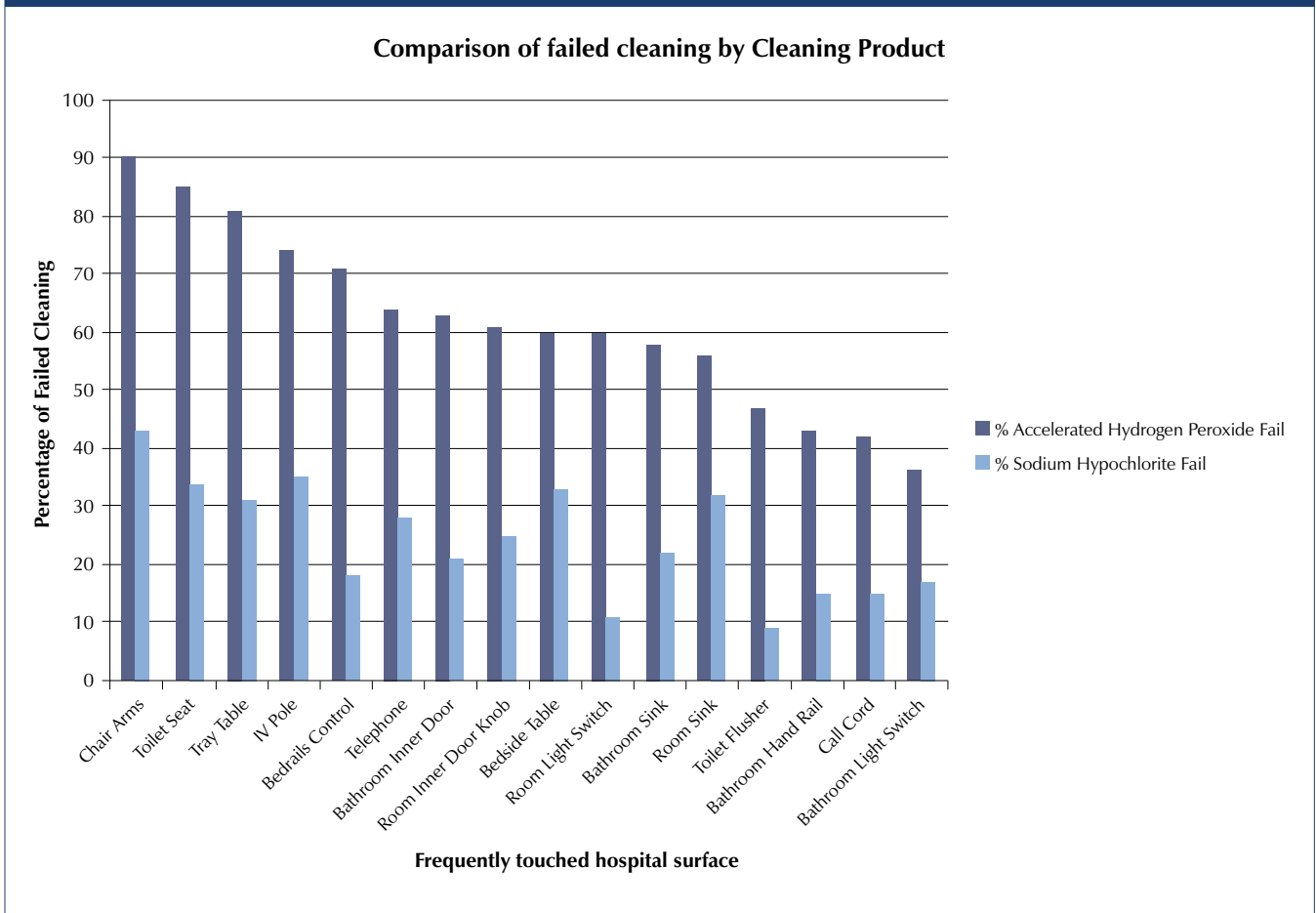
The Process Improvement Working Group (PIWG) was created with the objective of improving the quality of cleaning at TEGH. The group, comprised of manager and supervisors

of EVS, was facilitated by an infection preventionist. Five PIWGs were facilitated by a leader from infection prevention and control (IPAC) using continuous process improvement frameworks (9). Participation was voluntary and all members of EVS were eligible to attend. Records from each PIWG were kept by the group leader for each session and summarized in actionable items.

EVS point-of-service consultation was done separately through meetings with the infection preventionist at shift changeovers at the time of staff “huddles.” These huddles of five minutes were done twice a week to allow for maximum information flow. Several gaps were identified by PIWG (Figure 1). This included factors specific to the current cleaner/ disinfectant used at the institution. We had been using Oxivir™ Accelerated Hydrogen Peroxide (AHP) (Diversey™, Wisconsin) in two concentrations; a 0.5% for regular disinfection and 4.5% Rescue™ (Virox™ Ontario) for sporicidal cleaning since 2008. PIWG and EVS staff reported poor compliance in using the AHP as per the manufacturer’s requirements of maintaining a wet contact for 10 minutes. It was also revealed that rooms of patients suspected to have HACDI might erroneously be cleaned with the non-sporicidal disinfectant due to knowledge gaps of EVS or due to delayed update of patient status. Secondly, there was no clear

FIGURE 1: Fishbone diagram of improvement opportunities in room cleaning



**FIGURE 2: Cleaning Failures – Sodium Hypochlorite Wipes vs. Accelerated Hydrogen Peroxide**

auditing methodology. The hospital had historically used an environmental marking tool (Glo Germ<sup>®</sup>, Utah). This tool was an adaption from hand hygiene training, and provided limited information on the quality of cleaning.

### Planning

A conservative rollout calendar was planned focusing on staggering conversion to SH wipes on a new care unit every two weeks. Information sessions for hospital staff and patients were scheduled, as well as education for EVS personnel. A communication plan was set in motion, including email broadcasts to all hospital staff, an announcement of the planned conversion on the hospital's internal website, and an article in the hospital newsletter. The PIWG spoke at departmental meetings throughout the hospital and was available as a support for staff, patients and visitor enquiries. Training and standardization of swab technique for ATP was carried out to ensure thresholds had been established for the assessment of cleaning.

### Implementation

Education sessions for EVS involved a one-on-one demonstration of cleaning with SH wipes by the PIWG, as well

as subsequent reinforcement training. The proper technique for wiping was demonstrated with emphasis on cleaning (removal of debris) versus just disinfection. These sessions allowed demonstration of the personal protective equipment (PPE) to be used during cleaning. EVS personnel were reminded to visit the Occupational Health Department for any physiologic concerns that may arise during use of the product. Non-EVS staff had information sessions provided to them addressing the product odour, with education focusing on the noted odour depletion after the first two weeks of use.

### Sodium hypochlorite rollout

On April 16, 2012 SHwipes were trialed on a single General Medicine Unit. Support was offered to patients and staff by Occupational Health, EVS and infection preventionists on an as needed basis. Upon completion of the two-week trial, areas of improvement were noted. It was felt that staff that had not received information were more resistive to the change. Therefore, we modified the knowledge dissemination strategy prior to implementation, to ensure all EVS personnel were informed. Additional unit rollouts occurred approximately every two weeks with a product information sessions offered as a precursor to the launch. The training of EVS staff was

done continuously as the rollout proceeded. During implementation a medical unit that had been using AHP had a CDI outbreak. This outbreak resulted in an unscheduled earlier conversion to SH wipes.

### ATP

Cleaning/disinfection efficacy was assessed with an ATP monitoring system. All auditors were trained on the consistency of swabbing technique. Frequently touched objects were deduced using the tolls from the Centers for Disease Control and Prevention (CDC) and Safer Healthcare Now (10). Consensus was reached on how and where to swab various frequently touched objects (FTO) to ensure standardization. To establish initial ATP thresholds, trained auditors evaluated patient rooms immediately after cleaning. This process was continued until each FTO had a total of 10 points “after clean” audits. Using measures of central tendency and standard deviation it was calculated that a measurement of <300RLU was a pass (P), 300RLU-1000RLU a caution(C) and above 1000RLU a fail (F). FTOs were grouped into one of three groups related to their proximity to the patient.

### Statistical analysis

The ATP classification of *Pass* and *Fail* were used to make the data categorical, with *Caution* included in the fails. Univariate analysis evaluated categorical variables using chi-square or Fisher’s exact tests, and continuous variables using the Student’s t-test. A multivariate logistic regression (MVLR) was performed to identify factors associated with

failure. Factors considered in the MVLR were cleaning product (AHP vs. SH), bioload (distance from patient), date (time from initial rollout) and hospital ward. A *p*-value of less than 0.05 was deemed statistically significant. Analysis was performed using SAS/STAT® software, Version 9.1.3.

### RESULTS

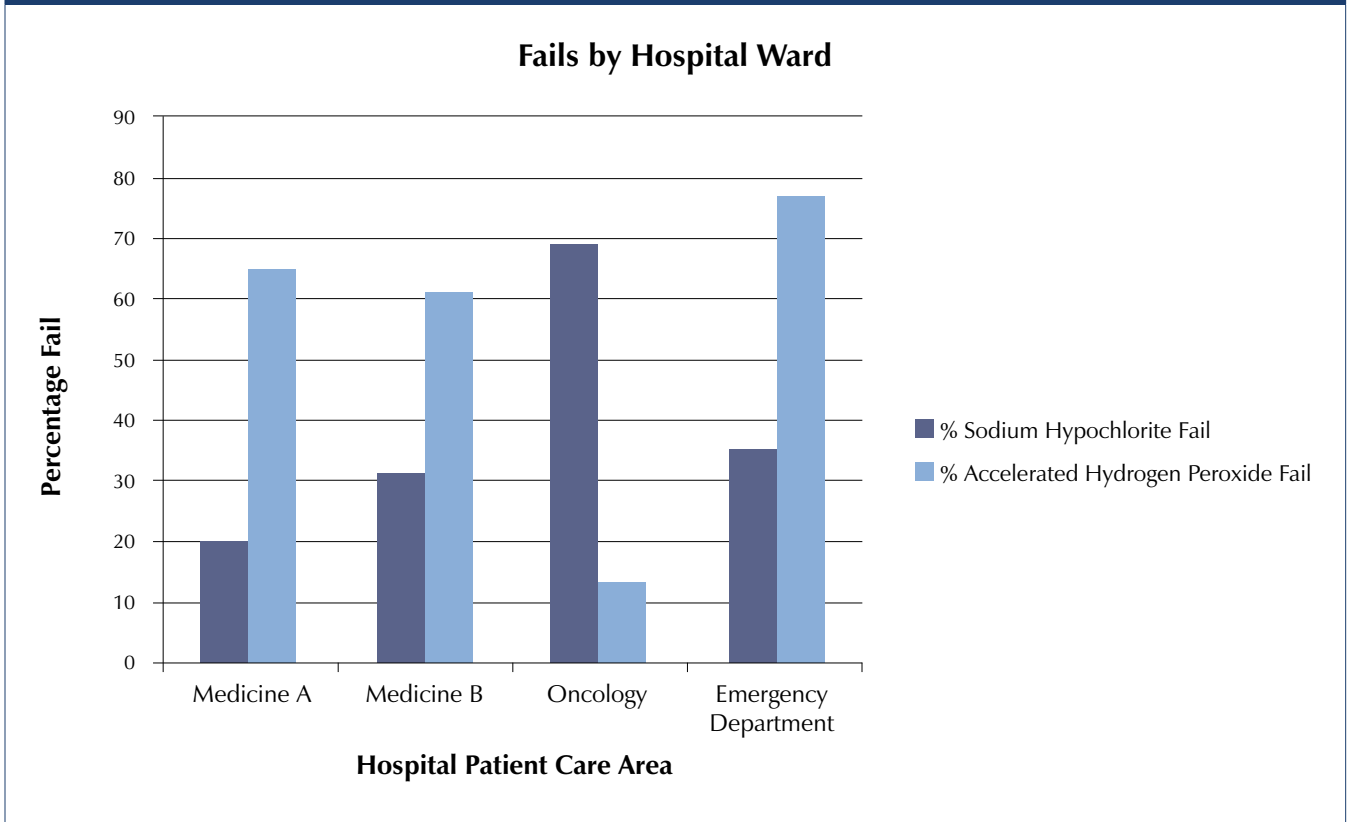
Over a 10-month period, all EVS staff and all clinical care wards had been trained on the use of bleach and had implemented SH wipes, respectively.

A total of 1,661 FTOs were swabbed for ATP by EVS staff. Some sample points (e.g., common counter and monitor cables) were removed from statistical analysis, as they had been used in an outbreak investigation. Overall, the use of SH wipes was associated with significantly fewer ATP fails (24%, 256/1065) compared to AHP (62%, 370/596) ( $p < 0.0001$ ). Stratifying the results by FTOs demonstrated that all surfaces, except the room sinks, were more likely to fail ATP auditing if AHP was used compared to SH wipes (Figure 2). On wards where ATP auditing information was available for both cleaning agents, SH was associated with fewer audit fails (Fig 3) on the Medical A unit ( $p < 0.001$ ), Medical B unit ( $p < 0.001$ ), the Emergency Department ( $p < 0.001$ ), but not on the Oncology Unit. ( $p = 0.4$ ).

MVLR model results (Table 1) demonstrate that cleaning product and proximity to patient were the two factors independently associated with the probability of ATP audit fails. The MVLR demonstrated that surfaces cleaned with AHP had a failure odds ratio of 4.85 [95% CI, 6.64-6.47];

**TABLE 1: Factors associated with failure in cleaning with accelerated hydrogen peroxide**

Factor	OR (95% CI)	p value
AHP	4.85 (3.64-6.47)	<0.0001
Wards		
• Peds/PBC	1	
• Chronic Care	0.80 (0.44-1.47)	0.479
• Surgery	0.71 (0.39-1.27)	0.246
• Critical Care/ER	1.52 (0.88-2.61)	0.134
• Medicine	1.05 (0.62-1.77)	0.867
Bioload		
• Furthest	1	
• Closest	2.34 (1.87-2.93)	<0.0001
Date (per day)	1.00 (1.00-1.00)	0.243

**FIGURE 3: Rate of cleaning failure by the type of cleaning product and location**

$p = <0.0001$ , compared to SH wipes. Surfaces in close proximity to the patient were significantly more likely to fail than those further away 2.34 [95% CI, 1.87-2.93];  $p = <0.0001$ . The probability of ATP audit failure was not affected by time after implementation 1.00 [95% CI 1.00-1.00];  $P < 0.243$ .

## DISCUSSION

Our study demonstrates the successful implementation of SH wipes in a large community urban healthcare facility and the use of ATP bioluminescence to assess cleaning efficacy. ATP evaluations demonstrated that cleaning product and bioload were the major predictors of environmental cleaning failure after SH wipe implementation as assessed by ATP auditing.

There are several factors that led to the successful implementation of SH at our institution that can be validated with studies in Implementation Science (25). The most important factor was the involvement of the PIWG, which resulted in an increased dialogue between IPAC and EVS. This resulted in opportunities for information flow as to the challenges and opportunities experienced by the EVS in their work. This concept, called Frontline-Ownership, has been successful with other complex infection prevention interventions like hand hygiene (22). This practice of respect, engagement and appreciation of the worker fosters a blameless environment

allowing for the realizations of the complexities of cleaning tasks faced by the EVS staff. We felt that when such a culture is created staff are more likely to share work errors, thereby promoting process improvement (e.g., staff would often miss the call bell – a point only verifiable through observation or dialogue with EVS).

Immediate, quantitative evaluation of cleaning efficacy was identified by the PIWG as a critical factor to optimize environmental cleaning. The ability of ATP assessments to provide quantifiable results allowed us the opportunity to determine thresholds for failure of environmental cleaning. Cleaning efficacy could then be immediately fed back to EVS staff providing for a continuous feedback loop allowing modification of EVS cleaning technique. ATP environmental assessment also allowed us the opportunity to assess factors associated with failure of environmental cleaning. Interestingly, we noted that SH wipes and proximity to the patient were independently associated in our multivariable modeling with ATP audit failure.

There are three possible reasons for the association between SH wipes and a higher rate of pass on ATP audit. First, the SH wipes contain a surfactant thereby, allowing a one-step cleaning and disinfection compared to other products that require multiple steps (11,12). This surfactant potentially provides superior liberation and removal of bioload thereby lowering ATP (13). Secondly, the PIWG had identified that the process of cleaning with the AHP was prone to errors

stemming from the recommended contact time and product selection criteria for sporicidal cleaning. Simplified processes improve quality in complex systems and are associated with superior cleaning outcomes (14,15). Thirdly, single-use SH wipes replaced the reusable rags that were used for application of AHP. These rags were commercially laundered and our PIWG had identified that occasionally cloths returned from the commercial laundry visibly soiled. These contaminated cloths may introduce bioload to the patient environment potentially contributing to the failure rate of AHP in our study (13, 16).

We also noted that surfaces closest to patient were associated with the highest likelihood of environmental cleaning failure. The area closest to the patient is most likely to be contaminated related to activities of daily living of the patient (17,18). Some studies demonstrated that surface texture and composition can have implications on the outcome of cleaning (19, 20, 21).

### Limitations

This was an observational study completed in a single institution, thus limiting generalizability of our findings. EVS and auditors were not blinded to the cleaning agents. Finally, there are reports of significant interaction between different ATP bioluminescent systems and different cleaners including hydrogen peroxide products and sodium hypochlorite containing products (24, 25). Both have been shown in various studies to interfere with different ATP bioluminescent assays. Our study did not control for this potential interference.

### CONCLUSIONS

Our study demonstrates that engaging point-of-service staff early in the implementation process allowed us to identify deficiencies in our prior approach and subsequently implement a simplified environmental cleaning process involving a quantitative evaluation. The ability to have a broadly applied sporicidal agent that was easy for EVS staff to use allowed us to transform the current wait and see (defensive) approach to a search and kill (offensive) approach with respect to controlling HACDI.

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# Device-associated infection and mortality rates, bacterial resistance, and length of stay in hospitals of Malaysia: International Nosocomial Infection Control Consortium (INICC)'s findings

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## ABSTRACT

**Background:** To report the results of the International Nosocomial Infection Control Consortium (INICC) study conducted in Malaysia from August 2009 through July 2015.

**Methods:** A device-associated healthcare-acquired infection (DA-HAI) prospective surveillance study was conducted in 3 adult and 1 pediatric intensive care units (ICUs) from two hospitals, applying the U.S. CDC/NHSN criteria and definitions and INICC methods.

**Results:** There were 2,292 ICU patients documented for 12,932 bed-days. In the medical/surgical ICU the central line-associated bloodstream infection (CLABSI) rate was 9.4 per 1,000 central line-days, the ventilator-associated pneumonia (VAP) rate was 21.2 per 1,000 mechanical ventilator-days, and the catheter-associated urinary tract infection (CAUTI) rate was 5.0 per 1,000 urinary catheter-days. These rates were similar to or higher than the rates of medical/surgical ICUs reported in the INICC international report (4.9 [CLABSI]; 16.5 [VAP]; 5.3 [CAUTI]), and higher than CDC/NHSN reported rates (0.8 [CLABSI]; 1.1 [VAP]; and 1.3 [CAUTI]) for the medical/surgical ICU. Device utilization ratios in the medical/surgical ICU were higher than INICC and CDC/NHSN reported rates for the same type of ICUs. Resistance of *Acinetobacter baumannii* to imipenem or meropenem was 30.8%, *P. aeruginosa* to piperacillin or piperacillin-tazobactam was 10.7%, and *K. pneumoniae* to ceftriaxone 25.0%. Excess length of stay was 6.4 days for patients with CLABSI, 12.3 for patients with VAP and 0.4 days for patients with CAUTI. Excess crude mortality was 53.1% for CLABSI, 14.8% for VAP, and 32.2% for CAUTI.

**Conclusions:** DA-HAI rates in our ICUs are higher than CDC/NHSN rates and INICC international rates.

## KEY WORDS

Hospital infection; healthcare-associated infection; antibiotic resistance; ventilator-associated pneumonia; catheter-associated urinary tract infection; central line-associated bloodstream infections

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## INTRODUCTION

Increasingly in scientific literature, device-associated healthcare-acquired infections (DA-HAIs) are considered one of the principal threats to patient safety in the intensive care unit (ICU) and are among the main causes of patient morbidity and mortality (1, 2).

The effectiveness of implementing an integrated infection control program focused on DA-HAI surveillance was demonstrated in the many studies conducted in the U.S. (3-5) Their results indicated not only that the incidence of DA-HAI can be reduced by as much as 30%, but that a related reduction in healthcare costs was also feasible (3).

Addressing the burden of antimicrobial-resistant infections and reporting on susceptibility of DA-HAI-associated pathogens to antimicrobials is important for making informed decisions when only few effective treatment options are available (6).

For more than 40 years, the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC/NHSN)(7) has provided benchmarking U.S. ICU data on DA-HAIs, which served as an inspiration to the International Nosocomial Infection Control Consortium (INICC) (8).

The INICC is an international non-profit, open, multi-centre, collaborative healthcare-associated infection control network with a surveillance system based on that of the CDC/NHSN.(9) Founded in Argentina in 1998, INICC is the first multinational surveillance and research network established to measure, control and reduce DA-HAI, and surgical site infections (SSIs) hospital wide through the analysis of data collected on a voluntary basis by a pool of hospitals worldwide (10).

Surveillance is conducted by means of an online platform called INICC Surveillance Online System (ISOS) which comprises 15 modules that demonstrated effective impact on DA-HAI rates in several studies (11-15). The ISOS allows the classification of prospective, active, cohort surveillance data into specific module protocols that apply U.S. CDC/NHSN's definitions published in January 2015 (16).

This is the first INICC DA-HAI prospective surveillance study conducted in Malaysia, which reports a summary of data collected between August 2009 and July 2015 in 4 ICUs in 2 hospitals (8, 17).

## METHODS

### Setting and study design

This prospective cohort surveillance study was conducted in 1 pediatric ICU, 1 Medical ICU, 1 Medical/Surgical ICU, and 1 Surgical ICU from two hospitals in two cities of Malaysia. Identities of all INICC hospitals and their specific geographic locations are kept confidential. The study was conducted through implementation of the INICC Multidimensional Approach (IMA), which is based on CDC/NHSN's definitions of HAIs and methodology with added patient-specific data, to increase infection control professionals' (ICP)'s sensitivity, and avoid underreporting (9). Unlike CDC/NHSN methodology relying on aggregate device-days, IMA methodology adds precision to the surveillance by collecting additional specific data of patients with and without HAI.

These data enables the matching of patients to estimate excess LOS, mortality and cost.

The IMA comprises simultaneous implementation of the following six components for HAI control and prevention: 1) a bundle of interventions; 2) education; 3) outcome surveillance; 4) process surveillance; 5) feedback on HAI rates and consequences; and 6) performance feedback.

This study presents the results of the cohort outcome surveillance of HAIs in the participating ICUs through the ISOS. The site-specific criteria include reporting instructions and provide full explanations integral to their adequate application (9).

### Data collection and analysis

The ISOS follows the INICC protocol and is managed by ICPs, who collect daily data on central line-associated bloodstream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), ventilator-associated pneumonias (VAPs), denominator data, patient-days and patient-specific device-days in the ICUs.

The data was uploaded to ISOS, and used to calculate DA-HAI rates per 1000 device-days. Mortality and LOS were calculated according to the following formulas: Device-days consisted of the total number of central line (CL)-days, urinary catheter (UC)-days, or mechanical ventilator (MV)-days. Crude excess mortality of DA-HAI equals crude mortality of ICU patients with DA-HAI minus crude mortality of patients without DA-HAI. Crude excess LOS of DA-HAI equals crude LOS of ICU patients with DA-HAI minus crude LOS of patients without DA-HAI. Device utilization ratio (DUR) equals the total number of device-days divided by the total number of bed days.

### Training

The INICC team trained infection control professionals (ICP) and hospital epidemiologists (HE) at the participating hospitals. ICPs were also provided with tutorial movies, manuals and training tools that described in detail how to perform surveillance and upload surveillance data through ISOS. In addition, investigators attended webinars, and had continuous access to a support team at the INICC headquarters in Buenos Aires, Argentina.

### Statistical analysis

ISOS version 2.0 (Buenos Aires, Argentina) was used to calculate HAI rates, device utilization, LOS and mortality. EpiInfo® version 6.04b (CDC, Atlanta, GA), SPSS 16.0 (SPSS Inc. an IBM company, Chicago, Illinois), and ISOS version 2.0 (Buenos Aires, Argentina), were used to conduct data analysis. Relative risk (RR) ratios, 95% confidence intervals (CIs) and P-values were determined for primary and secondary outcomes.

## RESULTS

During the study period from August 1st 2009 through July 31st 2015, 2,292 patients were hospitalized in the four participating ICUs, for a total of 12,932 bed-days. The mean length of participation of the ICUs in the study was (SD) 22.8 (4.3) months, ranging from 19 to 29 months.

Table 1 shows pooled means of the distribution of the rates of CLABSI, VAP and CAUTI, and DURs for CL, UC, and MV by type

**TABLE 1: Pooled means of the distribution of device-associated infections and device utilization ratios by type of location, adult and pediatric patients. Device-Associated Module, 2009-2015**

Type of ICU	Patients	Bed days	CL days	CL DUR (95% CI)	MV days	MV DUR (95% CI)	UC days	UC DUR (95% CI)	*DA-HAI, n	**DA-HAI rate per 1000 device days
Medical	363	1,382	716	0.52 (0.49 – 0.54)	446	0.32 (0.30 – 0.35)	792	0.57 (0.55 – 0.60)		
CLAB									0	0.0
VAP									3	6.7
CAUTI									2	2.5
Medical Surgical	833	5,341	5,618	1.05 (1.03 – 1.07)	3,963	0.74 (0.73 – 0.75)	4,396	0.82 (0.81 – 0.83)		
CLAB									53	9.4
VAP									84	21.2
CAUTI									22	5.0
Pediatric	809	5,075	2,850	0.56 (0.55 – 0.58)	3,073	0.61 (0.59 – 0.62)	2,495	0.49 (0.48 – 0.51)		
CLAB									9	3.2
VAP									49	15.9
CAUTI									1	0.4
Surgical	287	1,134	740	0.65 (0.62 – 0.68)	421	0.37 (0.34 – 0.40)	845	0.75 (0.72 – 0.77)		
CLAB									0	0.0
VAP									4	9.5
CAUTI									1	1.2
Pooled ICUs	2,292	12,932	9,924	0.77 (0.76 – 0.77)	7,903	0.61 (0.59 – 0.62)	8,528	0.66 (0.65 – 0.77)		
CLAB									62	6.2
VAP									140	17.7
CAUTI									26	3.0

ICU, intensive care unit; CL, central line; CLABSI, central line-associated bloodstream infection; MV, mechanical ventilator; VAP, ventilator-associated pneumonia; UC, urinary catheter; CAUTI, catheter-associated urinary tract infection; DUR, device utilization ratio; CI, confidence interval; DA-HAI, device-associated healthcare-acquired infections.

\*DA-HAI rates are expressed as DA-HAIs per 1000 device days.

**TABLE 2: Pooled means of the distribution of crude mortality, crude excess mortality, length of stay, and crude excess length of stay Intensive Care Units patients**

Patients	Patients, n	Deaths, n	Pooled crude mortality, %	Pooled crude excess mortality, % (95% CI)	LOS, total days	Pooled average LOS, days	Pooled average excess LOS, days (95% CI)
Without DA-HAI	2,123	165	7.8%	-	10,127	4.8	-
With CLABSI	23	14	60.9%	53.1% (31.9 – 71.3)	257	11.2	6.4 (5.0 – 7.7)
With CAUTI	5	2	40.0%	32.2% (-1.4 – 76.3)	26	5.2	0.4 (-1.5 – 2.7)
With VAP	93	21	22.6%	14.8% (7.9 – 23.4)	1,593	17.1	12.4 (11.4 – 13.1)

ICU, intensive care unit; CI, confidence interval; DA-HAI, device-associated healthcare-acquired infection; CLABSI, central line-associated bloodstream infection; VAP, ventilator-associated pneumonia; CAUTI, catheter-associated urinary tract infection; LOS, length of stay; CI, confidence interval.

**TABLE 3: Benchmarking of device-associated healthcare-acquired infection rates in this report against International Nosocomial Infection Control Consortium (2007-2012) and US National Healthcare Safety Network (2013) reports**

	This Report Rate (95% CI)	INICC Report (2007-2012) Rate (95% CI)	U.S. CDC/NHSN Report (2013) Rate
<b>Medical ICU</b>			
CL, DUR	0.52 (0.49 – 0.54)	0.47 (0.47 – 0.47)	0.45
CLABSI rate (CLABSIs per 1000 CL-days)	0.0	4.6 (4.4 – 4.9)	1.1
MV, DUR	0.32 (0.30 – 0.35)	0.47 (0.47 – 0.47)	0.9
VAP rate (VAPs per 1000 MV-days)	6.7 (1.4 – 19.7)	12.4 (11.9 – 12.8)	0.34
UC, DUR	0.57 (0.55 – 0.60)	0.71 (0.71 – 0.71)	0.61
CAUTI rate (CAUTIs per 1000 UC-days)	2.5 (0.3 – 9.1)	4.5 (4.2 – 4.7)	2.0
<b>Medical Surgical ICU</b>			
CL, DUR	1.05 (1.03 – 1.07)	0.54 (0.54 – 0.54)	0.37
CLABSI rate (CLABSIs per 1000 CL-days)	9.4 (7.1 – 12.3)	4.9 (4.8 – 5.1)	0.8
MV, DUR	0.74 (0.73 – 0.75)	0.36 (0.36 – 0.36)	0.24
VAP rate (VAPs per 1000 MV-days)	21.2 (16.9 – 26.2)	16.5 (16.1 – 16.8)	1.1
UC, DUR	0.82 (0.81 – 0.83)	0.62 (0.62 – 0.62)	0.54
CAUTI rate (CAUTIs per 1000 UC-days)	5.0 (3.1 – 7.6)	5.3 (5.2 – 5.8)	1.3
<b>Pediatric ICU</b>			
CL, DUR	0.56 (0.55 – 0.58)	0.50 (0.50 – 0.50)	0.45
CLABSI rate (CLABSIs per 1000 CL-days)	3.2 (1.4 – 6.0)	6.1 (5.7 – 6.5)	1.2
MV, DUR	0.61 (0.59 – 0.62)	0.53 (0.53 – 0.53)	0.37
VAP rate (VAPs per 1000 MV-days)	15.9 (11.8 – 21.1)	7.9 (7.4 – 8.4)	0.8
UC, DUR	0.49 (0.48 – 0.51)	0.31 (0.31 – 0.32)	0.21
CAUTI rate (CAUTIs per 1000 UC-days)	0.4 (0.0 – 2.2)	5.6 (5.1 – 6.1)	2.5
<b>Surgical ICU</b>			
CL, DUR	0.65 (0.62 – 0.68)	0.50 (0.50 – 0.51)	0.55
CLABSI rate (CLABSIs per 1000 CL-days)	0.0	5.7 (5.4 – 6.0)	0.9
MV, DUR	0.37 (0.34 – 0.40)	0.33 (0.33 – 0.33)	0.34
VAP rate (VAPs per 1000 MV-days)	9.5 (2.6 – 24.3)	15.6 (15.0 – 16.3)	2.0
UC, DUR	0.75 (0.72 – 0.77)	0.67 (0.67 – 0.67)	0.71
CAUTI rate (CAUTIs per 1000 UC-days)	1.2 (0.0 – 6.6)	4.7 (4.5 – 5.0)	4.4

ICU, intensive care unit; CLABSI, central line-associated bloodstream infection; VAP, ventilator-associated pneumonia; CAUTI, catheter-associated urinary tract infection; DUR, device utilization ratio; CI, Confidence Interval; CL, Central line; MV, mechanical ventilator; UC, urinary catheter; INICC, International Nosocomial Infection Control Consortium; U.S. NSHN, National Healthcare Safety Network of the United States of America.

of ICU. The most frequent DA-HAI was VAP with an overall rate of 17.7 per 1,000 MV days. The least frequent DA-HAI was CAUTI with an overall rate of 3.0 per 1,000 UC days. CL DUR was the highest (0.77) compared to duration ratios and their respective confidence intervals for UCs and MVs.

Table 2 provides data on crude ICU mortality and LOS in patients hospitalized in each type of unit during the surveillance period, with and without DA-HAI. The DA-HAI

with the highest mortality was CLABSI. The DA-HAI with the longest LOS was VAP. In contrast, VAP showed the lowest mortality, whereas CAUTI had the least LOS.

Table 3 is the comparison of the results of this report from Malaysia with the INICC international report for the period 2007-2012 the US CDC/NHSN report of 2013 (7, 8). In the Medical/Surgical ICUs, the rate of VAP was higher in this study than in INICC and CDC/NHSN's reports (7, 8). The CLABSI rate

in this study was higher than CDC/NHSN's and INICC rates. Finally, the rate of CAUTI was similar in this study to the cited INICC report, but was also higher than the CDC/NHSN rate (7, 8). DURs for all type of DA-HAIs were higher in this study than in the INICC and CDC/NHSN in the Medical/Surgical, Pediatric and Surgical ICUs. In the Medical ICU, by contrast, DURs for all types of DA-HAIs were higher than in the CDC/NHSN, but lower than in the INICC report (7, 8).

Table 4 is the comparison of antimicrobial resistance rates of this report from Malaysia with the INICC international report for the period 2007-2012(8) and with the US CDC/NHSN report of 2009-2010 (6). Resistance of *Klebsiella pneumonia* to ceftriaxone or ceftazidime was higher in study than in the CDC/NHSN report. Overall, antimicrobial resistance rates were lower in this study than in the INICC and CDC/NHSN reports.

## DISCUSSION

The few previous studies conducted in Malaysia have shown that DA-HAIs have a serious impact on patient safety. In a study conducted from 2003 to 2006, Katherason, S. et al found a VAP rate of 27.0 % (n = 58) (1). In 2008, Katherason et. al. found a rate of 8.9 bloodstream infection per 1,000 bed days, 4.7 nosocomial pneumonia per 1,000 bed days and 20.5 urinary tract infections per 1,000 bed days (18). Hughes et. al. found an overall DA-HAI rate of 13.9% per 100 patients, and the most common infection was pneumonia (19).

This study is the first conducted in Malaysia with a large number of patients (2,292) and using the CDC/NHSN methodology to calculate DA-HAI rates per 1000 device-days. In the ICUs of this study, DA-HAI rates were higher than the rates found in the U.S. CDC/NHSN's data (7), and in the

international INICC Report (2007-2012) for 43 countries (8), except for CAUTI, which was similar. CL, MV and UC DURs were higher in this study than in CDC/NHSN and INICC's in the medical/surgical, pediatric and surgical ICUs, whereas they were lower than INICC's DURs in the medical ICU (7, 8). The antimicrobial resistance rates found in this study were lower than U.S. CDC/NHSN (6) and INICC reports'(8) rates, although this could be due to the small sample size of isolated microorganism in this study.

The reasons for relatively higher DA-HAI rates in Malaysia are multifactorial (20). Common to the developing world, adherence to infection control bundles in Malaysia is suboptimal, nurse-to-patient staffing ratios are low, hospitals are overcrowded, and there is a shortage of experienced nurses or trained healthcare workers (21, 22).

In order to reduce the hospitalized patients' risk of infection, having an effective DA-HAI surveillance is an essential first step. It must be followed by the implementation of practices aimed at DA-HAI prevention and control and increasing the awareness of DA-HAI risks in the ICU, as well as providing an exemplary basis for the institution of infection control practices through the use of an online process surveillance tool.

For other Malaysian hospitals to compare their own DA-HAI rates with the rates identified in this report, it is recommended they collect the data by applying the methods and methodology described for U.S. CDC/NHSN and INICC, and then calculate infection rates and DU ratios for the DA-HAI Module.

### Study limitations:

The findings in this report did not consider the difference in time periods for the different data sources in the comparisons made with INICC and U.S. CDC/NHSN.

**TABLE 4: Benchmarking of antimicrobial resistance rates in this report against the report of the International Nosocomial Infection Control Consortium (2009-2012) and the report of the US National Healthcare Safety Network data (2009-2010).**

	This Report Resistance % (n/n)	INICC 2007-2012 Resistance %(8)	CDC/NHSN 2009-2010 Resistance, %(23)
<b>Pathogen, antimicrobial</b>	<b>Pooled</b>	<b>VAP</b>	<b>VAP</b>
<i>Pseudomonas aeruginosa</i>			
Ciprofloxacin	0% (0/19)	41.9%	32.7%
Piperacillin or piperacillin-tazobactam	10.7% (3/28)	35.8%	19.1%
Imipenem or meropenem	23.1% (3/13)	42.8%	30.2%
<i>Klebsiella pneumoniae</i>			
Ceftriaxone or ceftazidime	25.0% (2/8)	62.6%	23.8%
Imipenem or meropenem	0% (0/13)	17.2%	11.2%
<i>Acinetobacter baumannii</i>			
Imipenem or meropenem	30.8% (4/13)	77.1%	61.2%
<i>Escherichia Coli</i>			
Imipenem or meropenem	0% (0/5)	7.5%	3.5%
<b>VAP, ventilator-associated pneumonia</b>			

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## CONCISE REPORT

# Implementation of a carbapenemase producing *enterobacteriaceae* control program at a tertiary care hospital

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## ABSTRACT

**Background/Purpose:** Carbapenemase-producing Enterobacteriaceae (CPE) are multi-drug resistant organisms associated with significant mortality. A CPE management policy was developed based on the local epidemiology of CPE and provincial recommendations that addressed issues related to screening and precautions for patients potentially infected or colonized with CPE.

**Methods:** Implementation involved direct communication to all physicians and staff through email communications and in-service training, on-the-spot training, as well as the development of educational materials, an electronic admission checklist and a flagging system. Implementation was evaluated by monitoring the number of screening specimens performed, reviewing completion rates for the admission checklist, conducting quarterly prevalence studies to identify missed CPE screens in recently admitted patients with risk factors and through tracking our incidence of CPE.

**Results:** Over the 12 months following implementation, 10 CPE cases were identified. Of these, seven cases were identified as having a risk factor and four of these seven (57%) were screened appropriately on admission. The other three were identified by a clinical specimen, late identification of the CPE risk factor and by screening on admission to another facility after discharge. Quarterly admission screening specimens increased from eight to 44 over six months. Prevalence audits identified risk factors in 4/95 (4.2%) patients at the time of admission, with one being appropriately screened. Hospital-wide compliance with the admission screening checklist was 51% and did not change over time.

**Conclusion:** Implementing surveillance for a new ARO proved challenging. Targeted and repeated education and the use of an electronic admission checklist helped raise staff awareness and increase the number of appropriate specimens collected. However, despite one year of efforts, admission screening was only documented for half of patients, and 3 patients with CPE were admitted without appropriate screening. The metrics we used assisted in recognizing gaps in our implementation. Ongoing feedback of these results and repeated education would likely improve performance going forward.

## KEY WORDS

CRE, CPE, policy implementation, carbapenem resistant enterobacteriaceae, carbapenemase producing enterobacteriaceae

## INTRODUCTION

Carbapenemase-producing Enterobacteriaceae (CPE) (also known as carbapenem-resistant Enterobacteriaceae) are multi-drug resistant organisms universally resistant to carbapenems and all other beta-lactam antibiotics. They are also typically resistant to many or most other classes of commonly used antimicrobials as well. Treatment options for CPE are limited to toxic and/or less effective antibiotics and pan-drug resistant isolates have been described (1). While a variety of different CPE beta-lactamases exist, concern in Canada has focused on the emergence of New Delhi metallo-beta-lactamase 1 (NDM-1) and *Klebsiella pneumoniae* Carbapenemase (KPC), the most commonly identified CPE in Canada (1).

NDM-1 is of particular concern as it has disseminated globally after emerging in South Asia, appears capable of transmission within community settings, and is associated with

a mortality of >50% if clinically significant disease develops (1,2,3). KPC is also of concern given its widespread prevalence in USA hospitals and a mortality rate associated with established infection similar to what is reported for NDM-1.

Although CPE remain uncommon in Canada, cases and outbreaks have been identified in several hospitals and regions, and their incidence is increasing (1,4,5,6). Ontario has reported an upward trend with a total of 156 cases of CPE identified between April 2008 and June 2015 (7).

USA and Canadian guidelines for CPE control vary somewhat in their recommendations. Centers for Disease Control and Prevention (CDC, USA) guidelines recommend hand hygiene promotion, contact precautions, patient and staff cohorting, minimization of invasive device use, antimicrobial stewardship, lab notification, healthcare personnel education, screening patients with epidemiologic links to a confirmed case, and

periodic point prevalence surveys (8). CDC also recommends supplemental measures for facilities with CPE transmission, including active admission screening of high-risk patients and those admitted from facilities known to have CPE, and chlorhexidine bathing. Ontario's Provincial Infectious Disease Advisory Committee (PIDAC) guidelines are similar to CDC's but also recommend flagging the charts of positive patients, dedicating equipment and supplies, and placing contacts of cases on pre-emptive contact precautions pending screening results.

At our facility, our first recognized cases of CPE colonization and/or infection occurred in early 2010 and highlighted the facility's lack of preparedness to identify and contain this pathogen. To mitigate this, we developed a comprehensive CPE control program and synchronized our practices with the PIDAC guidelines.

## METHODS

The CPE policy was developed and implemented in a 450-bed academic, urban, acute care hospital in Toronto, Canada. The Knowledge to Action Cycle (KTA) for knowledge translation was used as a reference for guiding the project of policy development and implementation (9). The phases of the project included policy development, implementation, monitoring, evaluation, and sustainability.

### *Policy development*

We reviewed the literature on epidemiology and control of CPE. Our policy was structured similarly to other hospital policies for the control of antibiotic-resistant organisms to ensure consistency and ease of use. The policy addressed such topics as screening and risk factors, infection control measures, education and documentation. Risk factors included: travel within the last year to South Asia, direct transfer from or previous admission to a healthcare facility outside of Canada within the past 12 months, contact with a known case of CPE, transfer from any hospital or facility with a CPE outbreak or known CPE transmission, or previous colonization or infection with CPE. Lab-confirmed CPE patients, patients with the risk factors, and those exposed to CPE were to be placed in a single room on contact precautions.

### *Training and education*

After policy approval, the next steps were adapting knowledge, assessing barriers and implementing interventions. The target audience was identified as healthcare workers that would be involved in screening or initiating precautions for CPE. This included nurses, nurse practitioners, medical residents and staff physicians. Based on the needs and responsibilities of different professional groups, two separate communication and education plans were developed – (i) one for Registered Nurses, clinical assistants, and some allied health professionals; and (ii) another for physicians, medical residents and Nurse Practitioners. In order to provide education to address different adult learning styles and unit preferences, an education plan with several different strategies was developed. This plan included in-service training, on-the-spot training and education materials.

Face-to-face in-service training with a PowerPoint presentation was conducted by infection preventionists (IPs) to educate staff about CPE and IPAC strategies for CPE management. On-the-spot training sessions were carried on the units with lower in-service turnout, with the intent to promote more targeted and interactive education format. The educational materials included a PowerPoint presentation, a fact sheet for healthcare personnel on CPE, and posters with CPE screening criteria. Physicians, nurse practitioners and medical residents received an e-mail memo from the Medical Director of Infection Control.

### *Alerts and checklists*

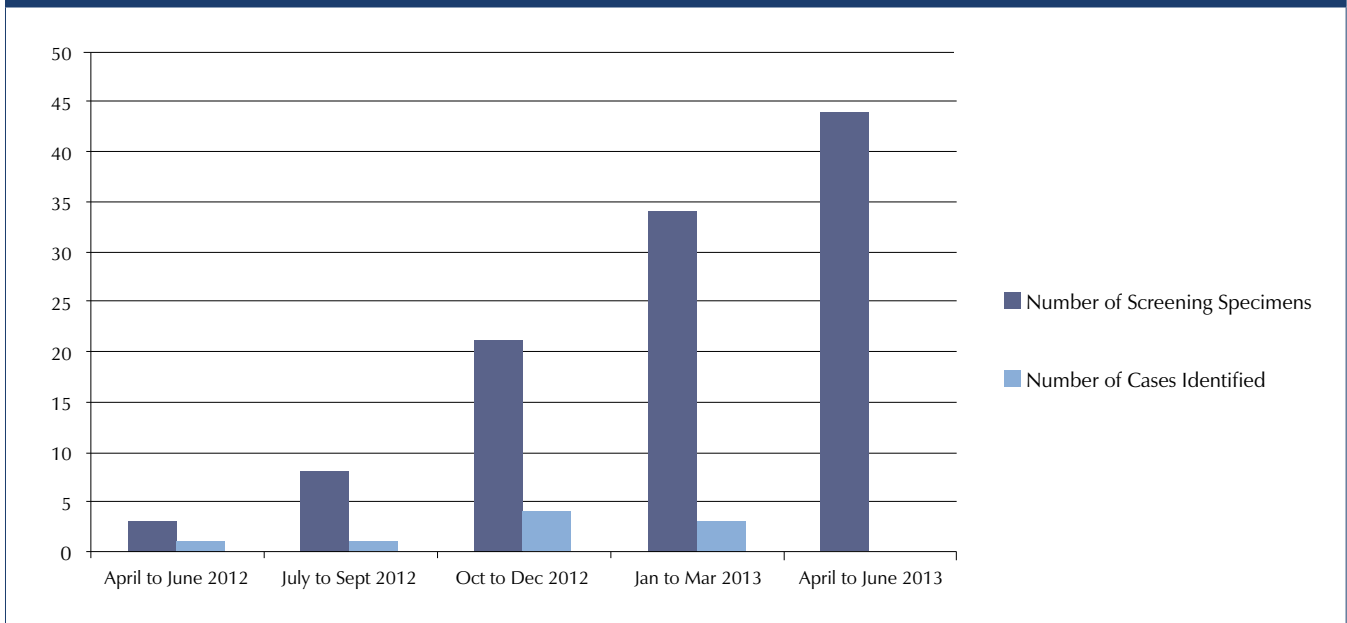
In order to alert staff to re-admissions with a CPE history, we developed an electronic flagging process in our admission, discharge and transfer (ADT) system. This alert was adapted from a system used for MRSA/VRE flagging. Registration staff were able to identify these flags and notify the triage nurse who would then take appropriate action. Training of staff responsible for registration and triage was provided by the patient registration educator and emergency department educator. A CPE admission screening checklist was added to the electronic patient admission assessment. A checked screening criterion would result in a pop-up box identifying the necessary actions.

### *Monitoring, evaluation and sustainability*

Our evaluation goal was to determine the efficacy of the CPE policy implementation by monitoring staff compliance with the CPE screening. A plan for monitoring and evaluating success was developed simultaneously with the implementation. Our techniques included:

- i. CPE surveillance that allowed us to identify cases where screening and specimen collection was missed. The most important surveillance technique was lab reports about possible or confirmed cases. This ensured immediate initiation of control measures and timely investigation of contacts to reduce transmission.
- ii. Monitoring of patterns of CPE screening based on the number of patients with screening specimens processed by the microbiology lab. This information was used to determine whether CPE screening improved over time and to provide feedback and reinforcement of screening practices to the hospital units with low screening compliance rates.
- iii. CPE risk factor prevalence audits were conducted by the IPs on each unit. They were quarterly for the first three quarters, and then bi-annual. The audits involved surveying all patients admitted on a given day to determine the proportion of patients with risk factors that were screened properly. If such patients were not screened, the appropriate healthcare personnel were notified.
- iv. Monitoring compliance with electronic admission screening checklist was performed through Decision Support service analyzing the rates of completion for admitted patients by unit. This allowed us to target education to units with low compliance.
- v. Observational audits were performed to determine whether appropriate control measures were being followed for CPE patients.



**FIGURE 1: Comparing the number of patients with CPE admission screening and the number of cases identified**

### Sustainability

Sustainability strategies were implemented over eight months following the policy implementation. Orders for CPE screening specimens were added to the electronic physician ordering system. A medical directive was developed to allow nurses to collect CPE screening specimens on patients who meet screening criteria without a physician order. Posters with CPE screening criteria were displayed. The policy was posted on computer desktops on some units. Pertinent information was added to our new-employee hospital-wide orientation. We also developed a brochure on Multi-Drug Resistant Organisms for distribution to patients and families.

### RESULTS

From June 2012 to July 2013 we identified ten cases of CPE at our facility. Of these, five met our criteria for admission screening for being hospitalized outside of Canada, but only three cases were appropriately screened (60%). The other two were identified following admission to another facility ( $n=1$ ) and a clinical specimen ( $n=1$ ). One of the 10 cases identified did not meet our screening criteria, but was screened on admission by unit staff because the patient was a resident of the Philippines.

Presumed nosocomial transmission was documented for four of the 10 cases (40%) in whom no risk factors for CPE were identified prior to hospital admission and their initial positive specimen was obtained >72 hours following hospital admission. One of these nosocomial cases was a roommate contact and another was a unit contact of a CPE case. The other two were identified through clinical specimens.

Ten CPE cases occurred on six different units and included KPC (7 cases), NDM-1 (2 cases) and OXA-48 with KPC (1 case). Recognized risk factors for CPE acquisition included hospitalization in USA (2 cases), India (1 case), Pakistan

(1 case), and Italy (1 case). One individual was a resident of the Philippines.

To assess the policy uptake, particularly the screening component, the number of screening specimens received by the laboratory between April 2012 (one quarter prior to the policy roll-out initiation) and June 2013 (one year after policy roll-out initiation) was monitored. Over this time period, 110 patients had specimens collected on admission. The number of specimens increased for five consecutive quarters, from three during the first quarter of policy implementation to 44 one year later, indicating gradual uptake of the policy (Figure 1).

As total screening specimens do not directly assess the appropriateness of screening, we also conducted prevalence audits for CPE risk factors among new admissions. Audits were completed in September 2012, February 2013 and May 2013 (Table 1). On each survey, only one to two individuals with risk factors were identified, ranging from 2% to 7% of admitted patients on the day of the survey. Of the patients with risk factors identified via the prevalence survey, only 25% (1 of 4) was appropriately screened. This provided an opportunity for feedback to the units. Such audits continue to be conducted on a bi-annual basis.

Compliance with completion of our electronic admission screening questionnaire was also assessed. Monthly compliance rates from the time of implementation in March 2013 to August 2013 ranged from 48% to 52%, with wide unit-by-unit variation from a low of 26% to a high of 79%.

### DISCUSSION

By monitoring the screening specimens collected on the unit each quarter, we were able to show a steady increase in the number of screening specimens. Although the number of specimens is low, the quarterly prevalence audits identified very few patients admitted per day that meet screening criteria. The CPE risk factor

**TABLE 1: CPE risk factor prevalence audit results**

	Screening Audit 1	Screening Audit 2	Screening Audit 3
Admissions that met CPE screening criteria	1	2	1
Admissions	37	29	29
Risk factor identified	Travel to India in past 12 months	Travel to South Asia in past 12 months	Hospitalization in Costa Rica 6 months ago
Specimen(s) sent?	No	No	Yes
Specimen(s) result?	Negative	Negative	Negative

prevalence audits that have been conducted have identified that specimens were collected for only 25% of patients meeting screening criteria. This reflects a low uptake of the CPE screening protocol. However, very few (n=4) patients met screening criteria during these audits. The compliance with the electronic admission screening checklist increased only slightly over a six-month period and varied greatly by unit.

#### Limitations

Our CPE surveillance has indicated a slow increase in CPE cases. We are not certain that our rates of CPE colonization/infection are accurate because it is not clear how many patients at our facility meet CPE screening criteria, due to low compliance with the electronic admission screening checklist and low screening compliance (25%). However, provincial numbers of CPE cases remained steady from July to Sept 2012 (quarter one of policy implementation) (n=22) to April to June 2013 (one year later) (n=20) of policy implementation, with an average of 21.6 cases per quarter (10).

It is unclear whether the increased screening specimen numbers were due to an improvement in screening practices rather than an increase in the admission of patients meeting CPE risk factors. However, based on our three CPE risk factor prevalence audits, few patients admitted to our facility met screening criteria. Therefore, it is likely that the improvement in screening practices led to the increased number of screening specimens.

#### Lessons learned and future implications

One of our sustainability practices involved adding a CPE alert for positive patients and contacts of positive patients to our electronic admission, discharge and transfer (ADT) system. This process involves a manual check by registration staff for the alert and notification to the emergency department triage staff. If this is missed, it can also be identified after admission on the paper printout of the unit census. Currently, several re-admissions of positive patients and contacts of positive patients were not identified on admission through this process and were later identified by the infection preventionist. We are currently working towards a better system, in which a CPE is visible to all staff whenever electronic results are accessed.

Authors recognize a need to increase awareness of CPE at our facility; to increase compliance with screening practices and to develop automated tools to ensure that admitted and readmitted patients with CPE are rapidly identified. As the epidemiology of CPE in Ontario evolves, we expect that our approach to screening may also need to change and therefore a flexible strategy is essential to allow required changes to be rapidly implemented.

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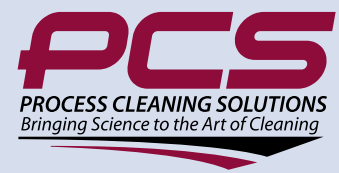
Procedures



Validation

To learn more about Accele® disinfectant cleaners, call customer service at 1-800-668-7171.

CONGRATULATIONS to Sealed Air Diversey Scholarship winners and to IPAC on 40 years of service.



June 13<sup>th</sup> CDC Alert to U.S. Healthcare Facilities:

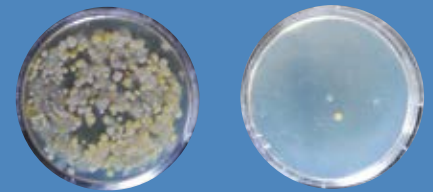
First mcr-1 Gene in E. coli bacteria found in a Human in the United States. (bacteria resistant to antibiotic drug of last resort)

One of the CDC recommendations

“Environmental Cleaning: Healthcare facilities should ensure rooms where patients with antibiotic-resistant infections have been placed receive thorough daily and terminal cleaning.”

PCS now assist facilities in validating our processes clean to a scientific standard with onsite microbial testing. Microbial sampling of surfaces after cleaning is the gold standard in measuring surface cleanliness. Microbial testing is not recommended as a routine audit but is a great way to validate the efficacy of a process and to train staff.

## Cleaning to a Scientifically Validated Standard.



**Safer Bleach Process leaves less chemical residue.**

PCS Stabilized 2% Bleach Concentrated Disinfectant/Disinfectant cleaner (DIN 02356082), dilutes to 1000 ppm of hypochlorite.

- #5948-2 • 2 x 3.78 litre closed loop
- #6035 • PCS Closed loop dispensing pump.  
No more need for wall mounted chemical dispensers.

Bettix workplace bottle with graduated convenient measuring for controlled moisture cleaning.

- #5948DK • PCS Oxidizing Disinfectant/Disinfectant Cleaner (DIN 02356082)  
Empty Bettix Bottle 6 x 946ml

**PCS Microfibre Cloths**

Use our controlled moisture process with PCS microfibre cloths. Disinfecting wipes do not provide the thorough cleaning recommended by the CDC.

- Microfibre cloths packaged in bundles of 25
- #PCSMF-BLUE #PCSMF-RED #PCSMF-GREEN #PCSMF-YELLOW

- New four sided microfibre cloths.
- 7" x 14" (17.78 cm x 35.56 cm) packaged in bundles of 50
- #PCS4FMF-GREEN #PCS4FMF-YELLOW #PCS4FMF-BLUE



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Practical  
Affordable  
Safe & Simple

Findings show that up to **43%** of mattresses in Canadian hospitals are damaged!\*\*

damage gone  
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It's only a thin sheet of cotton that lies between your patient and exposure to a potential reservoir of harmful pathogens, inside the foam core of a compromised mattress or treatment pad. CleanPatch® is an effective repair alternative to costly mattress replacement.

Mattress Integrity Assessment and repair service, delivers convenience, peace of mind, and an attractive return on investment.



\*Investing in a Mattress Integrity Assessment not only increases patient safety but it pays for itself through cost savings.

\*\*Mattress damage rate findings from 2014-2015 manufacturer sponsored Canadian field trials.



Suzanne Rhodenizer Rose, RN, BScN, MHS, CIC

President, IPAC Canada

## A unique opportunity

It has been my experience, generally, that infection prevention and control professionals are extraordinarily invested in the role they fulfil. Whether it's in the community, in a continuing care facility, in the prehospital care setting, or in an acute care organization, they are all dedicated, hardy (as in the proverbial broad shoulders) advocates for doing what is best practice and what protects patients, staff, families, and communities from infectious diseases. We lose sleep over many things we observe in our myriad settings while others would be none-the-wiser to what potential harms can and do manifest from their actions.

Our healthcare workforce is aging, as is our population, and we hear time and time again how healthcare is an increasingly complex beast. Our organizations are struggling to keep expenditures within operational budgets without impacting patient care, and expectations are high for healthcare's leadership to address a growing list of performance metrics that highlight important areas for improvement. Infection prevention and control professionals can and do play a vital part in achieving these seemingly lofty goals. Concurrently, albeit anecdotally from my peers, many in this field are coming up to retirement, myself included. The changes that need to happen in healthcare will not occur overnight (we have been, since Nightingale's time in the Crimea, simply trying to make hand washing mainstream) and the "seasoned" professionals have ample opportunity to both become active and engaged in



local, provincial/territorial, national and international issues as well as "bring along" younger healthcare professionals to continue and advance the charge. Yes, I am talking succession planning; but I'm also talking about instilling that same passion and verve in younger professionals for what can be achieved when you look beyond the boundaries or your workplace. We will likely still have hand hygiene campaigns; likely see more novel and re-emerging pathogens; and we will likely be battling antimicrobial resistance for generations to come. Climate change will indeed exert its profound impact on microorganisms and vector-borne transmission, and we may see our

challenges take on a pre-Pasteur-like quality if resistance overwhelms our chemotherapeutic defenses.

Given these challenges and the current climate, infection prevention and control professionals have a unique opportunity to step up to the broader stage, look beyond the box (our day-to-day infection prevention and control activities), and take action. At the risk of sounding cliché, serve as mentors, in the truest sense, for those up-and-comers so that when it comes time to hand over the reins, we have a new force of professionals that will drive the research agenda, advocate for science, and be at the forefront of innovation and practice improvement on a global stage! 🍀



## **Eliminate Cross-Contamination With Vernacare's Human Waste Disposal Systems**

The Vernacare system was designed for the safe, discreet and environmentally responsible elimination of human waste.





Suzanne Rhodenizer Rose, IA, B.Sc.Inf., MHS, PCI

Présidente, PCI Canada

## Une occasion unique

**M**on expérience m'a permis de constater que les professionnels de la prévention et du contrôle des infections prennent leur rôle très au sérieux. Qu'ils travaillent dans la communauté, dans un établissement de soins continus ou dans un contexte de soins préhospitaliers, ce sont tous des défenseurs dévoués et costauds (ils ont les « reins solides ») des pratiques exemplaires et de tout ce qui peut préserver au mieux les patients, le personnel, les familles et les communautés des maladies infectieuses. Dans nos milieux respectifs si divers, nous observons des choses qui nous font perdre le sommeil alors que d'autres sont inconscients des dangers que leurs gestes provoquent ou peuvent provoquer.

Le personnel vieillit, tout comme l'ensemble de la population. Au dire de beaucoup, les services de santé sont devenus une bête au comportement complexe. Nos organisations luttent pour que les dépenses respectent les budgets opérationnels sans porter atteinte aux soins. Les responsables doivent appliquer des normes de rendement toujours plus nombreuses pour mettre en lumière ce qu'il faut améliorer en priorité. Les professionnels de la prévention et du contrôle des infections ont un rôle essentiel à jouer – et ne s'y dérobent d'ailleurs pas – pour atteindre ces objectifs soi-disant nobles. D'après ce que j'entends autour de moi, la retraite approche pour beaucoup (pour moi aussi, d'ailleurs). Comme tous les changements nécessaires ne se produisent pas du jour au lendemain (n'essaie-t-on pas depuis l'époque de Florence Nightingale en Crimée de faire comprendre que le lavage des mains va



de soi?), c'est, pour les professionnels aguerris, l'occasion de se mobiliser, de s'attaquer de manière dynamique à une problématique locale, provinciale, territoriale, nationale ou internationale et d'entraîner les plus jeunes à leur suite pour assurer continuité et progression. Je parle bien sûr de planifier la relève, mais aussi d'insuffler aux jeunes beaucoup de fougue et de passion à l'égard de tout ce qu'il y a à faire, au delà des limites de notre milieu de travail. Nous ferons vraisemblablement encore des campagnes de sensibilisation à l'hygiène des mains, nous verrons probablement émerger et réémerger divers pathogènes et nous ne sommes sans doute pas près de vaincre la résistance aux antimicrobiens. Les changements climatiques auront une incidence profonde sur les microorganismes et la

transmission vectorielle des maladies, et il se peut que la situation ressemble à nouveau à ce qu'elle était avant Pasteur si la résistance l'emporte sur nos défenses chimiothérapeutiques.

Étant donné ce tableau et le climat actuel, nous, professionnels de la prévention et du contrôle avons une occasion unique de monter sur une scène plus vaste, de voir plus loin que nos activités quotidiennes de prévention et de contrôle et d'agir. Au risque de me répéter, devenez de véritables mentors auprès de jeunes entrepreneurs, pour que nous disposions, quand viendra le temps de passer les rennes, d'un nouveau contingent de professionnels prêts à faire progresser la recherche, à défendre les besoins de la science, à innover et à améliorer les pratiques à l'échelle mondiale! 🌸

# WORKING HARD TO ACHIEVE HAND HYGIENE COMPLIANCE?



## WE'LL HELP YOU WORK SMARTER.

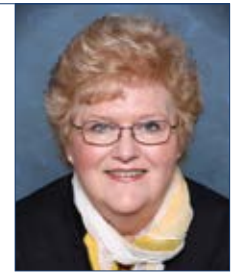
With hand hygiene compliance rates at lower than 50% nationwide, maybe it's time to work smarter. GOJO® SMARTLINK™ Hand Hygiene solutions combines 24/7 monitoring with the industry's most trusted sanitizers, soaps and dispensers, plus clinician-based on-site support. The new electronic Observation System collects and reports hand hygiene and PPE. It's an innovative hand hygiene compliance monitoring system that represents the most comprehensive way to achieve optimum compliance levels.

Call **800-321-9647** today to learn more about SMARTLINK™ solutions. It could be one of the smartest calls you ever make.

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Gerry Hansen, BA

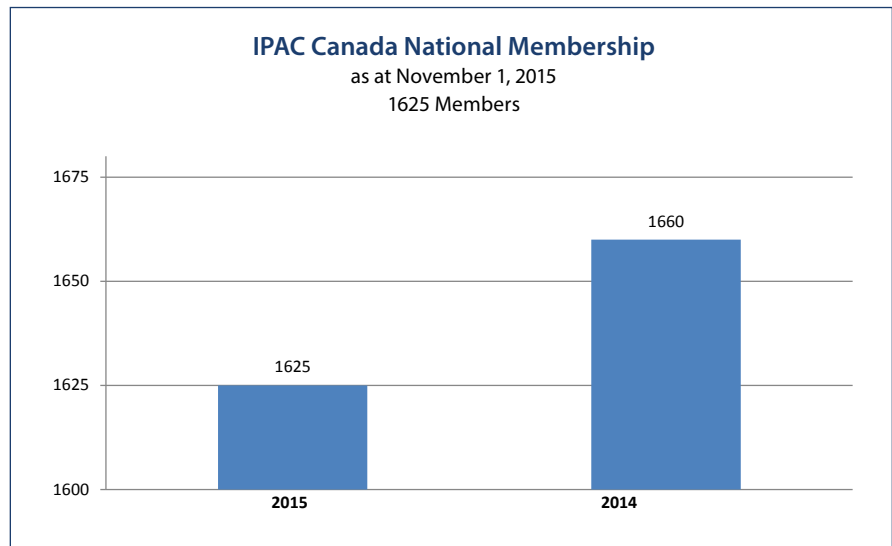
Executive Director, IPAC Canada

# Membership update

Membership figures and demographics are calculated as of November 1. Below are the charts for November 1, 2015.

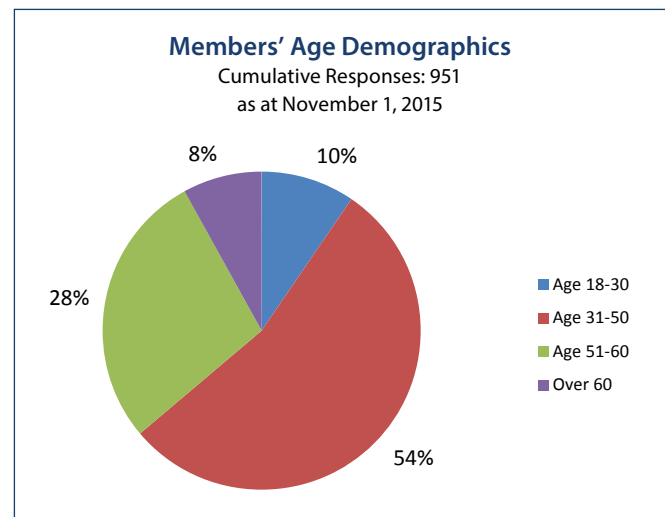
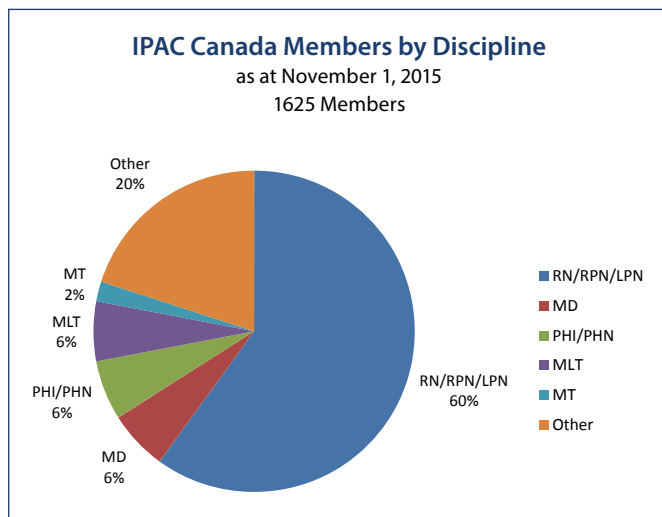
National membership shows an overall decrease of 35 memberships in the 2014-2015 period. This is actually due to reduction of memberships held by two major institutions, not to large-scale individual losses. Institutional membership was developed in the late 1990s to encourage large institutions to offer IPAC Canada membership to all of its ICPs. This is still a successful scenario; however, we are watching for any additional trends in reduction of institutional memberships due to budget cuts.

At the same time, we are very cognizant that these same budget restrictions are affecting individual memberships. It is our larger plan to increase IPAC Canada's profile nationally and internationally so that membership in IPAC Canada will become a sought-after opportunity and membership will increase. Our profile is enhanced by our being an advocate for a significant number of ICPs.



How important are the numbers? We certainly need to maintain or increase our numbers for our national profile and to generate funding to continue to provide excellence in advocacy and member benefits. However, is the true value of association

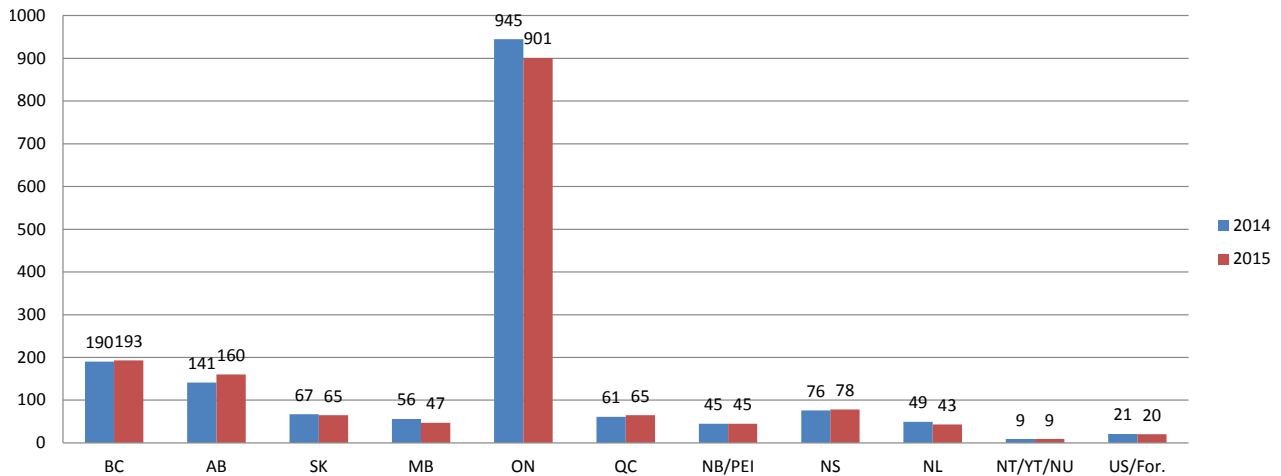
membership not in those same benefits, rather than the actual number of members? Is it not more important to provide proactive advocacy and high quality best practice resources and tools? It is our philosophy to provide the best in education, communication,



### IPAC Canada Membership by Province

as at November 1, 2015

1625 Members



networking, representation and resources to our members, no matter how many.

Provincially we see that the chapters in our provinces are overall maintaining membership. There was a slight decrease in Manitoba and a decrease of 35 in Ontario. Our chapters are doing a good job of providing local support for members. There have been some challenges which were addressed by the 2014 Chapter Task Force, which subsequently provided recommendations for both chapters

and IPAC Canada to increase positive member experiences at all levels. Ongoing discussion and support will be provided by the newly formed Chapter Council which will begin its work in the fall.

Institutional settings have remained consistent since 2014. In 2015, acute care representation was up by 2% and Other (PreHospital, administration, housekeeping, alternative care settings) has increased by 4%. Interestingly, the mix by discipline has not changed since 2014.

Yep, we are all getting older!

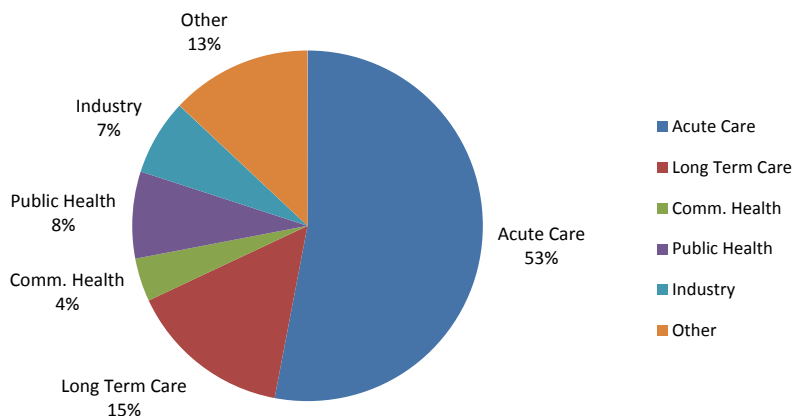
The majority of our members are mid-career (31-50). The 18-30 age group has increased by 1%; the 51-60 age group has decreased by 3%, moving that percentage into the over 60 group.

Let's talk for a moment about membership. It is my philosophy that the first generation group (18-30) know very well the importance of belonging to a national association and utilizing the resources and mentorship. They are, however, working on developing their careers and growing their families. Most often, they are not in our base of volunteers, either at the chapter or national level, but they do acknowledge the important role that IPAC Canada plays in their world. And we know their importance as well. They are looking at IPAC issues with fresh eyes and coming up with innovative and creative solutions. They are certainly teaching us more about technology! By the time they are mid-career (31-50) they have more time to offer as they volunteer on chapter executives and national committees. As their careers advance, our members then feel that it is time to give back to their profession and their association. This is when we see leaders come forward and take national and international roles. IPAC Canada is a family and this is what a family does – it nurtures the future. ✨

### IPAC Canada Members by Institution Type

as at November 1, 2015

1625 Members



# Announcement of Sage International Attendee Scholarship

PAC Canada and Sage Products LLC are pleased to announce the launch of the **Sage International Attendee Scholarship**. The purpose of the Scholarship is to provide financial assistance to eligible infection prevention and control professionals from under-resourced nations to attend an IPAC Canada National Education Conference.

The amount of \$5,000 will be set aside for the Scholarship by IPAC Canada and Sage Products LLC. The maximum amount granted to each recipient per award year would be the equivalent of five thousand dollars (\$5000.00 CAD). Applicants will not necessarily receive the full amount.

The award will include registration for the entire conference, including both pre- and post-conference education sessions, economy air travel, and a maximum of five (5) nights' accommodation, and meals.

#### DEADLINE FOR APPLICATIONS:

**November 30, 2016**

Criteria and application guidelines available at [http://www.ipac-canada.org/opps\\_sage\\_international\\_scholarship.php](http://www.ipac-canada.org/opps_sage_international_scholarship.php)

We thank Sage Products LLC for their support of IPAC Canada through this and other significant sponsorships – the Five Best First Time Abstracts and the Moira Walker Memorial Award for International Service. 🍁



## HEALTH CARE FACILITY DESIGN & MAINTENANCE CRITICAL TO INFECTION CONTROL AND BETTER CARE

Surroundings are an important part of reducing the risk of infection control in health care. Crowded rooms and poor design can spread infection, impede workflow, and lead to unnecessary spread of illness. This was part of the reason why **CSA Z8000 Canadian Health Care Facilities** was published, followed by **Z8001 Commissioning of Health Care Facilities** and **Z8002 Operation and Maintenance of Health Care Facilities**.

Applicable to virtually every health care setting - in any location from coast to coast - these standards work together to ensure that health care facilities are design and maintained to support healthy environments & optimal patient care.

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# Moira Walker Memorial Award for International Service

This award honours an individual or group that has demonstrated extraordinary efforts to bring about change or improvement related to infection prevention and control in parts of the world that are under developed or under resourced. The annual award is in honour of Moira Walker, RN, CIC, a Past President of IPAC Canada (formerly CHICA Canada) and Past Honourary Secretary of the International Federation of Infection Control. Moira's life was dedicated to enhancing the physical and spiritual health of her many friends and colleagues.

## NOMINATION GUIDELINES

### Preferred: Current IPAC Canada members in good standing

The award may be presented to individuals, prior nominees, or a group of individuals, but not past award recipients, who have demonstrated international cooperation in the field of infection prevention and control or public health. Fundraising efforts alone will not be sufficient criteria for this award. Lifetime achievement in international service would be considered.

## Who May Nominate

Any member of IPAC Canada or a chapter of IPAC Canada may submit a nomination. The IPAC Canada Board of Directors (the Board) may also nominate candidates. The nomination form is available at [www.ipac-canada.org](http://www.ipac-canada.org) (Opportunities).

## How to Nominate

A completed nomination form and covering letter outlining the nominee's projects that have resulted in this nomination must be forwarded to the Membership Services Office no later than March 31st of each year.

## Selection Process

The Board will select the recipient(s) through an evaluation process.

## Award

Artwork with a First Nations and Inuit art theme. The accompanying engraved plate will announce the recipient's award. In addition, award winner(s) will be provided with travel (economy) to the 2016 conference, two nights' accommodation, and a complete waived registration for the national education

conference at which the award is presented. In the case of a group award, one representative of the group will be provided with the full award.



## Deadline

The deadline for nominations is March 31, 2017.

## Announcement and Presentation

The award winner(s) will be advised by April 15th of each year. The award will be presented at the Opening Ceremonies of the IPAC Canada National Education Conference.

## Award Sponsor

The Moira Walker Memorial Award for International Service is made possible through the generous support of Sage Products LLC. \*



# 2017 Champions of Infection Prevention and Control

In collaboration with 3M Canada, IPAC Canada established the Champions of Infection Prevention and Control Award in 2009.

The Award recognizes IPAC Canada members who have demonstrated innovative initiatives to prevent infection, raise awareness, and improve the health of Canadians.

The candidate may also be nominated for lifetime achievement. The nomination may be made by a member of IPAC Canada or by an IPAC Canada chapter. Formal presentation of the Award will be made at the Opening Ceremonies of the 2017 National Education Conference (Charlottetown, June 18, 2017).

Deadline for 2017 nominations is **March 1, 2017.** \*



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*Hygie is proud to be  
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40 years of experience

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Our vision is an **80% reduction** in Healthcare Acquired Infections by **2024**

- 200,000 people in Canada get an infection from a hospital each year
- 5% (10,000) will die
- Healthcare acquired infections cost us \$4-5 billion EACH year

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A not-for-profit professional and industry organization dedicated to reducing HAI in Canadian healthcare facilities through engineered solutions including: antimicrobial surface coatings, UV technology, downdraft ventilation and more.



**CHAIR**  
Coalition for Healthcare  
Acquired Infection Reduction

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# Wisdom Begins With Wonder

IPAC CANADA

## 2016 National Education Conference

We wish to thank our generous sponsors for their support of the 2016 IPAC Canada conference (at time of printing):

### PLATINUM



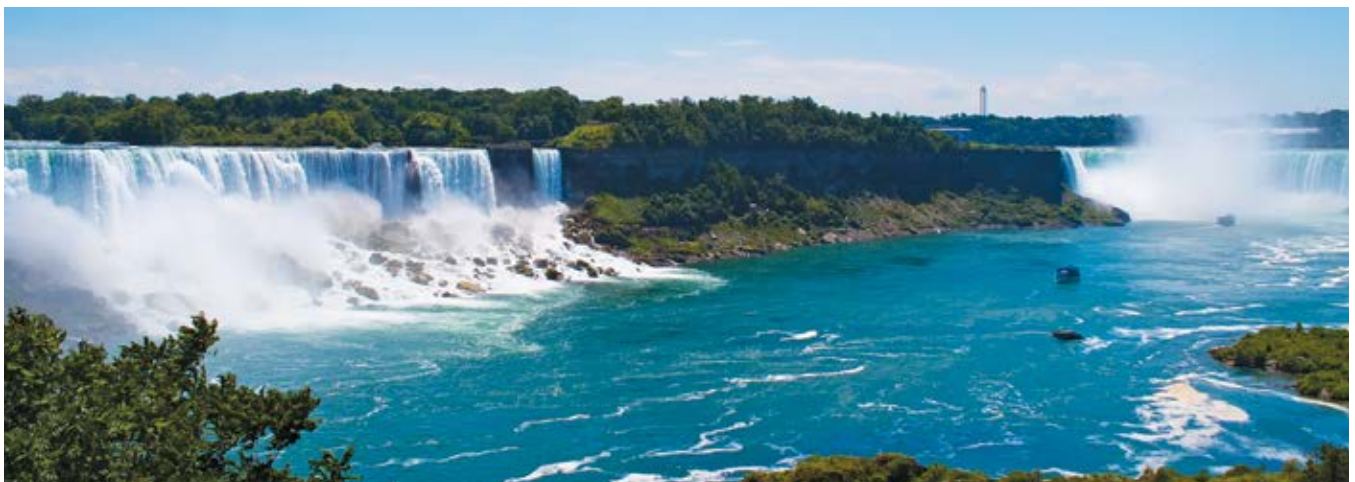
### SILVER



### BRONZE



### SPONSOR





# IPAC Canada and HandyMetrics Collaborate on Audit Tool App

IPAC Canada is pleased to announce that HandyMetrics will be sponsoring the creation of an electronic mobile platform to host current and future forms for the IPAC Audit Toolkit. The platform will be available free to eligible members and is expected to be available in the coming year. This means you will be able to conduct your favourite audits including Reprocessing, Routine Practice, Outbreak Management, Housekeeping and PPE in an electronic format. Over the course of the next year, HandyMetrics will be working closely with the members of the board as well as other members within the IPAC Canada



**HandyMetrics**  
CORPORATION

membership to get feedback and refine the platform. There will be announcements forthcoming on the progress and how to get involved.

We are grateful for HandyMetrics generous sponsorship and are excited about being able to finally provide our members with electronic access to the IPAC Canada Audit Toolkit. ✨

“Over the course of the next year, HandyMetrics will be working closely with the members of the board as well as other members within the IPAC Canada membership to get feedback and refine the platform.”

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"Where service is a commitment"

  
The clean solution

### TopLine

Expanding the boundaries of patient-focused solutions

Patient-focused solutions are an increasingly popular choice when it comes to planning infection control systems in hospitals. By integrating bedpan washer/disinfectors in ensuite bathrooms or directly in patients' rooms, these new solutions maximize hygiene by minimizing the distance bedpans are transported.

The MEIKO TopLine 30 is a perfect example. This wall-mounted cleaning and disinfection appliance offers state-of-the-art technology and an impressive array of design options to suit any environment. TopLine technology has earned our customers' trust and loyalty all over the world. From stand-alone appliances and combined care units to fully-fitted utility rooms, MEIKO TopLine offers top-quality clean solutions custom-made to your specifications. Consistently hygienic, economical and user-friendly, MEIKO TopLine is the clean solution from MEIKO.

Photograph:  
The Stevens / Meiko Project  
Oakville, Ontario



[www.stevens.ca](http://www.stevens.ca)

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# 2016 SealedAir Diversey Scholarship

**T**hrough the generous support of SealedAir Diversey, 16 IPAC Canada members have been supported to attend the 2016 annual conference. The recipients include members with novice, intermediate, and advanced expertise. IPAC Canada thanks SealedAir Diversey for the opportunity for

selected candidates to have the support needed to attend the conference. We commend all applicants for the quality of their work in infection prevention and control. Watch for an announcement of the 2017 scholarship guidelines.

**Deadline date for 2017 scholarship: January 31, 2017. \***



NOW LAUNCHED

## IPAC CANADA LEARNING OBJECT REPOSITORY



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TOGETHER WE ARE BRILLIANT."**

– S. Anderson, Educator

- ▶ A repository for digital learning objects
- ▶ For teaching and learning
- ▶ Created by IPAC Canada members



For information see the Learning Object Repository page at  
[http://www.ipac-canada.org/Members/members\\_LOR.php](http://www.ipac-canada.org/Members/members_LOR.php)

# New Board Members Elected

The following board members were elected to office as of May 18, 2016 for three-year terms.



**MANDY DEEVES, BScN RN, CIC** has been elected for her second term as a **Director (Programs & Projects)**. Mandy is Network Coordinator, Public Health Ontario – North Simcoe Muskoka Infection Control Network, Orillia, Ontario. She has been in Infection Prevention and Control

for nine years and has been an IPAC Canada member during that time. Her role at the Network is to provide a specialized range of evidence-based, educational and consultative services to Infection Prevention and Control staff, management and frontline healthcare providers in regional and provincial stakeholder organizations. Mandy was instrumental in the formation of IPAC Simcoe Muskoka chapter and has served as its president. Her responsibilities as a Director of IPAC Canada have included oversight of the Programs and Projects Committee and she has served as Chair of the Programs and Projects Core Committee.



**TARA DONOVAN, BHSc, MSc, Director (Standards & Guidelines)** completed an MSc in Community Health and Epidemiology in 2007 at Queen's University in Kingston Ontario. Motivated by her interest and a desire to continue learning, Tara completed a Certificate in

Infection Control at Queen's University. She began her career as the Communicable Disease Epidemiologist with the Kingston,

Frontenac, Lennox and Addington Public Health Unit and particularly focused on the monitoring and evaluation of a real-time syndromic surveillance system. In 2009, Tara moved across the country to work with the Immunization Program at the BC Centre for Disease Control as a Vaccine-Preventable Disease Epidemiologist. Following the contract term, Tara joined Fraser Health Authority in 2010 as the Regional Epidemiologist for Infection Prevention and Control. Tara has recently taken a Managing Consultant position with the Fraser Health IPAC program and will continue to collaborate with team members and stakeholders to enhance and maintain surveillance initiatives as well as pursue other important projects to drive quality improvement and patient safety. Tara co-chaired the Surveillance and Applied Epidemiology Interest Group in 2012 and 2013. She is actively involved with the IPAC BC Chapter having served as treasurer and then president for three years respectively.



**STEPHEN PALMER** has been elected to the new position of **Public Representative**. Stephen is an Investment and Insurance Advisor with HollisWealth. He is well known in his community and has served as volunteer Chair, Georgina Community Food Pantry (current), former Director/Treasurer of East Gwillimbury Chamber of Commerce, and is a Permanent Deacon with the Archdiocese of Toronto (current). Stephen is very knowledgeable on current events and issues at all levels. He has broad-based experiential knowledge, has solution-oriented thinking, and is committed to successful outcomes. 🍁

## Bring in a New Member!

**M**embership has its benefits – education, collaboration and representation. The IPAC Canada website ([www.ipac-canada.org](http://www.ipac-canada.org)) has so much information on the benefits of being a member. The annual member resource guide for finding other IPAC Canada members, links to infection control sites, audit tools, the audit tool app, upcoming mentor program, Learning Object Repository...the list is extensive. Tell another Infection Prevention and Control Professional (ICP), tell an infection control or ID physician, tell your Medical Laboratory Technologist, tell Environmental Services, tell EMS, tell your designate, and tell your director about the benefits of joining our national organization.

If that person joins IPAC Canada by March 1, 2017, both you and the new IPAC Canada member will be eligible to win a complimentary 2017 conference registration (Monday-Wednesday, value \$650). You are eligible for the draw with every new IPAC Canada member that you get to sign up from June 1, 2016 to April 30, 2017 inclusive. Should the winning members have already paid their 2017 conference registration, a refund will be made to the person or the institution which has paid the fee. The New Member Contest form is available from [www.ipac-canada.org](http://www.ipac-canada.org) or by contacting the IPAC Canada office. An announcement of the winners of this offer will be made by March 15, 2017. Membership applications can be found at [http://www.ipac-canada.org/about\\_join.php](http://www.ipac-canada.org/about_join.php). 🍁

# CIC® Graduates

New and certified CIC®s from a variety of healthcare settings have spent hours studying, digesting facts, and reading current literature. This information and life experience, along with a successful completion of the CIC® examination, ensure infection prevention and control professionals deserve to place a CIC® after their names. Congratulations to the following January-March 2016 graduates.

## First-time Certifiers

Bandar Alwan Albaradi, MD, CIC  
Jennifer Barris, RN, CIC  
Lindsay M. Belford, CIC  
Rhonda A. Beliveau, RN, BScN, CIC  
Rachelle A. Breen-Wilson, CIC  
Natalie Cooper, BScN, CIC  
Diane M. Deveau, RN, CIC

Josephine Chulu Kalunga, BSc., RN, CIC  
Jessica J. Keddy, RN, CIC  
Mohammed Eldossoky Hamed Noweir, MD, MPH  
JoAnna C. Olbach, RN, MSN, CIC  
Katherine Perkin, CIC  
Tiffany L. Rock, BScN, RN, CIC  
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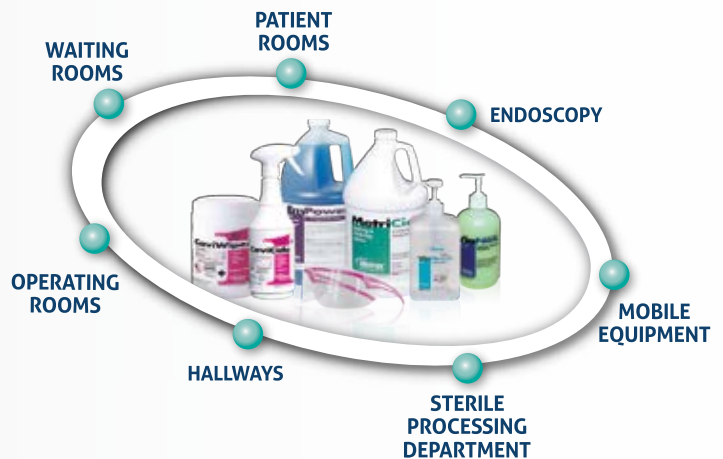
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