INSIDE

11  Hand hygiene knowledge, attitudes and self-reported behaviour in family medicine residents

18  Surgical site infection prevention: What are the gaps in Vietnamese hospitals?

24  Spatio-temporal analysis of *Acinetobacter baumannii* outbreak with multiple routes of transmission in ICU setting


35  Wound infection due to *Escherichia vulneris*: A rare human pathogen
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  - *Pseudomonas aeruginosa*
  - *Acinetobacter baumannii*
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INTRODUCTION

Hand hygiene (HH) plays a key role in reducing infection transmission rates in hospitals. Hospital-acquired infections (HAIs) are the most frequent adverse event in healthcare worldwide resulting in significant financial loss and patient mortality (1). In developed countries, 5-15% of hospitalized patients (9-37% in Intensive Care Units) contract an HAI (1). The chance of acquiring an HAI in Canadian hospitals is approximately one in ten for adults and one in twelve for children (2). Although HH is vital to reducing HAIs, campaigns to sustainably increase compliance have been unsuccessful (3). Self-reported and observed HH adherence among health care professionals (including students) is approximately 40-70% or lower, (4-16) while in Canada adherence can be as low as 25% (17).

Reasons for lack of HH adherence include: attitudes and low knowledge regarding infection control practices; poor access to sanitizer, sinks, soap and gloves; personal concerns such as skin irritation; lack of time due to clinical responsibilities and poor mentoring (4) (5) (6) (18) (19) (15) (16) (20) (8) (21) (10) (11) (14). HH adherence is also influenced by healthcare workers’ level of training; with higher levels of medical training associated with lower HH compliance (5) (10). Health knowledge refers to the information and understanding about a health-related issue. Knowledge is a necessary component of behaviour change, but is not sufficient on its own to bring about change in behaviour. An attitude is the psychological evaluation of health-related knowledge in terms of like or dislike (22), while behaviour is the result of the interrelationship between knowledge and attitudes. As such, the interrelationship between knowledge and attitudes inform behaviour. Self-reported behaviour is captured using methods of data collection that depend on participants to report their behaviours, thoughts, or feelings (23, 24). Studies examining HH-related knowledge, attitudes and behaviour (5) (9) (15) (16), suggest medical students are more compliant

Acknowledgements

We wish to acknowledge the support of Hotel Dieu Hospital Infection Control specialists Kelly Monaghan and Ian Kudryk and thank Queen’s University Faculty of Health Sciences, as well as the Department of Family Medicine for their assistance with this study. We are also grateful to Dr. G. DiDiodato for permission to modify and use his questionnaire. The authors declare no conflict of interest. No financial support was needed for this study.
with HH than physicians. Basurrah et al. (5) identified a 70% compliance rate for medical students and 9% for physicians. Kadi et al. (15) also found 29% of medical students could identify all 5 WHO moments of HH. Differences in HH compliance between physicians and medical students are well documented; however, few studies have examined self-reported behaviour of medical residents as they transition from learning to practice. This study investigated knowledge and self-reported behaviour related to HH within a clinical setting among first and second year Family Medicine residents at Queen’s University.

**METHODS**

**Study design**
A cross-sectional study design was used to examine self-reported behaviour related to HH practices among first and second year Family Medicine residents.

**Study protocol**
A questionnaire consisting of closed questions and one open-ended question was used to capture self-reported HH knowledge and behaviour. Prior to administering the questionnaire face validity was confirmed by three infection control specialists and Research Ethics approval was received.

**Data collection**
Cross-sectional survey data was collected from medical residents in a lecture hall. Residents were informed their participation was voluntary and they could withdraw at any time. Participants were given both written and verbal instructions to complete the questionnaire (Appendix 1).

**Outcome measures**
The outcome measures of interest were HH knowledge and self-reported behaviour.

**Data analysis**
Data were analyzed using IBM SPSS (2012) Statistics for Windows, Version 21.0 (Armonk, NY: IBM Corp.). Chi Square and t-tests as well as two-way ANOVA tests were used to test significance levels. Statistical significance was set at p=.05.

**RESULTS**
Of the 150 medical residents enrolled in the two-year Family Medicine Program 89 (59%) participated in this study; 52% were in first year and 48% were second year residents. Sixty-four percent of the medical residents who participated in this study were female and 36% were male. Ages ranged from 25 years to 47 years (M=29 years). Sixty-four percent were 29 years of age or younger. Eighty-eight percent had an undergraduate degree in Health Sciences; 81% attended medical school in Canada, while 19% attended medical school elsewhere (i.e., Australia, Caribbean, Egypt, Iran, Sudan, United States, United Kingdom and Hungary).

Family Medicine residents were found to have a mean HH knowledge, based on the WHO Guidelines on Hand Hygiene in Health Care (1), of 42.2%. The following moments of HH were frequently identified by the medical residents who participated in this study: before patient contact (79%), after patient contact (65%), before entering/touching patient environment and after leaving/touching patient environment (62%), before aseptic procedure (43%), after fluid exposure/aseptic procedure (38%), and when hands are visibly soiled (14%). The least frequent moments of HH identified by

<table>
<thead>
<tr>
<th>TABLE 1: Residents’ self-reported hand hygiene behaviour:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before patient contact</strong></td>
</tr>
<tr>
<td>Always (n=89) 40 (48.2%)</td>
</tr>
<tr>
<td>Almost Always (n=89) 42 (50.6%)</td>
</tr>
<tr>
<td>Sometimes (n=89) 1 (1.2%)</td>
</tr>
<tr>
<td>Rarely (n=89) 0</td>
</tr>
<tr>
<td><strong>Before aseptic procedures</strong></td>
</tr>
<tr>
<td>68 (81.9%)</td>
</tr>
<tr>
<td>15 (18.1%)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>After bodily fluid exposure</strong></td>
</tr>
<tr>
<td>78 (94%)</td>
</tr>
<tr>
<td>5 (6%)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>After patient contact</strong></td>
</tr>
<tr>
<td>43 (51.8%)</td>
</tr>
<tr>
<td>38 (45.8%)</td>
</tr>
<tr>
<td>2 (2.4%)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>After touching patient environment/surroundings</strong></td>
</tr>
<tr>
<td>26 (31.3%)</td>
</tr>
<tr>
<td>48 (57.8%)</td>
</tr>
<tr>
<td>8 (9.6%)</td>
</tr>
<tr>
<td>1 (1.2%)</td>
</tr>
<tr>
<td><strong>Before blood sample collections</strong></td>
</tr>
<tr>
<td>55 (69.9%)</td>
</tr>
<tr>
<td>18 (22.8%)</td>
</tr>
<tr>
<td>2 (2.5%)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>After blood sample collections</strong></td>
</tr>
<tr>
<td>58 (73.4%)</td>
</tr>
<tr>
<td>14 (17.7%)</td>
</tr>
<tr>
<td>3 (3.8%)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>Before wearing gloves</strong></td>
</tr>
<tr>
<td>23 (28%)</td>
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<tr>
<td>36 (43.9%)</td>
</tr>
<tr>
<td>19 (23.2%)</td>
</tr>
<tr>
<td>4 (4.9%)</td>
</tr>
<tr>
<td><strong>After removal of gloves</strong></td>
</tr>
<tr>
<td>49 (59%)</td>
</tr>
<tr>
<td>30 (36.1%)</td>
</tr>
<tr>
<td>4 (4.8%)</td>
</tr>
<tr>
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</table>
# APPENDIX A: Moments of Hand Hygiene Questionnaire

1. Please list below, to the best of your knowledge, the “moments of hand hygiene” in health care.

2. Please indicate the year in which you were born: Year: 19_____

3. What is your sex? Male □ Female □

4. What is your year of training?
   - 1st year medical student □
   - 2nd year medical student □
   - 3rd year medical student □
   - 4th year medical student □
   - 1st year resident □
   - 2nd year resident □

5. In what field was your undergraduate degree?

6. At which university did you attend medical school?

7. What is your country of origin?

8. Other than through your current course, have you ever had:
   - (a) training in universal precautions in hygiene □ □
   - (b) training in microbiology □ □
   - (c) training in hand hygiene □ □

9. Are you completing or have you completed the “JUST CLEAN YOUR HANDS” education and training module? YES □ NO □ DON’T KNOW □
   9(a) If YES, approximately, how long ago did you complete the module? _______ months ago

10. Have you worked either as a volunteer or paid employee in a health care setting, prior to medical school? YES □ NO □

11. How many weeks on average have you spent in the clinical setting? _______ weeks

12. Have you ever treated a patient with a hospital acquired infection? YES □ NO □
   If YES:
   12(a) The hospital-acquired infection was at least partly attributable to the care provided to the patient while in hospital.
   - Strongly Disagree □ Disagree □ Undecided □ Agree □ Strongly Agree □
   12(b) Better hand hygiene practices could have prevented this hospital-acquired infection.
   - Strongly Disagree □ Disagree □ Undecided □ Agree □ Strongly Agree □
medical residents were in relation to PPE; before use (8.9%) and after use (6.3%). No significant differences were found in mean HH knowledge by year of residency, gender or having an undergraduate degree in health sciences. Residents who attended Canadian medical schools were found to have greater HH knowledge (M = 4.40) than residents who did not (M = 2.93), p = 0.01. Younger residents (<29 years) had greater HH knowledge (M = 4.11) than their older counterparts (M = 3.32), p = .03. A two-way ANOVA test, to determine co-variance between students not trained in Canada and age, revealed poor HH knowledge was associated with prior medical training outside of Canada (F = 4.4, df = 1, p = 0.041), while age was not associated with HH knowledge (F = 0.915, df = 1, p = 0.342).

Examination of self-reported HH adherence behaviour rates indicated both first and second year medical residents reported adherence as “always” or “almost always” for each HH scenario (see Appendix A); no difference was found between years of residency (Table 1). Residents reported to “always” perform HH for the following scenarios: after bodily fluid exposure (94%), before aseptic procedure (82%), after blood sample collection (73%), before blood sample collection (70%), after removal of gloves (59%), after patient contact (52%), before patient contact (48%), and after touching patient environment/surroundings (31%). Conversely, residents reported they were least likely to perform HH before wearing gloves (“always” 28%; “rarely” 5%).

In assessing attitudes, Family Medicine residents were asked to use a five-point Likert scale to indicate their level of agreement with the statement “hand hygiene compliance among healthcare providers is a serious problem”; 50% “agreed” with the statement, 31% were “undecided”, and 20% “disagreed” or “strongly disagreed”. A non-significant trend was noted for year of residency. When asked if better hand hygiene practices could have prevented HAIs among patients they have treated, 55% of medical residents “disagreed” and 45% “agreed” or “strongly agreed” better HH would aid in preventing HAIs.

**DISCUSSION**

Since the SARS epidemic in 2003 and with current awareness of HAIs, one would hope that HH knowledge would be higher; however, Family Medicine residents surveyed demonstrated little knowledge of recommended HH practices. Although the most commonly identified HH moment was before patient contact, less than half self-reported “always” performing HH for this scenario; suggesting knowledge of HH moments does not necessarily translate into adherence. This finding is similar to Herbert et al., (9) who reported 70% of medical students indicated an excellent/good knowledge of HH guidelines, but only 43% adhered to WHO HH recommendations.

Our findings indicated self-report behaviour of HH before and after using PPE was low; a third of the sample reported “always” performing HH before the use of gloves. Few residents correctly identified the need for HH after the use of gloves; however, there was higher self-reported HH adherence. This raises questions whether lack of recall of an HH moment translates into poor HH behaviour in clinical settings. More concerning is, despite medical residents self-reporting “always” or “almost always” performing HH for each clinical scenario, self-reported behaviour for clinical scenarios were never higher than 82%.

Lack of knowledge and low self-reported HH behaviour, especially in relation to using PPE, raises serious concerns in light of the recent Ebola outbreak, where nurses in the US reported lack of clear guidelines, training and knowledge in the use of PPE (25). Appropriate understanding of HH guidelines when using PPE is also relevant given incorrect removal of PPE was the reported reason a Spanish nurse contracted Ebola (26). This study indicates HH education must be reinforced during medical residency programs. Review and reformulation of HH training in medical school and residency is therefore recommended. To this end, using best practice examples from hospitals meeting HH targets is important.

The application of paradigms from behavioural psychology to better translate knowledge into behaviour is also encouraged. Additionally, gaps in HH knowledge between medical residents trained inside and outside of Canada need to be addressed.

Several limitations of this study should be acknowledged. This research used self-reported HH behaviour, which can be higher than actual adherence. Generalization of the results is also limited as only one residency program was studied. Future research would benefit from investigating actual observed HH adherence in comparison to self-reported HH behaviour and its effect on other aspects of infection control. Longitudinal studies of HH knowledge, attitudes and behaviour in medical students as they progress through medical school, residency and professional practice would allow trends to be identified, and gaps to be addressed. Multi-site studies would provide meaningful aggregate data and comparison opportunities. There is also a need to investigate how knowledge of HH can be better translated into practice.

**CONCLUSION**

HH adherence is essential in preventing HAIs. This study raises questions regarding the reinforcement of HH knowledge and adherence in infection control practices among medical residents. Low levels of knowledge among Family Medicine residents regarding HH behaviour, particularly for those not trained in Canada, suggests the need for a more rigorous, standardized, accountable infection control curriculum. Emphasis placed on the rationale for HH, the importance of adherence to recommended guidelines, and periodic assessment of knowledge and practice is needed. By addressing this issue at its roots it is hoped that the rate of HAIs can be attenuated.
### 13. Having witnessed a missed opportunity for hand hygiene, I would feel comfortable having a conversation about the importance of hand hygiene compliance with that person if the person was:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Nurse</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Physician</td>
<td></td>
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<td></td>
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<tr>
<td>(c) Family member of patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Administrator</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(e) Dietitian</td>
<td></td>
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<td></td>
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<tr>
<td>(f) Volunteer</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>(g) Paramedic</td>
<td></td>
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<tr>
<td>(h) Allied healthcare professional</td>
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</tbody>
</table>

### 14. Having witnessed a missed opportunity for hand hygiene, I have approached that person and discussed with them the importance of hand hygiene when that person was:

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Almost Always</th>
<th>Always</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Nurse</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Physician</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(c) Family member of patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Administrator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Dietitian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Volunteer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) Paramedic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) Allied healthcare professional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 15. If you did not perform hand hygiene in front of the patient, how comfortable would you be if they asked you to clean your hands before you touched them?

- Not comfortable at all
- Not very comfortable
- Somewhat comfortable
- Comfortable
- Very comfortable

### 16. If you had performed hand hygiene but not in front of the patient, would you perform hand hygiene again if they asked you?

- Yes
- No, with an explanation
- No, without an explanation

### 17. Rate your knowledge of:

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Sufficient</th>
<th>Not-Sufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) General hygiene guidelines for healthcare settings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) The World Health Organization’s “My five moments of Hand Hygiene”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX A: Moments of Hand Hygiene Questionnaire (continued)

18. Please indicate which hand hygiene technique(s) you would use in each of these situations:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Soap and water</th>
<th>Alcohol-based hand rub</th>
<th>Both Soap and water and Alcohol-based hand rub</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) BEFORE taking a patient’s pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) BEFORE dressing a wound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) When hands are visibly soiled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) AFTER taking a patient’s pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) AFTER touching a patient’s bed rail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) AFTER removing gloves used when treating a patient suspected of having C. difficile</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19. How often do you perform hand hygiene?

<table>
<thead>
<tr>
<th>Situation</th>
<th>Always</th>
<th>Almost always</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) BEFORE patient contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) BEFORE aseptic procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) AFTER bodily fluid exposure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) AFTER patient contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) AFTER touching patient surroundings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) BEFORE blood sample collections</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) AFTER blood sample collections</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) BEFORE wearing gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) AFTER removal of gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20. Do you shake hands with the patient when greeting each other?

Always  
Often  
Sometimes  
Seldom  
Never

21. Rate your agreement:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 100% compliance with hand hygiene for every moment in every patient is an achievable goal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Repeated failure to comply with hand hygiene despite education, training, and system engineering to facilitate compliance along with repeated warnings should eventually result in escalated penalties regardless of professional status.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Lack of hand hygiene compliance among healthcare providers is as serious a problem for a patient as a medical error.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Healthcare provider immunization with seasonal flu vaccine is an important patient safety initiative.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


Surgical site infection prevention: What are the gaps in Vietnamese hospitals?

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ABSTRACT
Background: Surgical site infections (SSIs) could be prevented by using evidence-based recommended practices. However, surveillance programs for these practices remain inadequate and inaccurate in developing countries. This study evaluated the compliance of surgical team members (STMs) and patients with recommended practices for SSI control and prevention in Vietnamese hospitals.

Methods: An observational survey was conducted between November 2009 and February 2010 to evaluate the compliance with SSI control and prevention practices including preoperative showering, hair removal, surgical hand preparation and surgical attire use in the elective surgical patients and STMs at four hospitals. All types of elective surgery were included. Each practice was evaluated based on five items following standard guidelines.

Results: During the survey period, 568 elective surgical patients, 864 STMs and 5,509 STM turns (entries/exports to and from the operation room) were observed. The median scores for preoperative showering, hair removal, surgical hand preparation, and surgical attire were 2.0 (0-4.0), 5.0 (0-5.0), 2.0 (0-4.0), and 4.0 (0-5.0), respectively. Cross-hospital comparisons demonstrated significant differences for patient showering and hair removal practices among the participating healthcare institutions. The compliance of STMs with surgical hand preparation and surgical attire use was significantly influenced by hospital and professional activity.

Conclusions: Our findings indicate poor compliance with some routine SSI control and prevention practices in Vietnamese hospitals, and also emphasize the need for adapting the guidelines to the local setting, local needs, and resource limitations of health care facilities combined with intensive education, auditing and surveillance strategies to address this issue.

KEY WORDS
Compliance; prevention; surgical site infection; surgical team member; Vietnam

INTRODUCTION
Surgical site infections (SSIs) are challenging problems with reported rates ranging from 5% to 30% (1,2) and may reflect the level of adherence to infection control (IC) policies (3,4). Despite availability of guidelines for SSI prevention, compliance among healthcare workers remains suboptimal (1,2,5).

In Vietnam, 2 million patients undergo surgical procedures each year and SSI rates vary between 9.6%-17.9% (6-8). To our knowledge, this is the first study on the compliance with IC measures for SSI prevention in Vietnam. The purpose of this study is to evaluate compliance of surgical team members (STMs) and patients with some routine SSI control and prevention practices in four Vietnamese hospitals.

METHODS
Setting and sampling
General hospitals that provide surgical services in Vietnam belong to one of the three tiers: national, provincial/municipal and district. Only national and provincial/municipal tiers of hospitals were included in this survey. The survey was sent to 109 hospitals across the country. Of these, 21 hospitals agreed to participate. From these, we randomly selected one hospital from each national and provincial/municipal tier. All of the hospitals in the mountainous regions of the country are included in the provincial tier. So we randomly selected two provincial hospitals, one from a mountainous area and one from the delta area. Altogether, four hospitals were randomly selected (lucky draw): one from the municipal tier (Pho Noi hospital, hereafter denoted as hospital A), one from the national tier (Bach Mai hospital hereafter denoted as hospital B), and two from the provincial tier (Ninh Binh and Yen Bai hospitals, hereafter denoted as hospitals C and hospital D). The bed size of the participating hospitals ranged from 462 to 1,900 hospital beds and from 95 to

Acknowledgements
We thank the IC teams from the participating hospitals who contributed to the data collection and management of this study.
156 surgical beds; the average number of surgical procedures per year ranged from 3,500 to 14,688.

To evaluate surgical patient preparation at the participating hospitals, we recruited 568 elective surgical patients between November 2009 and February 2010. Direct observations of IC practices were rotated on every operating room (OR) of each hospital to verify compliance of different surgical teams. A total of 279 observation sessions were conducted during the study period.

This study was reviewed and approved by the Ethics and Health Research Review Committee of the Vietnamese Ministry of Health in September 2009. All patients were asked to sign a written informed consent sheet to participate in the study.

**Study design**

An observational survey was conducted to identify the elective surgical patients and STMs and examine IC practices aimed at SSI prevention at the participating hospitals. All types of surgery were included (except for emergency surgical procedures).

**Study materials**

Our survey forms were prepared by a team of IC experts, including a surgeon and developed based on the current CDC and WHO guidelines (9,10).

The first survey form about the preoperative surgical patient preparation consisted of two sections including (1) the methods of preoperative hair removal and (2) the methods of preoperative showering.

The second survey form about the compliance of STMs consisted of two additional sections including (1) compliance with surgical hand preparation and (2) compliance with the use of surgical attire.

For evaluation of each section our research group was convened to review the guidelines, the experiences of clinicians, and the resources for basic SSI prevention. We reached consensus on five items where strict compliance is required for SSI prevention. Where consensus could not be reached (e.g., relationship between the wearing of nail polish by surgical team members and SSI risk), items were excluded from the survey.

**Evaluation of the preoperative showering methods**

Appropriate items about preoperative showering included (1) patient showered at least on the night prior to surgery, AND (2) showering was done with water provided by the hospital water treatment services, AND (3) skin antiseptic agent containing iodophors, chlorhexidine gluconate or alcohol based solutions was applied for showering, AND (4) patient was provided an instruction explaining showering procedure, AND (5) showering was taken in the designated area of participating hospitals (9). Preoperative showering was considered inappropriate if it did not meet the criteria for any of these five items.

**Evaluation of the preoperative hair preparation**

Hair preparation methods were considered appropriate if (1) the hair at or around the incision site interfered with the operation, AND (2) clippers or scissors were used to cut the hair off at the skin’s surface, AND (3) hair was removed immediately before surgery, AND (4) hair removal was performed in the preoperative holding area, AND (5) hair removal was done by surgical nurses. Instances where hair removal was not required were counted towards appropriate practice compliance (9). Hair removal was considered inappropriate if it did not meet the criteria for any of the aforementioned five items.

**Evaluation of the compliance of STMs with surgical hand preparation and the use of surgical attire in ORs**

Surgical hand preparation was defined as appropriate if (1) rings, watches, and bracelets were removed before beginning surgical hand preparation, AND (2) hands and forearm were scrubbed for at least three minutes, AND (3) brushless surgical hand scrub was performed, AND (4) all the scrub steps of surgical hand technique were followed (10), AND (5) hands and forearm were dried using a sterile cloth towels before putting gown and gloves on (10). Surgical hand preparation was considered inappropriate if it did not meet any of the above five criteria.

The compliance with the use of surgical attire in the OR was considered appropriate if (1) surgical fluid-resistant or impermeable shoe cover/boots were worn, AND (2) a cap/hood fully covered head hair, AND (3) a surgical mask fully covered nose and mouth, AND (4) a scrub suit consisting of pants and a short-sleeve shirt was worn, AND (5) indications for wearing or not wearing non-sterile single-use gloves according to WHO guidelines were followed (10). Surgical attire use was considered inappropriate if it did not meet any of the above five criteria.

**Data collection**

Survey form for preoperative patient preparation: we collected data on patient characteristics (age, sex, surgery type, and wound class and American Society of Anesthesiology (ASA) physical status score), methods and timing of preoperative hair removal and showering for all elective surgical patients by trained surveillance team from each hospital comprising an IC practitioner and a surgical nurse. The data were transcribed from patient charts and recorded through direct interviews with the recruited patients.

Survey form for the compliance of STMs with routine IC practices: data were collected by two IC practitioners from each participating hospital through direct observations of STMs’ practices. One IC practitioner was responsible for observing the compliance of STMs with surgical hand preparation. The other was in charge of observing STM turns that were defined as entries to or exits from the OR during surgical procedure. Observation sessions were conducted in the mornings and afternoons, with 2-4 observation sessions per day. Each session was taking place in an OR from the beginning to the end of an elective surgical procedure. Completed data collection forms were checked for accuracy and completeness at the end of the survey day by the principal investigator and the IC practitioner from the participating hospital.
### TABLE 1: Median score and correlates of preoperative hair and showering preparation

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of patients (n = 568)</th>
<th>Median hair preparation (Minimum-Maximum)</th>
<th>Median showering preparation (Minimum-Maximum)</th>
<th>P*</th>
<th>P**</th>
<th>P†</th>
<th>P‡</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 18</td>
<td>49</td>
<td>5.0 (1.0-5.0)</td>
<td>0 (0-3.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&lt; 0.01</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>18 – 39</td>
<td>149</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 – 59</td>
<td>225</td>
<td>5.0 (0-5.0)</td>
<td>3.0 (0-4.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td></td>
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<tr>
<td>&gt; 60</td>
<td>145</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>304</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Female</td>
<td>264</td>
<td>5.0 (0-5.0)</td>
<td>3.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td><strong>Hospital</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>43</td>
<td>5.0 (1.0-5.0)</td>
<td>0 (0-3.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
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<tr>
<td>B</td>
<td>185</td>
<td>5.0 (0-5.0)</td>
<td>3.0 (0-3.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td></td>
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<tr>
<td>C</td>
<td>201</td>
<td>5.0 (0-5.0)</td>
<td>0 (0-4.0)</td>
<td>&lt; 0.01</td>
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<td></td>
</tr>
<tr>
<td>D</td>
<td>139</td>
<td>5.0 (4.0-5.0)</td>
<td>3.0 (0-3.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
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<tr>
<td><strong>Ward</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>496</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Obstetric-gynecologic</td>
<td>72</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
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<tr>
<td><strong>Wound class</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Clean</td>
<td>206</td>
<td>5.0 (0-5.0)</td>
<td>1.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>263</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated</td>
<td>66</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-3.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirty</td>
<td>33</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ASA score</strong>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>412</td>
<td>5.0 (0-5.0)</td>
<td>2.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>5.0 (1.0-5.0)</td>
<td>1.0 (0-3.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 3</td>
<td>93</td>
<td>5.0 (0-5.0)</td>
<td>3.0 (0-4.0)</td>
<td>&gt; 0.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>5.0 (0-5.0)</strong></td>
<td><strong>2.0 (0-4.0)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*American Society of Anesthesiologists (ASA) physical status score

Variables included in a linear regression analyses: hospital, ward, wound class, and ASA score

† P values obtained in Wilcoxon rank sum test for two dichotomous variables and Kruskal - Wallis test for variables had ≥ three levels

‡ P values obtained in linear regression analyses
Statistical analyses
Analyses were performed using SPSS. The following four measures of survey items were calculated: (1) a score of 1 or 0 was assigned for each appropriate or inappropriate survey item, respectively; (2) the maximum total score was calculated; (3) the scaled score was calculated by adding up assessment scores of the five items. To describe the STM turns (entries/exits to/from the OR during surgical procedure), the mean number of door opening throughout the procedure was calculated by number of turns, divided by total number of procedures. We compared differences in median scores by using Wilcoxon rank sum test for dichotomous variables and Kruskal-Wallis test for variables that had three or more levels. All factors with a p value of less than 0.1 were included in a linear regression analyses to compute the correlation between a scaled score and the variables studied (i.e., age, sex, hospital, professional activity, ward, surgery type, wound class). All reported p-values are two-sided and p-value < 0.05 is considered statistically significant.

RESULTS
Preoperative patient preparation
A total of 568 elective surgical patients were interviewed in the four surveyed hospitals. Among them, 304 (53.5%) were male and 264 (46.5%) were female, with median age of patients being 48 years (range 13-89).

Of 568 patients, 326 (57.4%) had a preoperative shower. For survey items about preoperative showering method, only small number of appropriate practices were observed: none of the patients had a shower with antiseptic agent, 54 (16.6%) were provided oral instructions by surgical nurses, 187 (57.4%) had a shower that was taken in the designated area of participating hospitals, 266 (81.6%) had a shower with water provided by the hospital water treatment services, and 292 (89.6%) had a shower the night prior to surgery.

The median score for preoperative showering was low 2.0 (0 - 4.0) compared with the maximum total score of five. After controlling for covariates through linear regression analyses, the median score of showering methods varied substantially from facility to facility (Table 1).

The overall rate of patients who had hair removed was 21.5% (122 of 568 patients). Of these, 74 (60.7%) patients had hair removed at or around the incision site if it interfered with the operation, 71 (58.2%) used clippers, 74 (60.7%) had hair removed immediately before surgery, 64 (52.5%) had it done in the preoperative holding area.

The median score for hair removal was 5.0 (0 - 5.0). Our findings show that there was a correlation of the hair removal means score with hospital and ward specialty (P < 0.01) (Table 1).

### TABLE 2: Median score and correlates of surgical hand hygiene

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of STMs* (n = 864)</th>
<th>Median (Minium-Maximum) (Maximum score: 5)</th>
<th>P†</th>
<th>P‡</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hospital</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A</td>
<td>118</td>
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<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>B</td>
<td>232</td>
<td>1.0 (0 – 4.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>425</td>
<td>2.0 (0 – 3.0)</td>
<td></td>
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<tr>
<td>D</td>
<td>89</td>
<td>4.0 (3.0 – 4.0)</td>
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<td>Anesthesiologist</td>
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<td>1.0 (0 – 3.0)</td>
<td>&lt; 0.01</td>
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<td>Surgeon</td>
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<tr>
<td>Anesthesiology</td>
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<td><strong>Total</strong></td>
<td>864</td>
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</tbody>
</table>

*Surgical team member
†P values obtained in Wilcoxon rank sum test for two dichotomous variables and Kruskal-Wallis test for variables had ≥ three levels
‡P values obtained in linear regression analyses

Variables included in a linear regression analyses: hospital, professional activity, and ward
Compliance of STMs with surgical hand preparation and use of surgical attire in ORs

A total of 864 STMs who performed surgical hand hygiene and 5,509 turns of STMs were observed in the four participating hospitals. The mean number of times the OR door was opened throughout the procedure was 19.8 (5,509/279). Nurses and medical students were the most frequent individuals to enter/exit the OR with the mean number of door openings at 10.2 (2,826/279).

Of the 864 STMs, none complied with all survey items about surgical hand preparation. Appropriate practices were less frequent for at least three-minute scrubs with antiseptic agent (145, 16.8%) and brushless surgical hand scrubs (199, 23.0%). Survey items about scrub steps and hands and forearm dryness were correctly done by 523 (60.5%) and 538 (62.3%) of STMs, respectively. Almost all STMs (815, 94.3%) removed rings, watches, and bracelets before beginning surgical hand preparation.

The median score for surgical hand hygiene was low 2.0 (0 - 4.0) compared with the maximum total score of 5.

The survey showed that there was a significant association between the surgical hand preparation median score with occupation and hospitals (Table 2).

Compliance with surgical attire varied considerably, and was highest for wearing shoe covers/boots (5,500, 99.8%), followed by appropriate use of surgical mask (4,311, 78.2%), appropriate use of cap/hood (4,315, 78.3%), appropriate use of gloves (4,650, 84.4%), and wearing scrub suits (2,582, 46.9%). Full compliance of STMs with surgical attire was only 37.8%.

The rates of STM turns complying with appropriate use of scrub suits in hospitals C, D, and A were only 4.0%, 17.0%, and 44.0%, respectively. Only 62.7% of STM turns in hospital C correctly wore surgical mask. The rates of STM turns complied with correct use of cap/hood were only 60.9% in hospital C and 63.5% in hospital A.

Cross-hospital comparisons showed significant differences for surgical attire compliance. Compliance was also significantly influenced by professional activity. Anesthesiologists had a significantly higher median score than did other professional activities (Table 3).

### Table 3: Median score and correlates of surgical attire use

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of STM turns* (n = 5,509)</th>
<th>Median (Minimum-Maximum) (Maximum score: 5)</th>
<th>P†</th>
<th>P‡</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2,432</td>
<td>3.0 (1.0 – 5.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>247</td>
<td>4.0 (0 – 5.0)</td>
<td></td>
<td></td>
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<td><strong>Professional activity</strong></td>
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<tr>
<td>Anesthesiologist</td>
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<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
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<td>Surgeon assistant</td>
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<td></td>
</tr>
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<td>Surgeon</td>
<td>1,001</td>
<td>4.0 (1.0 – 5.0)</td>
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<tr>
<td>Nurse</td>
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<td>4.0 (1.0 – 5.0)</td>
<td></td>
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<td>Nurse assistant</td>
<td>640</td>
<td>4.0 (1.0 – 5.0)</td>
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<td>Medical student</td>
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<td>3.0 (1.0 – 5.0)</td>
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<td><strong>Ward</strong></td>
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<tr>
<td>Surgery</td>
<td>3,072</td>
<td>4.0 (0 – 5.0)</td>
<td>&lt; 0.01</td>
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<td>1,808</td>
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<td>Anesthesiology</td>
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<td>4.0 (1.0 – 5.0)</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,509</td>
<td>4.0 (0 – 5.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Surgical team member turns
† P values obtained in Wilcoxon rank sum test for two dichotomous variables and Kruskal-Wallis test for variables had ≥ three levels
‡ P values obtained in linear regression analyses
Variables included in a linear regression analyses: hospital, professional activity, and ward.
DISCUSSION

We found significant gaps between the practices recommended in the guidelines and the actual compliance with SSI prevention practices at the point of care. Despite evidence that an antiseptic shower the night before operation reduces skin microflora and decreases the risk of SSI (1,9), our findings showed that only 326 (57.4%) of the interviewed patients had a shower. Insufficient availability and limited access to showering facilities and antiseptic agent with a broad spectrum of activity and a rapid onset were the main reasons for the poor compliance of our patients. Provision of education and better institutional financial support could improve the compliance with preoperative showering.

Our study revealed inappropriate preoperative hair removal practices, which were similar to that reported in previous studies in developing countries (4). Among the patients who had hair removed, approximately half had them shaved with a razor – a practice known to result in razor injuries contributing to microbial contamination of the surgical site and increased risk of SSIs (4,9). The long-standing tradition of shaving surgical sites by patients is still very popular in Vietnamese health care facilities. The lack of surgical nurses could be an issue as well. Patients often remove their hair unsupervised by the surgical nurses.

Our findings emphasize the need for further studies on the effect of continuing intensive education combined with appropriate staffing and provision of facilities for basic SSI prevention on compliance with SSI control and prevention practices.

Our study also found that the mean number of door openings into ORs was 19.8. This is consistent with previous research which found a large number of entries/exits in the OR during the operation (1), mostly by anesthesiologists, nurses and medical students. Thus, a revision of the ergonomics in workplace could be an important way to limit STM turns during the operation.

Hand hygiene is one of the most important components of any SSI control and prevention strategy (12). However, we found poor surgical hand hygiene practices in participating hospitals. No STM fully complied with surgical hand preparation, which resulted in a small median score of 2.0 (0 - 4.0) for this survey item. The most frequent inappropriate practices were forearm and hand scrub using brushes and surgical scrub less than three minutes. Implementation of a multimodal and multidisciplinary strategy including education, leadership engagement, and peer pressure and role models would be important interventions to improve surgical hand hygiene compliance (11). Among participating hospitals, surgical hand preparation with waterless, alcohol-based hand rub (ABHR) that improves compliance hand hygiene (10,12) was only practiced in hospital D. Use of ABHR is less time-consuming and more effective against microorganisms. Furthermore, ABHRS are recommended when quality of water is ambiguous (10,12,13). Poor water quality control remains a problem at all levels of Vietnamese healthcare facilities. We recommend a switch from surgical handwashing to surgical handrubbing to improve compliance with surgical hand hygiene in Vietnam.

In ORs, the use of non-sterile surgical attire is important in minimizing the risk of microbial contamination of the operating site from the theatre environment (14). Wearing surgical attire is also needed to maintain theatre discipline and may therefore contribute to a reduced risk of SSI. Inappropriate use of surgical attire was common in this study. Only 37.8% of observed STMs correctly used surgical attire including scrub suits, mask, cap/hood, shoe covers/boots, and gloves. We found the lower median score for surgical attire use in provincial hospitals (hospitals A, C, and D) where institutional support for the purchase of personal protective equipment (PPE) was limited. Medical students were less likely to comply with surgical attire use in the ORs. Our finding suggests that a combination of strategies including continuous education in IC, easy accessibility to PPE may help address this issue.

This study has several limitations. It did not evaluate the compliance with the use of sterile surgical attire including fluid-resistant or impermeable gown and sterile gloves. The study was conducted in only four hospitals with some fields of practice not included in the analysis, thus limiting the generalisability of our findings.

REFERENCES
Spatio-temporal analysis of *Acinetobacter baumannii* outbreak with multiple routes of transmission in ICU setting

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**ABSTRACT**
An imipenem-resistant *Acinetobacter baumannii* (IRAB) outbreak occurred in five different hospital units after a patient repatriated from Romania was not screened on admission. Due to persistent nature of *A. baumannii* as a hospital pathogen and multiple vectors of transmission, robust infection control measures had to be put in place from the onset of the index case.

**INTRODUCTION**
*Acinetobacter baumannii* is an opportunistic pathogen that is responsible for outbreaks primarily in intensive care units and burn departments (1). This Gram-negative pathogen, which is naturally present in the environment in various environmental locations (animals, vegetables, soil etc.) (2) has in recent years developed high level resistance to β-lactams including imipenem, thus limiting therapeutic options and leading to high mortality (3). It is also a hardy microorganism able to withstand and survive desiccation on inert surfaces for several months. These two characteristics make this pathogen particularly dreaded in hospitals (4,5). The major route of transmission of *A. baumannii* is through hands, with poor hand hygiene compliance being a known risk factor for the spread of the organism (6).

Several reports have already described hospital outbreaks involving *A. baumannii* and put forward theories about cross-transmission (7,8). Our study investigates how such cross-transmission may have occurred, how we could have avoided this outbreak and been more efficient in controlling it.

**METHODS**

**Definition**
The outbreak occurred in a 1,660-bed University Hospital with two surgical intensive care units (SICUs A and B) and in a medical intensive care units (MICU). A case was defined as a hospitalized patient for whom a clinical or screening sample was positive for *A. baumannii* with the same susceptibility panel as that of the index case. We defined the epidemic phase as the time when there were at least two cases (person) in the same geographic location (place) over 48 hours (time).

**Description of the outbreak**
Acute phase of the outbreak occurred from February to late March 2013 (Figures 1 and 2). On February 6, two imipenem-resistant *A. baumannii* (IRAB) cases were reported in SICU A (cases 2 and 3). The index case (case 1) was a 37-year-old man repatriated from an ICU in Romania and admitted on January 25. Screening detected IRAB, vancomycin-resistant enterococcus (VRE) and methicillin-resistant *Staphylococcus aureus* (MRSA). All patients in SICU A were then placed under contact precautions and screened every three days for IRAB and VRE. Reminders were issued about the importance of control measures, focusing on hand hygiene and the need for high quality cleaning and disinfection of rooms (9). All patient rooms on the affected units were cleaned and disinfected twice a day.

On 20 February, case 4 was reported in SICU A, at which point it was decided that this unit would become a cohorting unit. On 22 February, two new cases were reported (cases 5 and 6). Case 5 was already present in SICU B and case 6

**Acknowledgements**
The authors thank all SICU and MICU staff for their collaboration in the management of this outbreak.
Canadian Journal of Infection Control | Spring 2016 | Volume 31 | Issue 1 | 24-27

pre-moistened in normal saline that were rubbed back and forth three times over each surface. The swabs were applied on Drygalski agar with 2mg/L of imipenem, at 37°C during 48h. The sampling plan was made by analyzing the risk of contamination of different parts of the patient rooms.

RESULTS
Over the course of four months, 10 cases (eight clinical infections and two cases of colonization) were reported from five different units. The rep-PCR technique confirmed the clonality of nine of these strains. Case 10 was a patient transferred from our facility to another hospital where he was screened, and included into our case count retrospectively. Cases 2 and 3 were located in two rooms adjacent to case 1. Hand transmission by healthcare workers seems to be the most likely route of transmission, as with Case 4, who was also hospitalized in this unit. Case 5 was detected in the room previously occupied by a patient later recognized as an IRAB case (Case 10). Environmental contamination might have been a likely source in the emergence of this case, with inadequate cleaning and environmental disinfection as contributing factors.

Case 6 detected in MICU was separated from the rest of the affected units by ten hospital floors. However, we identified a visitor to MICU who also happened to spend some time at SICU A. When patient logs and itineraries were analyzed, it became apparent that Case 2, who was hospitalized in this unit, had her husband hospitalized at the same time in MICU. The healthcare teams confirmed that their children had come to visit them on several occasions thus likely contributing to cross-transmission of the pathogen between the units.

Case 7 had multiple risk factors and developed a clinical IRAB infection while hospitalized in the SICU. Case 8 was a roommate of Case 2, which might have contributed to transmission.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Investigations</th>
<th>Possibility of cross-transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 2</td>
<td>Patients in the rooms adjacent case 1</td>
<td>Hand transmission by health care workers</td>
</tr>
<tr>
<td>Case 3</td>
<td>Patient in the former room of case 10</td>
<td>Environmental persistence of IRAB</td>
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<td>Case 4</td>
<td>Common equipment, cross-functional team and visitor in SICU and MICU</td>
<td>Hand transmission</td>
</tr>
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<td>Case 5</td>
<td>Patient with several risk factor (invasive medical devices and antibiotic pressure)</td>
<td>Low level persistence of IRAB in MICU’s ecology</td>
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<tr>
<td>Case 6</td>
<td>Follow case 7 in an operative room in February</td>
<td>Environmental persistence of IRAB</td>
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</table>

was hospitalized in MICU. Both patients were transferred to the cohorting unit. The cohorting unit and contact precaution measures were discontinued on March 15. However, three sporadic cases occurred from May 2013 to July 2013 in MICU, orthopedic and urology wards; so measures taken during the acute phase were reactivated.

Investigations
The microbiology department isolated all strains from clinical specimens and screening samples on selective agar (Brilliance CRE, Oxoid). Since antimicrobial susceptibility results were identical, the strains were compared by the rep-PCR method with the Acinetobacter spp kit (DiversiLab®, bioMerieux) as per the supplier’s recommendations. Rectal and oropharyngeal swabs were taken to increase sensitivity (10).

To determine the different routes of transmission, all patients’ itineraries were reconstructed, examined in detail and cross-referenced. We examined all surgical procedures and radiographic exams, compared occupation of rooms for all cases, and checked the use of common hospital equipment. We compared the schedules of all interventions in ICU where physiotherapists and other cross-functional teams or specialists were involved.

To find potential contact patients who might have carried the pathogen from one unit to another, the hospital’s medical information systems was deployed to examine the lists of all patients and trace their movements across the hospital units. Visitors’ itineraries were also investigated through interviews conducted by the hospital staff.

We conducted environmental investigation by swabbing designated high-touch surfaces (bedside tables, bedrails, door handles, and mattresses) and sinks in patient rooms, as well as medical and office equipment on the affected units, looking for an environmental reservoir of the pathogen. For environmental sample collection we used sterile cotton swabs pre-moistened in normal saline that were rubbed back and forth three times over each surface. The swabs were applied on Drygalski agar with 2mg/L of imipenem, at 37°C during 48h. The sampling plan was made by analyzing the risk of contamination of different parts of the patient rooms.

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<td>Case 4</td>
<td>Common equipment, cross-functional team and visitor in SICU and MICU</td>
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<td>Case 5</td>
<td>Patient with several risk factor (invasive medical devices and antibiotic pressure)</td>
<td>Low level persistence of IRAB in MICU’s ecology</td>
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<tr>
<td>Case 6</td>
<td>Follow case 2 on technical platform in February</td>
<td>Environmental persistence of IRAB</td>
</tr>
<tr>
<td>Case 7</td>
<td>Follow case 7 in an operative room in February</td>
<td>Environmental persistence of IRAB</td>
</tr>
</tbody>
</table>

TABLE 1: Cross-transmission investigations.
Case 9, reported on July 2013 was traced back to an operating room where he had a surgical procedure on 15 February 2013, only hours after Case 7 was operated in the same room. We hypothesize that environmental contamination might have played a role in this episode of transmission, though all subsequently collected environmental samples tested negative. The common routes of cross-transmission were suspected (but never confirmed through lab cultures) to be hand transmission by healthcare workers and visitors, and transmission through environmental fomites (Table 1).

**DISCUSSION**

The outbreak unfolded in two stages; first with seven cases over the course of 15 days and then the second phase with three cases spread over three months. Our control measures were not effective enough to curb the spread of IRAB early in the outbreak. The potential for cross-transmission by visitors and staff working across the facility was underestimated and could explain part of the caseload and distribution of cases between five different units.

Cleaning and disinfection are essential in the control of outbreaks of *A. baumannii*, and the role of environmental surfaces as sources of hand contamination and re-contamination, cannot be underestimated (11,12). Environmental surfaces are epidemiologically important reservoir for this pathogen, second only to hands of healthcare personnel, so to avoid any resurgence of infection thorough cleaning and disinfection are a must (13).

All rooms on the affected units were environmentally screened before being re-opened. Any instance of the pathogen isolated from an environmental screen was regarded as a proxy marker for suboptimal quality of environmental cleaning and disinfection.

One of the key lessons learned from our experience was importance of instituting intensive control measures immediately following identification of the index case. Current best practice guidelines in France recommend only contact precautions for IRAB both in ICUs and in other care settings. In our opinion, in ICU settings contact precautions alone are insufficient. Our experience shows that IRAB has a significantly stronger epidemic propensity than VRE and can carry a greater risk of serious infection. For a more effective control of cross-transmission, patients with a lab-confirmed IRAB should be placed in single rooms, with dedicated nursing personnel, as is currently recommended for VRE and CPE. Cho et al. suggested that cohorting patients colonized or infected with IRAB had a significant impact on reducing the transmission (14). Infection control measures should subsequently be modified according to the outcome of the case, contact screening and a risk analysis of cross-transmission. The latter should include a minimal assessment of infection control measures, monitoring of the volumes of alcohol-based hand rub utilization and the health care team’s experience in managing multidrug-resistant pathogens.
Canadian Journal of Infection Control | Spring 2016 | Volume 31 | Issue 1 | 24-27

Given the persistent nature of *A. baumannii* as a hospital pathogen and its multiple routes of transmission, various national and international recommendations on control measures to prevent its spread have been issued (15,16). The efficiency of these outbreak control measures is better when they are applied in a multidisciplinary team approach and early in the outbreak, ideally when the index case has been identified.

**REFERENCES**


**FIGURE 2:** Synoptique curve

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<td>IPAC control measures</td>
<td>24</td>
<td>6</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>1</td>
<td>14</td>
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<tr>
<td>SICU B</td>
<td></td>
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<td>case 5</td>
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<tr>
<td>IPAC control measures</td>
<td>24</td>
<td>6</td>
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<tr>
<td>MICU</td>
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<td>case 6</td>
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<td>IPAC control measures</td>
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<td>14</td>
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<tr>
<td>Orthoped ward</td>
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<td>case 8</td>
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<tr>
<td>IPAC control measures</td>
<td>24</td>
<td>6</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>1</td>
<td>14</td>
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<tr>
<td>Urology ward</td>
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<td>case 9</td>
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<tr>
<td>IPAC control measures</td>
<td>24</td>
<td>6</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>1</td>
<td>14</td>
</tr>
</tbody>
</table>

Unknown IRAB carriage | Positive patient | Screening and contact precautions and env. disinfection x2/day | Cohorting


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2Hospital Clínica Bíblica, San José de Costa Rica, Costa Rica.
3International Nosocomial Infection Control Consortium (INICC), Buenos Aires, Argentina.

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Website: www.inicc.org

ABSTRACT
Objective: To report the results of the International Nosocomial Infection Control Consortium (INICC) study conducted in Costa Rica from April 2007 to April 2015.

Methods: A device-associated healthcare-acquired infection (DA-HAI) prospective surveillance study in two adult intensive care units (ICUs) from two hospitals applying CDC/NHSN's criteria and definitions, using INICC Online Surveillance System.

Results: Data was collected from 1,128 adult ICU patients over 4,055 bed-days. The central line-associated bloodstream infection (CLABSI) rate was 2.9 per 1,000 central line (CL)-days, the ventilator-associated pneumonia (VAP) rate was 30.7 per 1,000 mechanical ventilator (MV)-days, and the catheter-associated urinary tract infection (CAUTI) rate was 1.5 per 1,000 urinary catheter (UC)-days. The CLABSI rate was similar to INICC rates (4.9) and higher than CDC/NHSN rates (0.8), with a higher CL device utilization ratio (DUR). The CAUTI rate was lower than INICC's (5.3) and similar to CDC/NHSN's (1.3), with a lower UC DUR. Despite the VAP rate being higher than INICC (16.5) and CDC/NHSN's rates (1.1), MV DUR was lower in this study’s ICUs.

Resistance rates of S. aureus to oxacillin and of E. coli to imipenem and meropenem were higher than INICC and CDC/NHSN's rates.

Excess length of stay was 11.2 days for patients with CLABSI and 13.6 for patients with VAP. Excess crude mortality was 25.6% for patients with VAP.

Conclusions: Most DA-HAI rates found in this study’s ICUs are higher than CDC/NHSN’s rates and similar to or higher than INICC rates.

KEY WORDS
Hospital infection; device-associated infection; antibiotic resistance; ventilator-associated pneumonia; catheter-associated urinary tract infection; central line-associated bloodstream infections.

INTRODUCTION
Device-associated healthcare-acquired infections (DA-HAIs) are among the primary threats to patient safety in the intensive care unit (ICU), and are responsible for substantial patient morbidity and mortality (1). Comprehensive infection control programs focused on DA-HAI surveillance have had effective results, as demonstrated in different studies conducted in the U.S. that stated the incidence of DA-HAI can be reduced by as much as 30%, and that a parallel reduction in healthcare costs was also possible (2).

In the same way, it is essential to address the burden of antimicrobial-resistant infections and report pathogens and susceptibility to antimicrobials of DA-HAI-associated pathogens, so that informed decisions can be made to effectively prevent transmission of resistant strains and their determinants, such as strains with phenotypes with very few available treatments with chances of success (3).

In the U.S., the Centers for Disease Control and Prevention’s National Healthcare Safety Network (CDC/NHSN) (4) has provided benchmarking U.S. ICU data on DA-HAIs, which have

Acknowledgements
The authors thank the many healthcare professionals at each member hospital who assisted with the conduct of surveillance in their hospital; Mariano Vilar and Débora López Burgardt; Haifaa Hassan Al-Mousa, Hail Alabdaly, Areej Alshehri, Altal Ahmed, Carlos A. Álvarez-Moreno, Anucha Apisarnthanarak, Bije Hu, Hakan Leblebicigü, Yatin Mehta, Toshihiro Mitsuda, and Lul Raka; and members of the INICC Advisory Board who have so generously supported this unique international infection control network.

Potential conflicts of interest: All authors report no conflicts of interest related to this article. Every hospital’s Institutional Review Board agreed to the study protocol, and patient confidentiality was protected by codifying the recorded information, making it only identifiable to the infection control team.
proven invaluable for researchers during more than 40 years, and served as an inspiration to the International Nosocomial Infection Control Consortium (INICC)(5).

Founded in Argentina in 1998, 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 (6). 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 (7, 8).

The INICC has the following goals: to create a dynamic global network of hospitals worldwide and conduct surveillance of DA-HAIs and SSIs using standardized CDC/NHSN definitions and established methodologies, to carry out applied infection control research and promote the implementation of evidence-based infection control practices; to provide surveillance tools and training to individual hospitals to conduct outcome and process surveillance of DA-HAIs and SSIs, measure their consequences, and assess the impact of infection control practices; to improve the safety and quality of healthcare world-wide through the implementation of systematized programs to reduce rates of DA-HAIs and SSIs, their associated mortality, excess lengths of stay (LOS), excess costs, antibiotic usage, and bacterial resistance (9). Surveillance is conducted by means of an online platform called INICC Surveillance Online System (ISOS) that comprises 15 modules, whose effective impact in DA-HAI rates reduction was shown in several studies (10-25).

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 (6). The site-specific criteria into specific module protocols that apply U.S. CDC/NHSN’s definitions published in January 2015 (6). The site-specific criteria include reporting instructions and provide full explanations of the site-specific criteria that apply to the surveillance of HAIs in inpatient wards and step down units; 3) Surveillance of Needle Stick Injuries, 4) Cohort Surveillance of surgical procedures and surgical site infections (CDIs); 2) Antimicrobial Consumption; 3) Surveillance of Needle Stick Injuries, 4) Cohort Surveillance of surgical procedures and surgical site infections; 5) feedback on HAI rates and consequences; and 6) performance feedback.

Outcome and process surveillance are conducted by means of an online platform called INICC Surveillance Online System (ISOS). The ISOS comprises 15 modules: 10 for Outcome Surveillance and five for Process Surveillance. The modules of the outcome surveillance and process surveillance components may be used singly or simultaneously, but once selected; they must be used for a minimum of one calendar month.

This study presents the results of the Cohort Surveillance of HAIs in adult, pediatric and neonatal ICUs. The results of the remaining Outcome Surveillance modules (1) C. difficile infections (CDIs); 2) Antimicrobial Consumption; 3) Surveillance of Needle Stick Injuries, 4) Cohort Surveillance of HAIs in inpatient wards and step down units; 5) Cohort Surveillance of surgical procedures and surgical site infections; and of the modules for Process Surveillance, Feedback on HAI rates and consequences, and Performance Feedback were not included in this report, because they will be published in another future study.

Outcome surveillance
Outcome surveillance included Cohort Surveillance of HAIs in adult ICUs conducted through the ISOS, which allows the classification of prospective, active, cohort surveillance data into specific module protocols that apply U.S. CDC/NHSN’s definitions updated in 2015 (6). The site-specific criteria include reporting instructions and provide full explanations integral to their adequate application (6).

METHODS
Background on INICC
INICC is comprised of more than 2,000 hospitals in 500 cities of 66 countries in Latin America, Asia, Africa, Middle East, and Europe, and has become the only source of aggregate standardized international data on the epidemiology of healthcare-associated infections (HAIs) internationally (5). The INICC is focused on the surveillance and prevention of DA-HAI in adult, pediatric ICUs and neonatal ICUs (NICUs), step down units, inpatient wards, and of SSIs in surgical procedures hospital wide.

Setting and study design
This prospective cohort surveillance study was conducted in two medical/surgical ICUs from two hospitals in San José, Costa Rica, through the implementation of the INICC Multidimensional Approach (IMA), as described below. In accordance with the INICC’s charter, the identity of all INICC hospitals and cities is kept confidential.

INICC multidimensional approach
The IMA includes the implementation of CDC/NHSN’s definitions of HAIs and methodology, but adds the collection of other data essential to increase ICPS’s sensitivity of to detect HAIs, and avoid underreporting (6). According to standard CDC/NHSN methods, numerators are the number of HAIs of each type, and denominators are device-days collected from all patients, as pooled data; that is, without determining the number of device-days related to a particular patient, and without collecting features or characteristics per specific patient (6). This aspect differs from the INICC surveillance system, because the design of the cohort study through the INICC methods also includes collecting specific data per patient from all patients, both those with and those without HAI, collecting risk factors of HAIs, such as invasive devices, and surrogates of HAIs, which include, but are not limited to, high temperature, low blood pressure, results of cultures, antibiotic therapy, LOS and mortality. By collecting data on all patients in the ICU, it is possible to match patients with and without HAI by several characteristics to estimate extra LOS, mortality and cost.

The IMA comprises the 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.

Outcome and process surveillance are conducted by means of an online platform called INICC Surveillance Online System (ISOS). The ISOS comprises 15 modules: 10 for Outcome Surveillance and five for Process Surveillance. The modules of the outcome surveillance and process surveillance components may be used singly or simultaneously, but once selected; they must be used for a minimum of one calendar month.

This study presents the results of the Cohort Surveillance of HAIs in adult, pediatric and neonatal ICUs. The results of the remaining Outcome Surveillance modules (1) C. difficile infections (CDIs); 2) Antimicrobial Consumption; 3) Surveillance of Needle Stick Injuries, 4) Cohort Surveillance of HAIs in inpatient wards and step down units; 5) Cohort Surveillance of surgical procedures and surgical site infections; and of the modules for Process Surveillance, Feedback on HAI rates and consequences, and Performance Feedback were not included in this report, because they will be published in another future study.
### TABLE 1: Pooled means of the distribution of crude mortality, crude excess mortality, length of stay, and crude excess length of stay, of adult intensive care unit patients with and without device-associated healthcare-acquired infection

<table>
<thead>
<tr>
<th>Patients</th>
<th>Patients, n</th>
<th>Deaths, n</th>
<th>Pooled crude mortality, %</th>
<th>Pooled crude extra mortality, % (95% CI)</th>
<th>LOS, total days</th>
<th>Pooled average LOS, days</th>
<th>Pooled average extra LOS, days (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without DA-HAI</td>
<td>1,086</td>
<td>41</td>
<td>3.8%</td>
<td>-</td>
<td>3,093</td>
<td>2.8</td>
<td>-</td>
</tr>
<tr>
<td>With CLABSI</td>
<td>6</td>
<td>0</td>
<td>0.0%</td>
<td>-</td>
<td>67</td>
<td>11.2</td>
<td>8.3 (5.9–11.2)</td>
</tr>
<tr>
<td>With VAP</td>
<td>34</td>
<td>10</td>
<td>29.4%</td>
<td>25.6% (12.4–42.4)</td>
<td>461</td>
<td>13.6</td>
<td>10.7 (9.6–11.9)</td>
</tr>
</tbody>
</table>

ICU, intensive care units; 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 2: Antimicrobial resistance rates in the participating intensive care units

<table>
<thead>
<tr>
<th>Pathogen, antimicrobial</th>
<th>(CLABSI)</th>
<th>(CLABSI)</th>
<th>(VAP)</th>
<th>(VAP)</th>
<th>(CAUTI)</th>
<th>(CAUTI)</th>
<th>(Pooled)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S. aureus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxacillin</td>
<td>0</td>
<td>-</td>
<td>1</td>
<td>100%</td>
<td>0</td>
<td>-</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Coagulase-negative staphylococci</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxacillin</td>
<td>1</td>
<td>100%</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>100%</td>
</tr>
<tr>
<td><strong>P. aeruginosa</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>0</td>
<td>-</td>
<td>5</td>
<td>20%</td>
<td>0</td>
<td>-</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Piperacillin-tazobactam</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>5</td>
<td>40%</td>
<td>1</td>
<td>0%</td>
<td>37.5%</td>
<td></td>
</tr>
<tr>
<td><strong>Amikacin</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>5</td>
<td>40%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td><strong>Imipenem or meropenem</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>100%</td>
<td>0</td>
<td>-</td>
<td>8</td>
<td>50%</td>
<td>55.6%</td>
<td></td>
</tr>
<tr>
<td><strong>K. pneumoniae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imipenem or meropenem</td>
<td>0</td>
<td>-</td>
<td>4</td>
<td>0%</td>
<td>0</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td><strong>A. baumannii</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piperacillin-tazobactam</td>
<td>0</td>
<td>-</td>
<td>1</td>
<td>0%</td>
<td>0</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Imipenem or meropenem</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-</td>
<td>1</td>
<td>0%</td>
<td>0</td>
<td>-</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td><strong>E. coli</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imipenem or meropenem</td>
<td>0</td>
<td>-</td>
<td>2</td>
<td>50%</td>
<td>0</td>
<td>-</td>
<td>50%</td>
</tr>
</tbody>
</table>

CLABSI, central line-associated bloodstream infection; VAP, ventilator-associated pneumonia; CAUTI, catheter-associated urinary tract infection.
Data collection and analysis

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

These data were uploaded to the ISOS, and were used to calculate DA-HAI rates per 1000 device-days, mortality and LOS, 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 (ICPs) and hospital epidemiologists at 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 the ISOS. In addition, ICPs assisted webinars, had continuous e-mail and telephone access to a support team at the INICC headquarters in Buenos Aires, Argentina.

Definitions

The ISOS uses the CDC/NHSN surveillance definitions and criteria for all specific types of HAIs published in 2015 (6).

Statistical analysis

INICC Surveillance Online System (ISOS) version 2.0 (Buenos Aires, Argentina), was used to calculate HAI rates, DUR, LOS and mortality. EpInfo® 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 1 April 2007 through 30 April 2015, 1,128 patients were hospitalized in the two participating medical surgical ICUs, amounting to 4,055 bed-days. The mean length of participation of the ICUs was (SD), 43.7 (35.6) months, range from 22 to 97 months.

The pooled means of the DA-HAI rates were 2.9 (n, 7) CLABs per 1,000 CL-days, during 2,422 CL-days with a DUR of 0.60 (95% CI, 0.58 – 0.61); 30.7 (n, 36) VAPs per 1,000 MV-days, during 1,173 MV-days, with a DUR of 0.29 (95% CI, 0.28 – 0.30); and 1.5 (n, 3) CAUTIs per 1,000 UC-days, during 2,021 UC-days, with a DUR of 0.50 (95% CI, 0.48 – 0.51).

Table 1 provides pooled means on crude ICU mortality and LOS in patients hospitalized during the surveillance period, with and without DA-HAI, and crude excess mortality and LOS of patients with CLABSI and VAP. The DA-HAI associated with the highest mortality and longest LOS was VAP. CAUTI mortality was not calculated due to the small sample size.

Table 2 provides data on bacterial resistance of pathogens isolated from patients with DA-HAI in ICUs. Resistance rates of S. aureus and coagulase negative staphylococcus to oxacillin and of P. aeruginosa to imipenem/meropenem were high.

Table 3 compares the results of this report from Costa Rica with the INICC international report for the period 2007-2012 and with the US CDC/NHSN report of 2013 (4, 5). The rate of VAP was higher in this study than in INICC and CDC/NHSN reports. The CLABSI rate was higher in this study than in CDC/NHSN, but it was similar to the INICC rates. Finally, the rate of CAUTI in this study was lower than INICC and similar to CDC/NHSN’s rate. Although the DUR was higher for CL in this study compared to INICC and CDC/NHSN, UC DUR was lower than INICC and CDC/NHSN’s.

Table 4 compares the antimicrobial resistance rates of this report from Costa Rica with the INICC international report for the period 2007-2012(5) and with the US CDC/NHSN report of 2009-2010 (3). Resistance of S. aureus to oxacillin and E. coli to imipenem or meropenem was higher in this study than in both of the afore-mentioned international reports.

DISCUSSION

This is the first study that has analyzed DA-HAIIs in Costa Rica. If compared with other similar studies conducted in Latin America, the DA-HAI rates found in this study are significantly higher. In a study conducted in Colombia, DA-HAI rates were higher than this study’s: the rate of VAP was 32.3 per 1,000 MV-days, the CLABSI rate was 47.4 per 1,000 CL-days, and the CAUTI rate was 20.3 per 1,000 UC-days (27). By contrast, pooled crude mortality was higher in this study than in a study conducted in Colombia, whose findings showed that the crude unadjusted mortality attributable to DA-HAI was 16.9% among patients with VAP (relative risk [RR], 1.93; 95% confidence interval [CI], 1.24-3.00; P=.002); 18.5% among those with CLABSI (RR, 2.02; 95% CI, 1.42-2.87; P<.001); and 10.5% among those with CAUTI (RR, 1.58; 95% CI, 0.78-3.18; P=.19).(27)In Peru, Cuellar L. et al. found that the VAP rate was 31.3 per 1000 MV-days; the CLABSI rate was 7.7 cases per 1000 CL-days; and the rate for CAUTI was 5.1 cases per 1000 UC-days. In a similar study conducted in ICUs in Brazil, VAP posed the greatest risk (20.9 per 1000 MV-days), followed by CAUTI (9.6 per 1000 UC-days) and CLABSI (9.1 per 1000 CL-days) (29).

From an international perspective, the results of this study show that most DA-HAI rates and DURs found in the ICU setting of Costa Rica were significantly higher than the rates reported by the U.S. CDC/NHSN, which would well represent the situation in high-income countries (4). On the other hand, the CLABSI rate in this study was higher than the international INICC Report (2007-2012) for 43 countries (5),

<table>
<thead>
<tr>
<th>Medical Surgical ICU</th>
<th>This Report Rate (95% CI)</th>
<th>INICC Report (2007-2012)(5) Rate (95% CI)</th>
<th>U.S. CDC-NHSN Report (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI rate (CLABSI per 1000 CL-days)</td>
<td>2.9 (1.2 – 6.0)</td>
<td>4.9 (4.8 – 5.1)</td>
<td>0.8</td>
</tr>
<tr>
<td>MV, DUR</td>
<td>0.29 (0.28 – 0.30)</td>
<td>0.36 (0.36 – 0.36)</td>
<td>0.24</td>
</tr>
<tr>
<td>VAP rate (VAPs per 1000 MV-days)</td>
<td>30.7 (21.5 – 42.5)</td>
<td>16.5 (16.1 – 16.8)</td>
<td>1.1</td>
</tr>
<tr>
<td>UC, DUR</td>
<td>0.50 (0.48 – 0.51)</td>
<td>0.62 (0.62 – 0.62)</td>
<td>0.54</td>
</tr>
<tr>
<td>CAUTI rate (CAUTIs per 1000 UC-days)</td>
<td>1.5 (0.3 – 4.3)</td>
<td>5.3 (5.2 – 5.8)</td>
<td>1.3</td>
</tr>
</tbody>
</table>

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; CDC-NHSN, Centers for Disease Control and Prevention’s National Healthcare Safety Network.


<table>
<thead>
<tr>
<th>Pathogen, antimicrobial</th>
<th>This Report Resistance % (n/n)</th>
<th>INICC 2007-2012 Resistance %</th>
<th>CDC-NHSN 2009-2010 Resistance, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus Oxacillin</td>
<td>100% (1/1)</td>
<td>62%</td>
<td>48.4%</td>
</tr>
<tr>
<td>P. aeruginosa Ciprofloxacin</td>
<td>20% (1/5)</td>
<td>41.9%</td>
<td>32.7%</td>
</tr>
<tr>
<td>Piperacillin or piperacillin-tazobactam</td>
<td>40% (2/5)</td>
<td>35.8%</td>
<td>19.1%</td>
</tr>
<tr>
<td>K. pneumoniae Imipenem or meropenem</td>
<td>0% (0/4)</td>
<td>17.2%</td>
<td>11.2%</td>
</tr>
<tr>
<td>A. baumannii Imipenem or meropenem</td>
<td>0% (0/1)</td>
<td>77.1%</td>
<td>61.2%</td>
</tr>
<tr>
<td>E. coli Imipenem or meropenem</td>
<td>50% (1/2)</td>
<td>7.5%</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

VAP, ventilator-associated pneumonia; CDC-NHSN, Centers for Disease Control and Prevention’s National Healthcare Safety Network.
representing middle and low-income countries, as was the CL DUR. By contrast, despite the VAP rate in this study being substantially higher than INICC’s, the DUR for MV in this study was lower, pointing to potential risk factors other than DURs influencing DA-HAI rates. Finally, the CAUTI rate in this study was lower than INICC’s and similar to CDC/NHSN’s, with a lower UC DUR than both international reports; however, these results should be considered cautiously due to a small sample size (4, 5).

The antimicrobial resistance rates found in this ICUs were higher than CDC/NHSN (4) and INICC reports (5) rates for \textit{S. aureus} as resistant to oxacillin, for \textit{P. aeruginosa} as resistant to piperacillin-tazobactam, and for \textit{E. coli} as resistant to imipenem or meropenem. On the other hand, the resistance rates for \textit{P. aeruginosa} to ciprofloxacin, \textit{K. pneumoniae} as resistant to imipenem or meropenem, and \textit{A. baumannii} as resistant to imipenem or meropenem were lower in this study than U.S. CDC/NHSN report, (3) and also lower than the INICC reported resistance rates (5).

There are many reasons that can explain these higher DA-HAI rates compared both to US CDC/NHSN and INICC reports (30, 31). As in other countries, adherence to infection control bundles in Costa Rica is variable, nurse-to-patient staffing ratios are usually low (and closely associated with higher DA-HAI rates in ICUs), as well as hospital over-crowding, and an insufficient number of experienced nurses or trained healthcare workers (32).

In order to reduce the risk of infection of patients hospitalized in ICUs, surveillance targeting DA-HAI is fundamental to effectively addressing the burden of DA-HAIs. Surveillance should be complemented with implementation of other practices aimed at DA-HAI control and prevention. In this sense, participation in INICC has played a critical role, not only in increasing the awareness of the risks posed by DA-HAIs in the ICU, but also providing an exemplary basis for the implementation of infection control practices through the use of an online process surveillance tool.

The INICC program is focused on surveillance of DA-HAIs in the ICUs, step down units and general wards, and surveillance of SSIs hospital wide. This particular study was focused on ICUs, because they are the healthcare settings that represent the highest HAI rates, due to patients’ critical condition and exposure to invasive devices (32). Through the last 12 years, INICC has undertaken a global effort in America, Asia, Africa, Middle East, and Europe to prevent and control DA-HAIs, and has demonstrated success by increasing HH compliance, improving compliance with infection control bundles and interventions as described in several INICC publications, and consequently facilitating reduction of the rates of DA-HAI and mortality (15, 16, 33-35).

To compare a hospital’s DA-HAI rates with the rates identified in this report, it is required that the hospital team concerned collect their 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.

The particular and primary application of these data is to serve as a guide for the implementation of prevention strategies and other quality improvement efforts in Costa Rica for the reduction of DA-HAI rates to the minimum possible level.

\textbf{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.

\textbf{CONCLUSIONS}

In conclusion, the data presented in this report fortify the fact that DA-HAIs in Costa Rica are a challenge for patient safety. It is INICC’s main goal to enhance infection control practices, by facilitating elemental, feasible and inexpensive tools and resources to tackle this problem effectively and systematically, leading to greater and stricter adherence to infection control programs and guidelines, and subsequently to the reduction in DA-HAI in the hospitals participating in INICC, as well as at any other healthcare facility worldwide.

\textbf{REFERENCES}


INTRODUCTION

Escherichia vulneris is a relatively recently identified environmental organism that can colonize humans and animals (2). Escherichia vulneris was formerly known as CDC enteric group 1 and was recognized as a new species of the family Enterobacteriaceae only in 1982 (3). It is a gram-negative, oxidase-negative, indole-negative, fermentative, motile rod with the characteristics of the family Enterobacteriaceae. It has been isolated from animals, the environment, potable water, and humans (3, 4). In humans, E. vulneris can colonize the respiratory tract, female genital tract, urinary tract, and gastrointestinal tract; however, its propensity for wound colonization led to it being named “vulneris” (Latin for “wound”) (3).

To date, only few human infections with E. vulneris have been reported (1). Here we report on a rare case of wound infection caused by this pathogen.

METHODS

Three wound swabs were collected from the margins of the wound. One swab was transported in thioglycolate broth for anaerobic culture. From second swab primary cultures were done on blood agar, chocolate agar, MacConkey agar, Sabouraud agar and glucose broth was also inoculated. Cultures were incubated aerobically and anaerobically at 37°C overnight. Two Sabouraud agar plates were incubated at 25°C and 37°C. Microscopic examination of Gram-stained smears of the purulent secretions from the third swab, revealed many white cells and gram-negative rods.

RESULTS

Following overnight incubation aerobically, pure colonies were obtained on blood agar and MacConkey agar plates. No growth was seen on plates incubated anaerobically. Colonies on blood agar were circular, 1-3 mm in diameter, low convex, smooth, translucent and yellow-pigmented. On MacConkey agar colonies were pink indicating that the organism ferments lactose. The isolated microorganism was motile. It was identified as Escherichia vulneris by use of the Vitek® 2 system (BioMérieux). Specifically, the microorganism fermented d-glucose to acid and gas, d-mannitol, l-arabinose, maltose, trehalose, cellobiose, d-mannose; negative for lactose, sucrose, adonitol, d-sorbitol arabinose, d-arabitol. It gave negative reactions for indole, oxidase test, esculin hydrolysis, arginine dihydrolase, H2S, and urease production, and for lysine and ornithine decarboxylase and citrate; its Voges-Proskauer reaction was also negative. Methyl red test was positive, and nitrate was reduced to nitrite. Antimicrobial susceptibility testing of the microorganism was determined by the VITEK® 2 system according to the CLSI MIC interpretative standards (1). The isolate was found susceptible to amoxicillin, ampicillin-sulbactam,
piperacillin-tazobactam, cefazolin, ceftriaxone, ceftipime, ceftazidime, aztreonam, imipenem, meropenem, ertapenem, ciprofloxacin, moxifloxacin, tobramycin, amikacin, gentamicin, trimethoprim-sulfamethoxazole, and resistant to cefuroxime and nitrofurantoin. Based on the susceptibility results, the patient was given augmentin and patient improved after 72 hours.

**DISCUSSION**

In 1982, Brenner et al. (3) classified *Escherichia vulneris* as a new species in the family Enterobacteriaceae on the basis of DNA relatedness studies and biochemical reactions. *E. vulneris* has a propensity for causing human wound infections, particularly of the arms and legs (5), which is consistent with our case that developed a wound on his foot. Most isolates of *E. vulneris* have been recovered from wounds. However, pathogenicity has not always been evident (5).

The patient had injury from a wooden block on the road and *E. vulneris* has been reported to be an environmental organism that can colonize and infect wounds in humans and animals (2). Clinical significance of *E. vulneris* has not been established yet, however *E. vulneris* has been reported to be the sole pathogen in some cases of osteomyelitis, urosepsis, and bacteremia (6, 7, 8). Previous isolations from wound have been reported but *E. vulneris* was not the sole isolate (6). In wounds with *E. vulneris* infection, co-infection with other bacteria has been observed. (5), (9), (10). However, in our case, the organism grew in primary cultures as a pure growth. The organism showed biochemical reactions to place it in genus *Escherichia* and species *vulneris* (5). No other aerobes or anaerobes or fungi were isolated from wound suggesting that it was a sole pathogen, further attested by the fact that patient improved after appropriate antibiotic therapy.

In this case, susceptibility testing was performed by disk diffusion methods using CLSI zone diameter interpretive standards for *Enterobacteriaceae* because *E. vulneris* is a recognized species of this family (5) and by VITEK® 2 system; however, *E. vulneris* is not noted specifically in the CLSI performance standards for antimicrobial susceptibility testing. A review of 23 *E. vulneris* strains found that they were not identical to *Escherichia coli*, being slightly more susceptible to aminoglycosides and slightly less susceptible to nitrofurantoin (2, 11). This is consistent with our case as it was also susceptible to most of the antibiotics except cefuroxime and nitrofurantoin.

Though *E. vulneris* can cause infections in wounds particularly in upper and lower limbs, it responds to most of the routinely used antibiotics.

*Escherichia vulneris* isolation has been reported from reusable sharps container by Runner J C (12). Wild birds have also been reported to transmit multidrug resistant *E.coli* and *E.vulneris* to water streams and other environmental sources through their faecal residues, and to remote regions by migration (13). Within hospital environment patients colonized or infected with *E. vulneris* should be managed on Universal Precautions/ Routine Practices to reduce the risk of transmission.
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<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>President’s Message</td>
</tr>
<tr>
<td>46</td>
<td>Message de la présidente</td>
</tr>
<tr>
<td>47</td>
<td>From the Executive Desk</td>
</tr>
<tr>
<td>49</td>
<td>2016 National Education Conference</td>
</tr>
<tr>
<td>59</td>
<td>Board Elections</td>
</tr>
<tr>
<td>65</td>
<td>Honorary Member</td>
</tr>
<tr>
<td>66</td>
<td>CIC® Graduates</td>
</tr>
</tbody>
</table>
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The **what, how and why**

It’s spring... I think!? With the sprouting of daffodils comes a time of some much-needed inspiration! Colleague and friend, Greg Bruce, shared an inspirational speaker’s video with me and I have to say, I was inspired! It was entitled *Start with Why: How great leaders inspire action* with Simon Sinek.

Sinek describe what he calls the Golden Circle; a series of concentric circles with the outer ring signifying the *what*, the middle ring as the *how* and the inner circle representing the *why*. He went to explain that there are leaders, those in positions of authority, and then there are those who lead and who inspire others. The key point is that those leaders who can inspire start thinking, acting, and communicating from the inside out or from the inner circle of the *why*. Have I confused you? In other words, people (insert patients/healthcare workers/teenagers!) don’t buy what you do but *why* you do.

I have seen this philosophy successfully in action a number of times in the field of infection prevention and control; not often, but often enough to know it can be a key to success. I think the general collective relies on thinking, acting and communicating from that outer ring; from the *what*. As Sinek summed up his talk, he cited Martin Luther King’s famous words, “I have a dream!” What Martin Luther King did not say was “I have a plan!” Let’s just try out this approach and see how we all do. Let’s see if we can get better, safer, patient outcomes because we thought, acted, and communicated the *why*.

In my own professional life, I am closing out one chapter, leaving the civil service, and going back to my roots in the clinical setting with the Nova Scotia Health Authority. The last day of work was a tough day indeed; however, it was affirming to have well-respected colleagues share their thoughts and what impacts I had on them professionally. I was told by one that he saw me as a “true believer of what healthcare should be” and that he had no doubt that that vision will transfer nicely with me as I embark on my new role. My hope and expectation of myself is that I will, in fact, show to my new team and colleagues the *why* of what we are doing and that the patients in our care reap the results.

Looking forward to seeing everyone at the 2016 IPAC Canada Education Conference in Niagara Falls! This year’s theme is *Wisdom Begins With Wonder* – perhaps the IPAC Conference Scientific Planning Committee was unknowingly channeling MLK?

See you in Niagara Falls! 🌟

“With the sprouting of daffodils comes a time of some much-needed inspiration! Colleague and friend, Greg Bruce, shared an inspirational speaker’s video with me and I have to say, I was inspired!”
Le quoi, comment et pourquoi

C'est le printemps... au moins, je pense que oui! Le bourgeonnement des jonquilles arrive à un moment où nous pouvons nous trouver en deuil d'inspiration. Mon collègue et ami, Greg Bruce, a partagé avec moi la vidéo d'un conférencier motivation et je dois l'admettre, j'ai été inspiré! La vidéo est produite par Simon Sinek et s'intitule « Start with Why: How great leaders inspire action ». Dans cette vidéo, M. Sinek décrit ce qu'il appelle le Cercle d’or : un ensemble de trois cercles concentriques dont le pourquoi est au centre. Le cercle suivant représente le comment, et le dernier cercle, le quoi. M. Sinek enchaîne en précisant qu’il y a des dirigeants qui sont en position d’autorité, et il y a des dirigeants qui guident et qui inspirent les autres. Le point essentiel est que les dirigeants inspirés pensent, agissent et communiquent de l’intérieur vers l’extérieur, à partir du pourquoi. Autrement dit, les gens (patients/travailleurs de la santé/et même les adolescents!) ne sont pas convaincus par ce que vous faites; ils sont convaincus par la raison qui vous pousse à le faire (le pourquoi).

J’ai observé à plusieurs reprises la réussite de la mise en pratique de cette philosophie dans le domaine de la prévention et du contrôle des infections. Pas souvent, mais assez souvent pour savoir qu’elle peut être la clé du succès. Je crois qu’en général notre manière de penser, d’agir et de communiquer se fait à partir de l’extérieur, du quoi. M. Sinek résuma son exposé avec les célèbres paroles de Dr Martin Luther King : « I have a dream! » Dr King n’a pas dit, « I have a plan! » Essayons d’adopter cette démarche et d’observer comment nous nous en tirons. Voyons si nous pouvons obtenir de meilleurs résultats plus sécuritaires pour les patients parce que nous avons pensé, agi, et communiqué le pourquoi.

Dans ma vie professionnelle, je ferme tout un chapitre en quittant la fonction publique pour le retour aux sources en milieu clinique avec la Nova Scotia Health Authority. Mon dernier jour de travail a été très difficile. Cependant, c’était encourageant d’entendre mes collègues que je respecte énormément me faire part de leurs réflexions professionnelles et de l’effet positif que j’ai eu sur eux. L’un d’eux m’a dit que je représentais pour lui une vraie partisane de ce que les soins de santé devraient être et qu’il était sûr que j’aller bien transérer cette vision dans mon nouveau rôle. J’ai bon espoir que je démontrerai à ma nouvelle équipe et mes collègues le pourquoi de ce que nous faisons et que nos patients en retirent les bénéfices.

Au plaisir de vous voir tous au congrès éducatif 2016 de PCI Canada à Niagara Falls! Le thème de cette année sera « Wisdom Begins With Wonder ». Le comité de planification scientifique du congrès de PCI Canada a-t-il inconsciemment canalisé le Dr King?

On se retrouvera à Niagara Falls! 🌟

« Le bourgeonnement des jonquilles arrive à un moment où nous pouvons nous trouver en deuil d’inspiration. Mon collègue et ami, Greg Bruce, a partagé avec moi la vidéo d’un conférencier motivation et je dois l’admettre, j’ai été inspiré! »
Sharing a Common Interest

It was an honour to be able to attend the 2016 conference of the International Federation of Infection Control (IFIC) in Vienna in March 2016. With my colleagues from the IPAC Canada Board of Directors, Suzanne Rhodenizer Rose and Ramona Rodrigues, I spent a most enjoyable four days of education, international networking, and memorable social events.

My perspective at the conference was likely a little different than my practitioner colleagues. I looked at the administrative networking opportunities, interaction with industry, and the education sessions that would help me better understand the profession, the issues, and the practices of other professional organizations. What struck me, and this has been noted by others who have attended this international conference, is the diversity of attendees and their backgrounds, yet the similarity of the concerns and experiences.

In North America, we are fortunate to be able to work towards national recognition of the profession and facilitation of various initiatives with the support of a large membership base and collaboration with stakeholder organizations. Not so our colleagues in countries with significantly fewer resources. They are often working in silos, with little or no funding and even fewer opportunities for networking and education. It is ingrained in our Canadian nature to provide whatever support we can to those asking for assistance. We cannot possibly help everyone in every part of the world, but we certainly do what we can within our own means. It has been our honour for over a decade now to provide funding for IFIC scholarships, which bring attendees to the IFIC conference who might otherwise not be able to participate. Many of our chapters also support the IFIC scholarship through their individual donations, and the Board of IFIC gratefully acknowledged them. The enthusiasm and optimism of those mostly new infection prevention and control professionals attending this prestigious international conference is certainly a bug we want to catch.

The South African Infection Control Association will hold its conference in Johannesburg, South Africa in September 2016. One of the workshops being planned is designed to assist struggling countries with the creation of professional networking and education associations. Our 40 years as a professional organization have flown by and we do not forget the strength of purpose required by our pioneers in forming such an important body. The will to stand together to gain the wisdom to fight infections, to educate healthcare providers, and to reassure patients, residents and families that we are there to protect, continues to be a wonder.

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2016 Annual General Meeting

NOTICE IS HEREBY SERVED that the Annual General Meeting (AGM) of Infection Prevention and Control Canada will be held on Wednesday, May 18, 2016 at the Scotiabank Convention Centre, Niagara Falls, Ontario. Breakfast will be served at 0715. Registration will open at 0700. IPAC Canada members must register and pick up a voting card before entering the AGM. The AGM will commence at 0745. Registration will close at 0745 and the doors will be closed. After the doors are closed, attendees may enter the AGM, but may not vote unless registered.

Members may vote on business arising at the AGM by proxy using Form #15 2016 which must be submitted to the IPAC Canada Secretary at the IPAC Canada office no later than Thursday, May 12, 2016. The AGM Agenda, Rules of Order and Proxy Form #15 2016 will be posted to the website in early 2016 and an announcement made of their availability.

Marilyn Weinmaster, Secretary
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chodgkin@invacare.com

IPAC Canada
Booths 11-15
www.ipac-canada.org

Imperia Device Reprocessing Association of Ontario
7052684763
mdrao@ntl.sympatico.ca

Medical Mart
Booth 5
905-624-6200
marketing@medimart.com

MEDIQUE Medical Supplies (MGBR) Inc.
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nathalie@mediquemed.com

Medline Canada
Booth 23
905-636-2120
jrasavong@medline.com

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catherinet@moleculight.com

Nanosonics
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p.patole@nanosonics.com.au

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289-269-0204
roxanne.deabreu@olympus.com

Pall Medical
Booths 35, 36
613-291-2870
matthew_antoine@pall.com

Pall Medical
Booths 35, 36
613-291-2870
matthew_antoine@pall.com

Detecto Scale
Booth 73
417-673-4631
llihou@cardet.com

Ecolab
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678-896-4202
susan.peszko@ecolab.com

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alison.duffy@ergocentric.com

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michael.aguiar@hill-rom.com

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RL Solutions
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fernanda@rlsolutions.com

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customer service@sageproducts.com
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jm Cunning ham@southmedic.com

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paul@webbertraining.com

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steve@weeverapps.com

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melanie.moreau@sanimarc.com

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The new Maximizer Mop’s built-in cleaning efficiency makes even the biggest jobs seem small.

30% MORE FLOOR COVERAGE

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The following infection prevention and control professionals have been awarded the 2016 Sage Products LLC International Attendee Scholarship. They will both attend the 2016 conference in Niagara Falls. IPAC Canada thanks Sage Products LLC for making this prestigious scholarship possible.

**HILDA OROZCO, MD**  
Mexico City, Mexico

Dr. Orozco is with the National Pediatric Institute “Instituto Nacional de Pediatria” and is Head of the Infectious Committee. She has been in infection prevention and control for more than five years.

As Head of the Infectious Committee, her responsibilities are surveillance, education for healthcare workers, students, residents and visitors, determining strategies to prevent risk, implement policies, implementing a hand hygiene program, and publish research and data. She has been a presenter at many conferences in Mexico and Central America. She is a Professor at St. Jude Children’s Research Hospital in Mexico. She is a member of the Asociación Mexicana para el Estudio de Infecciones Nosocomiales.

**MYRIAN SCHERER**  
Infection Control Nurse, Buenos Aires, Argentina

Ms. Scherer is with the Medical Direction Department at Instituto Argentino de Diagnóstico y Tratamiento. She is certified in infection control and has been in infection control for more than sixteen years. She is a member of the Asociación Argentina de Enfermeros en Control de Infecciones (ADECi).

Myrian was co-director of the National Hand Hygiene Campaign in 2010 and co-investigator in the Argentinean Hand Hygiene Improvement Multicenter Study. She has published several times and acted as a presenter at many national conferences.
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Start winning the fight against invisible infectious pathogens today with STERIS's own PATHOGON UV Antimicrobial System.

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UV Antimicrobial System
By STERIS, the leader in Infection Protection.

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2016 SealedAir Diversey Scholarship

Through 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.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
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<tbody>
<tr>
<td>Melissa Botz</td>
<td>Barry’s Bay, Ontario</td>
</tr>
<tr>
<td>Blanda Chow</td>
<td>Calgary, Alberta</td>
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<tr>
<td>Adel Coulter</td>
<td>Owen Sound, Ontario</td>
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<tr>
<td>Betty Anne Elford</td>
<td>Corner Brook, Newfoundland and Labrador</td>
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<tr>
<td>Lola Gushue</td>
<td>Gander, Newfoundland Labrador</td>
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<tr>
<td>Catherine Ker</td>
<td>Mississauga, Ontario</td>
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<tr>
<td>Mary LeBlanc</td>
<td>O’Leary, Prince Edward Island</td>
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<tr>
<td>Sheila Lee</td>
<td>Bridgewater, Nova Scotia</td>
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<td>Debbie McIntyre</td>
<td>Brockville, Ontario</td>
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<tr>
<td>Devon Metcalf</td>
<td>Guelph, Ontario</td>
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<tr>
<td>Tracey Reid</td>
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<tr>
<td>Cheyanne Roth</td>
<td>Regina, Saskatchewan</td>
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<tr>
<td>Christine Sherren</td>
<td>Halifax, Nova Scotia</td>
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<tr>
<td>Dori Taylor</td>
<td>Varna, Ontario</td>
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<tr>
<td>Michele Terfry</td>
<td>Eastern Passage, Nova Scotia</td>
</tr>
<tr>
<td>Catherine Van Arkel</td>
<td>Chatham, Ontario</td>
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Elections to Board of Directors

The following candidates have been nominated for positions open on the Board of Directors in 2016. Additional nominations may be presented by not less than two IPAC Canada at the Annual General Meeting (Wednesday, May 18, 2016, Niagara Falls). Additional nominees must be present to confirm their willingness to be nominated, or just have provided a written confirmation to the nominator(s).

**DIRECTOR** (three-year term) (Programs and Projects)
Mandy Deeves, BScN, RN, CIC
Network Coordinator, Public Health Ontario
North Simcoe Muskoka Infection Control Network
Orillia, Ontario

**DIRECTOR** (three-year term) (Standards & Guidelines)
Tara Donovan, BHSc, MSc
Epidemiologist
Fraser Health
Surrey, British Columbia

**PUBLIC REPRESENTATIVE** (three-year term)
Nominations accepted by May 1, 2016

**CANDIDATE PROFILES**

**MANDY DEEVES, BScN, RN, CIC**
is nominated for her second term as a Director of IPAC Canada with responsibilities for 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 front-line 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.

**Philosophy:** Over the past three years, I have worked with members of the Board of Directors of IPAC Canada to represent the needs of our membership, working to promote resources and/or create tools that will assist them in meeting IPAC needs. Working with infection prevention and control professionals across the continuum of care, has afforded me the opportunity to better understand the IPAC challenges faced in these different sectors. As the chair of the Programs & Projects Committee, I will continue to support the work that is being done by this organization to maintain and support projects developed by our membership.

In the role of Director, I hope to continue to promote both IPAC Canada and the practice of IPAC by encouraging exchange of knowledge, experience, ideas and information for the prevention and control of infections as well as collaboration and networking among persons interested in Infection Prevention and Control.

**TARA DONOVAN, BHSc, MSc**
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 accepted a contract position and 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. Her primary role was to lead, direct and provide expertise in the development, implementation, maintenance and ongoing evaluation of a Regional Infection Prevention and Control Surveillance Program. 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. Tara has provided both poster and oral presentations at the IPAC Canada National Conferences in recent years and has been the Module 4 instructor for the IPAC Canada Novice Infection Prevention and Control course since 2012.

**Philosophy:** If I am granted the opportunity to hold a Director position with IPAC Canada, I pledge to actively communicate and collaborate with my fellow Board members to achieve results and maintain the values of the association. I would focus my efforts as liaison with the standards and guidelines committee as this group plays a crucial role as reviewer and generator of guidelines as requested by IPAC Canada members. I would be dedicated to employing critical thinking when making decisions in the Director role. I would strive to give effective and timely feedback in order to continue momentum and create resources that support members in their endeavours to uphold patient and staff safety by fortifying best practices. IPAC professionals strive to do the right thing at the right time and this is also my commitment in the role of Director.
IPAC CANADA LEARNING OBJECT REPOSITORY

“ALONE WE ARE SMART. 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

Demonstrate Due Diligence.
Manage risks of Legionella in building water systems.

Pinchin provides Canada Wide Legionella consulting and analytical services
• Proactive & reactive risk assessments
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Biofilms are forming on many dry hospital surfaces because they aren’t cleaned frequently or effectively enough.

The bacteria have a chance to attach and excrete extracellular organic substances, or slime, which makes them more resistant to removal and tolerant to disinfectants.

Process used by bacteria to form biofilms on dry surfaces
- Individual bacterial cells land on a surface.
- Some attach to surface, and may be aided by organic chemical or soil residues.
- Attached bacteria release extracellular organic substances which allow additional mixed bacteria to adhere to the colony being formed.
- Biofilm bacterial communities shed bacteria back into the environment
- Once the bacterial community has matured the bacterial population is protected from cleaning processes and biocides.

Biofilms are forming on many dry hospital surfaces because they aren’t cleaned frequently or effectively enough.

1 - PCS Prevention Process
Frequent cleaning with PCS microfibre cloths and PCS 7000 Oxidizing Disinfectant/Disinfectant Cleaner diluted to the cleaning and sanitizing solution of 200 ppm of sodium hypochlorite.

Frequently damp wiping surfaces with this process keeps organic soils oxidized and our microfibre cloths add the friction needed to remove and prevent organic soils from accumulating.

PCS 7000 cleaning and sanitizing solution has demonstrated a greater than 7 log reduction in Staphylococcus aureus and Escherichia coli in 30 seconds (Germicidal and Detergent Sanitizing Action of Disinfectants). Approved and recommended for no rinse sanitization of pre cleaned direct food contact surfaces.

Unlike detergents and disinfecting detergents PCS 7000 contains no organic substances that microbes could consume the residues as a nutrient source.

The process
- Dampen PCS microfibre cloths in a solution containing 200 ppm of PCS stabilized sodium hypochlorite solution.
- Double wipe surfaces applying pressure to maximize removal of soil.
- Oxidizing cleaning without depositing organic chemicals.

2 - PCS Deep Cleaning Process
For added efficacy during persistent outbreaks and to oxidize and remove accumulated organic soils. Organic soils or mature biofilms resist cleaning and disinfecting and there is evidence bacteria lodged within biofilms can be up to 1000 times more resistant to disinfecting chemicals.

The Process
- Apply PCS 7000 Disinfectant Cleaner with PCS Disinfectant Application cloths
- Keep surfaces wet for five minutes to kill C. difficile spores and to oxidize accumulated organic soils.
- To prevent oxidized organic soils from reattaching wipe surfaces with a PCS microfibre cloth dampened in cleaning and sanitizing solution of 200 ppm of PCS 7000.

*Alternatively PCS 7000 can be applied undiluted to a pre dampened PCS microfibre cloth.

There is evidence concentrations of sodium hypochlorite can oxidize biofilms matrix therefore adding a damp wiping step after disinfection will improve the removal of organic soils.

PCS OFFERS TWO OPTIONS TO ADDRESS ACCUMULATED FIXED ORGANIC SOILS FROM SURFACES.

PCS 7000 Disinfectant Cleaner is a stable formulation with a 24 month shelf life.
#6030-4 • 4 x 3.78 L closed loop

PCD Disinfectant Application Cloths
#6067 • 7” x 12” 100/container x 6/case
#6068 • 12” x 12.5” 110 per container x 4/case

Microfibre Cloths
#PCSMF-BL Blue   #PCSMF-R Red   #PCSMF-G Green   #PCSMF-Y Yellow

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**Detach → Capture → Remove**

**Scrubbing Foam Layer:** Non-abrasive scrubbing at a microscopic level, proven to detach Biofilm which detergent alone cannot.

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*Draco hand pad is compatible with any detergent or disinfectant • now available in our bestselling flexible endoscope First Step Bedside Pre-Clean Kit!

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**COMPARATIVE TEST STUDY** – Center for Biofilm Engineering, Montana State University – study done using Biofilm kill claim detergent.

**Control**

6000 x Magnification

**Traditional Urethane Pad**

Wiped Twice

6000 x Magnification

**Draco Deep Cleaning Pad**

Wiped Twice

1 x Scrubbing Foam Side

1 x Microfiber Side

6000 x Magnification

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**Capture → Remove → Dispose**

- Single-use: prevents cross contamination.
- Split microfiber technology captures spores & pathogens at a microscopic level (C.Diff, VRE, CRE, & Norovirus).
- Compatible with any detergent and disinfectant.
- Available sterile for use in the OR.

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**Scope Transport**

**NEW! Single-Use Rigid Containment**

- Oasis Scope Transport Trays: comply with CSA transport standards.
- Built-in reservoir for bed-side pre-clean.
- A reversible lid identifying clean & soiled scope.
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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.

CHAIR
Coalition for Healthcare Acquired Infection Reduction
www.chaircanada.org

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 costs 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.
Find out more at www.chaircanada.org

TopLine
Expanding the boundaries of patient-focused solutions

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Oakville, Ontario
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Choose Blue

Choose 3M™ Surface Disinfectant Cleaner Wipes
(DIN 02354381)

- Bactericidal, Fungicidal, Virucidal, Tuberculocidal\(^1\)
  Because you never know what is living on your surfaces

- Doesn’t damage surfaces\(^2\)
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- Three Minute Contact time\(^3\)
  Because we know your time is important

- Unique blue colour
  Because we know your patient’s safety is important

Test your knowledge, by taking the 3M Wipe Challenge at
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or call your 3M representative for further information at 1-800-364-3577.
The Board of Directors of IPAC Canada are very pleased to announce that Marion Yetman, RN, RN, MN, CIC has been appointed an Honorary Member. Marion was nominated for honorary membership by her chapter, IPAC Newfoundland Labrador.

Marion has been in Infection Prevention and Control for over 20 years. Her knowledge, professionalism, hard work and dedication to nursing and infection prevention and control has been a great asset to her fellow companions. Marion has not only been able to provide an abundance of professional knowledge and advice but she has been repeatedly able to make her fellow workers feel important and provide a role that others would want to follow in. Her constant reassurance and support to others have helped her fellow Infection Control Practitioners (ICPs) accomplish and achieve many goals.

She has served her colleagues in many professional positions, both provincial and national. She has undertaken the role of president of her chapter and in 2007 and 2008 Marion very ably took on the responsibilities of president-elect and then president of IPAC Canada. She is an educator, having delivered presentations in many forums and has chaired both provincial and national conferences. She has taken a lead role in provincial working groups for guidelines, works nationally on different task forces and committees, and has also taken a lead role in SARS, Pandemic and Ebola working groups.

Marion was the first appointed Provincial Infectious Disease Nurse Specialist; part of that role was to work collaboratively with the IPAC Newfoundland Labrador group in leading the province with guidelines on dealing with infectious diseases. She has been a mentor to many giving guidance and sharing her wealth of knowledge to novice as well as senior ICPs in the province and nationally. Her pleasant voice has answered many calls and provided unlimited guidance even when she has not been working. As a mentor and a friend, Marion is inspirational, caring, supportive, and devoted to her profession.

Marion Yetman Appointed Honorary Member

Marion holds education as a top priority; she has worked hard and continuously advanced her education. Her accomplishments include obtaining her Registered Nurse Diploma, Baccalaureate in Nursing Degree and her Masters in Nursing. She has been an avid promoter of the Certification in Infection Prevention and Control and has continued to maintain her certification throughout the years. Marion is very passionate and enthusiastic about infection prevention and control, including a priority of safety for staff, patients, and the community at large.

Marion is well respected by IPAC NL, her provincial colleagues as well as across the country. She recently was awarded the Provincial Public Service Award in Newfoundland Labrador, which is the highest public servant achievement award in the province.

Honorary Membership will be officially bestowed at the Opening Ceremonies of the 2016 annual education conference (Sunday, May 15; Niagara Falls).

“Her knowledge, professionalism, hard work and dedication to nursing and infection prevention and control has been a great asset to her fellow companions.”
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 October-December 2015 graduates.

**First-time Certifiers**
- Vishnuka Arulsundaram, RN, CIC, Toronto, ON
- Sherry L. Engel, CIC, Saskatoon, SK
- Khalid Haji-Kusow, CIC, Toronto, ON
- Taghi Naserpour Farivar, BSc., MSc., PhD., CIC, Burnaby, BC
- Will Ng, BSc(Hon), MHSc, CIC, Toronto, ON
- Chantal M. Porter, BScN, CIC, Timmins, ON
- Tristan S.C. Squire-Smith, RN, MBA, CHE, CIC, London, ON
- AnnMarie Tyson, CIC, Toronto, ON

**Recertified**
- Nalini Agnihotri, CIC, Oakville, ON
- Kimberley Allain, BScN, RN, MHS, CIC, Halifax, NS
- A. Naideen Bailey, CIC, Toronto, ON
- Stefania C. Cloutier, CIIPH(C), ICP, CIC, Toronto, ON
- Laurie J. Conway, CIC, Toronto, ON
- Melody C. Cordoviz, CIC, Edmonton, AB
- Alisa P. Cuff, RN, CIC, Lewisporte, NL
- Simona M. Dalgleish, CIC, Hamilton, ON
- Katherine E. Defalco, RN, CIC, Ottawa, ON
- Kristine G. Desjardine, MN, BScN, CIC, Ottawa, ON
- Joanne M. Dow, RN, CIC, London, ON
- Sandra M. Dunnett, RN, CIC, St. Catharines, ON
- Rohit Garg, MBBS, MPH, CIC, Toronto, ON
- James A. Gauthier, MLT, CIC, Oakville, ON
- Diana Gowanlock, CIC, Thunder Bay, ON
- Isabelle Guerreiro, CIC, Toronto, ON
- Frances L. Hanna, CIC, Edmonton, AB
- Debra Hayden, CIC, Toronto, ON
- Fatema Jinnah, CIC, Toronto, ON
- Jessica Kooger, BSc., CIC, Woodstock, ON
- Kathy L. Maxwell, RN, CIC, Toronto, ON
- Maja McGuire, CIC, Toronto, ON
- Lesley McLeod, MSc, CIC, Regina, SK
- Evelyn Myles, RN, BScN, CIC, Edmonton, AB
- Sandina M. Noble, RN, BSc, CIC, Toronto, ON
- Marilyn J. Petherick, CIC, Campbellford, ON
- Corinne L. Pidhorney, CIC, Calgary, AB
- Gordana Pikula, CIC, Toronto, ON
- Katherine Pollard, RN, CIC, Waterloo, ON
- Carly Rebelo, MSc, CIC, Toronto, ON
- Anne M. Rozalowsky, RN, BScN, CIC, Utterson, ON
- Lorraine Marie Schatzler, CIC, Sudbury, ON
- Slobodanka Varda, CIC, Scarborough, ON
- Sumana Vinod, MBBS, MPH, CIC, Toronto, ON
- Heidi N. Willekes, RN, BScN, CIC, Brantford, ON
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<th>Web Site</th>
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<tbody>
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<td>63</td>
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