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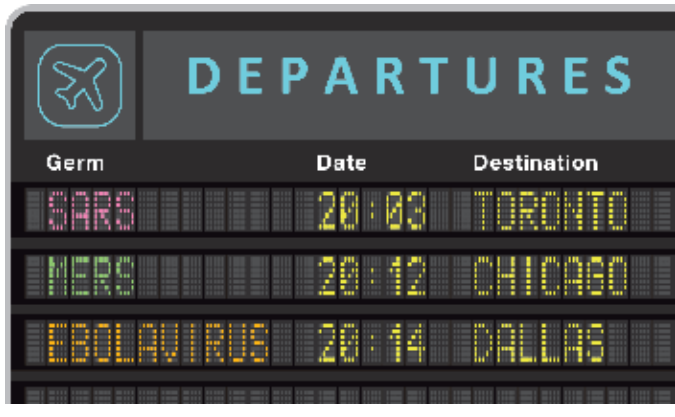

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[1]Alfa, M.J., Lo, E., Olson, N., MacRae, M., Buelow-Smith, L. Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates, Am J Infect Control 2015; 43: 141-6

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LETTER TO THE EDITOR

Medical hierarchy and comfort level with requests for hand hygiene

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Dear Editor,

It is with great interest that we read Ms. Flannigan's article **Asking for hand hygiene: Are patients comfortable asking, and, are healthcare providers comfortable being asked?** (1) This article addresses important issues related to hand hygiene (HH) practices.

We conducted a similar cross-sectional study from the perspective of medical residents, approved by Queen's University Health Sciences Research Ethics Board that assessed similar questions about comfort levels when asked by patients to clean one's hands before contact. Of 150 Queen's University Family Medicine residents, 89 (59%) completed the survey. This included 46 (52%) first year residents and 43 (48%) second year residents. Fifty-seven (64%) of the respondents were female and 32 (36%) were male, with a mean age of 29.5 years.

Our results are remarkably similar to those of Ms. Flannigan (1). 73 of 86 (85%) of respondents to this question indicated that they were very comfortable or comfortable being asked to perform hand hygiene in front of a patient. This is compared to Ms. Flannigan's finding of 86.5% of health care providers who indicated the same.

Further, 73 of 86 (85%) of respondents to this question, compared to Ms. Flannigan's finding of 85.9%, indicated that they would provide HH in front of a patient if asked. These results were consistent between males and females as well as year of residency.

It has been pointed out that learners play an important role in reducing patient harm (2). We found that the majority of family medicine residents surveyed reported that they are willing to be asked and to comply if a patient asks them to perform HH in view. However, as pointed out by Ms. Flannigan, the proportion of patients willing to speak to HH offenders is limited because of a perceived power differential. Despite this power differential, perceived or real, steps need to be taken to ensure patients are able to remind a healthcare provider to wash his or her hands without fear of repercussion.

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TABLE 1: Summary of responses of medical residents

Question: 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	0 (0%)
Not very comfortable	5 (5.8%)
Somewhat comfortable	8 (9.3%)
Comfortable	27 (31.4%)
Very comfortable	46 (53.5%)

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

Yes	73 (84.8%)
No, with an explanation	13 (15.1%)
No, without an explanation	0 (0%)

EDITORIAL

Dr. Peter Cruse and the reduction of surgical site infections

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KEY WORDS:
Peter J. E. Cruse, Surgical Site Infections, Surgeon-Specific Rate Reporting, 10-year Prospective study.

ABSTRACT

Surgical Site Infections (SSIs) have existed for as long as surgery itself. From antiquity to the present day, advances have been sought in the quest to decrease the incidence of infections.

Dr. Peter Cruse (1927-2006) was a South African-born surgeon who practiced at the Foothills Hospital in Calgary for more than 30 years, and published some of the most influential research on surgical wound infections. His seminal work was reported in a 10-year prospective study of 62,939 surgical wounds, the largest such study ever conducted.

Dr. Cruse was a pioneer in evaluating the myriad variables that impact SSIs. He found that the preoperative length of stay in hospital, the duration of the procedure, preoperative shaving of the wound site, and wound cleanliness all influenced the SSE rate, but the most important variable was the surgeon's technique. He found that implementing an accurate monitoring and feedback system was crucial in reducing the incidence of wound infections.

The initiation of surgeon-specific infection rate reporting has been credited to Dr. Cruse. His research has been cited over 2000 times, and has been instrumental in establishing guidelines, authoring textbooks and initiating research studies on the commonest surgical complication – wound infection.

While his findings and recommendations were initially met with scepticism, they were subsequently supported by the Centers for Disease Control and by other prominent leaders in the field.

INTRODUCTION

Surgical wound sepsis has been a challenge to surgeons for as long as surgery has been performed. For essentially all of human history, the problem of wound infection has been intractable. Therefore, theories such as Galen's "laudable pus" were developed – the idea that infection was necessary for healing to occur (1). With the rise of modern surgery and the use of general anesthesia in the late 1800s, antisepsis and asepsis became paramount in the prevention of wound infections. In the era of innovation that followed the Second World War, increasing attention was paid to nosocomial (hospital-acquired) infections. Surgical wound infections were no exception. Into this challenging setting came a young South African surgeon: Peter Cruse.

FROM STUDENT TO SURGEON

Peter Joseph Erasmus Cruse was born in 1927 in Stellenbosch, a university town near Cape Town, South Africa. He was the son of a professor of history. Young Peter's inspiration to enter the field of medicine began following a visit with a relative who was a physician in a Johannesburg emergency department. He watched as she carefully stanched a bleeding artery in a man's leg, while awaiting surgery. Inspired,, this became the event that convinced Peter to become a doctor (2).

Peter Cruse enrolled in the six-year medical program at the University of Cape Town, and graduated in 1951. While interning at the McCord Zulu Hospital in Durban, the surgeon-superintendent Dr. Alan Taylor encouraged Dr. Cruse to pursue surgery. After his two-year internship, during which the Cruses began their marriage of 54 years, they left South Africa for training in England and Scotland. Upon completion of his FRCS (Fellowship in the Royal College of Surgeons) examination in 1958, Dr. Cruse returned to South Africa.

FIGURE 1.
Dr. Cruse circa 1965.
Image courtesy of Diana Cruse.

During a brief stint as a junior surgeon at the Groote Schuur Hospital in Cape Town on Christiaan Barnard's team, Dr. Cruse encountered a patient who knew a Dr. Smitty Gardner, the chief of surgery at the Colonel Belcher Hospital in Calgary, Alberta. The Cruse family, together with their three children, left for Calgary in 1960 (3).

Over the next five years, Dr. Cruse studied for his certification and then fellowship exams. Successful, he joined the Colonel Belcher and Holy Cross medical staffs in 1965.

FIGURE 2. Dr. Cruse in the OR. 1986.

Image courtesy of the University of Calgary Archives (84.005_51.29).

In 1966, he began working at the newly opened Foothills Hospital (4). He would work at the Foothills for the next 30 years.

INFECTION CONTROL IN CALGARY

At the Holy Cross, the executive director, Dr. Irial Gogan, asked Dr. Cruse to restart the defunct Infection Control Committee, following a hospital accreditation survey. The committee began its work with an environmental survey of the hospital, which was non-productive, save for identifying a large colony of *Pseudomonas* in the hospital chapel's baptismal font. Sharing that particular finding almost cost Cruse his place on the committee (5). Frustrated, Dr. Cruse turned the committee's attention to the hospital's post-operative surgical wound infection rate.

To help with this, Dr. Cruse enlisted a registered nurse, Rosemary Foord, to determine the overall post-operative wound infection rate. The reported infection rate was 0.2% (6). When he applied a consistent definition, however, Cruse found it to be 6.1% (7). This discrepancy underlined the importance of having a consistent surveillance program with a single observer using pre-selected criteria to determine whether a wound was infected or not. His definition was simple – if a wound discharged pus during the first 28 days post-operatively, it was considered infected.

As Dr. Cruse moved his practice to the Foothills Hospital, he realized it was an ideal opportunity to begin a comparable study at both the Holy Cross and Foothills Hospitals. The data collection was staggered, with the Holy Cross' year of surveillance preceding the Foothills'. Over the two-year long study, both hospitals' infection rates decreased by more than 2% (8). He believed that surveillance itself could result in a significant rate reduction. When he published his findings, Cruse used pseudonyms and called the hospitals "A" and "B." Even though the rates at both hospitals were well below the rates reported in the literature, it was not difficult for local physicians and surgeons to determine which hospital was Hospital A and which was Hospital B. Hospital A, the Holy Cross, felt denigrated and physicians reduced their referrals to Dr. Cruse.

In spite of the backlash, the surveillance program continued at the Foothills with strong departmental and hospital support. New surgeons who joined the staff were automatically enrolled in it. When the first results were published in 1970 (9) they were well received. The 10-year prospective study had begun (10). The only exclusions from the study were oral, rectal, vaginal and burn operations, as well as circumcisions.

Fortuitously, a classification system had been created by the U.S. National Research Council in 1964 (11), to determine the efficacy of ultraviolet irradiation for infection control in the operating room (12). The classification system split surgical

wounds into four categories: clean, clean-contaminated, contaminated, and dirty. Clean wounds were those without the presence of pre-existing infection, while clean-contaminated wounds were similar to clean wounds but involved operative contact with a contaminated source like the lumen of the gut, respiratory tract, or oropharynx, barring undue spillage or contamination. Contaminated wounds included traumatic wounds less than four hours old and those with acute, non-purulent inflammation, while dirty wounds included older traumatic wounds, and those where pus was encountered operatively or where gross lumenal spillage occurred. This classification system was used for many years as a predictor of infection risk. Cruse's work has been cited as clearly demonstrating this relationship (13).

Cruse outlined four goals in the 1980-published 10-year study: 1) to accurately assess infection rates on an ongoing basis, 2) to compile a databank that could be used for future investigation, 3) to identify factors predictive of infection, and 4) to reduce the infection rate at the Foothills Hospital (14). The first was definitively accomplished – aggregate infection rates were shared with the respective departments. Each surgeon together with their division and department head, received yearly reports, comparing their personal wound infection rates with the departmental and overall hospital rates.

The data collected from each operation included patient characteristics and comorbidities, the wound classification, the length of the operation, the duration of the hospital stay, the type of gloves used and much more. The final two goals were accomplished by analysing the data. Fourteen factors were identified as influencing would infection rates. Over time, the clean wound infection rate at Foothills dropped from 2.5% in 1968 to 0.6% in 1977 (15).

Advantageously, the same nurse, Rosemary Foord, collected the data for every patient in the ten-year study – all 62,939 operative wounds. Analysing the data revealed many factors that increased the wound infection rate. For patient characteristics, old age, diabetes, obesity and malnutrition significantly increased the risk of infection. Shaving the patient's operative site the night before resulted in more infections. This was a surprising finding at the time, but confirmed the observations of Richard Seropian and Benedict Reynolds in 1971 (16). Glove punctures, of which there were 141, resulted in zero infections, leading Cruse to suggest that, "there is probably little risk in operating without gloves, except perhaps hepatitis to the surgeon" (17). Long pre-operative hospital stays also increased the rate of infection, but the particular operating room used, or the ward the patient stayed on had no effect on the rate of infections. Similarly, there was no difference in infection rates between individual anesthetists. A long operating time had a direct correlation with the incidence of infection. Cruse explained this risk as being due to several factors. First, airborne bacteria settle into the wound, which increases the infective load over time. Second, tissue trauma results from retractor use and air-drying of the wound. Third, foreign material (suture, staples, etc.) and electrocoagulation can weaken the innate resistance of the tissue. Fourth, long operations increase blood loss and thus increase the likelihood that the patient experiences shock (18). The largest single factor influencing infection rates, however, was the identity of the operating surgeon (19).

Overall infection rates from all four categories differed enormously between surgical disciplines (general surgery, orthopedic surgery, gynecology, etc.), ranging from 1.2% for neurosurgery to 9.2% for urology. Cruse focused on the clean wound infection rate as the most appropriate metric to use. That category included over 80% of all operations. There was much less difference between departments for the subset of clean wound infection rates – between 0.5% and 3% – with little variance. The difference in clean wound infection rates between individual surgeons within departments, by contrast, had tremendous variance.

In every discipline there existed some surgeons who consistently achieved infection rates of less than 1%, and some who had rates consistently above 3% (20). Since patient characteristics, operating rooms, specific procedures and other variables were common to surgeons within departments, this wide variability led Cruse to conclude that, "variation in their clean wound infection rates must be ascribed to differences in operating technique" (21). The personal responsibility of individual surgeons for their own infection rates explains why surveillance and reporting was such a crucial factor in decreasing infection rates over the course of the study.

Posting departmental rates and sharing the individual reports with each surgeon was controversial (22). Suddenly, every surgeon in the hospital had something new to be held accountable for. Cruse insisted from the start that individual rates be kept confidential and that publicly posted rates would be limited to aggregate data (23). Since individual operating techniques were responsible for so much of the variance, it followed that changes in technique by the surgeon could reduce their wound infection rates. In the 1970 study, surveillance for only six months was found to markedly decrease infection rates (24). The 1980 study confirmed that this decrease could be maintained and even improved upon, as shown by the decline from an overall clean wound infection rate of 2.5% in 1968 to 0.6% in 1977.

Cruse's results initially were met with scepticism, as no hospital was thought to be able to reduce their rate below 2%. (25). It is difficult to ascertain how much of the decrease can be attributed to surgeons deliberately working on improving their technique, and how much was simply due to the Hawthorne effect (26). Ultimately though, the explanation is less important than the results – especially when the results reduced morbidity to patients and a saved the hospital many patient days. Dr. Cruse calculated that based on data from the five-year point of the study, "wound infections delay the patient's discharge from the hospital by 9.9 days" (27), and that this cost $600 in 1973, or more than $3000 today, based on hospitalization costs alone.

At 62,939 wounds, the study was the largest single-site prospective wound infection study in the world. At the time

of publication, it was more than four times larger than the National Research Council study on the efficacy of ultraviolet irradiation (28), and more than ten times larger than any other preceding study. In the years following publication, only the CDC's National Nosocomial Infections Surveillance System (NNIS) (29) and SENIC (30) project recorded more wounds in total, at 84,691, and 117,850, respectively. However, the Cruse and Foord study remains the largest single-site prospective wound study ever undertaken.

Following the publication of the 10-year series, Dr. Cruse continued to track operative wounds at the Foothills Hospital for 12 more years, eventually collecting data on more than 160,000 surgical wounds. Dr. Cruse's work resulted in more than 2000 citations and earned him invitations to present at conferences in 18 countries around the world, including the United States, Japan, and England (31).

LEGACY

The early pioneers of surgery and infection control set the stage for the explosion of innovation in the post-WWII period. In 1847, Ignac Semmelweiss deduced the concept of sepsis as a contagious disease, using both clinical success on maternity wards and animal studies to confirm his theory (32). Later, in 1867, Joseph Lister applied the findings of his contemporary, the pioneering microbiologist Louis Pasteur. He attributed wound putrescence to "the germs of various low forms of life" (33), and began pervasive usage of carbolic acid as an antiseptic during surgery. He came up with the idea, after observing the compound's effect on sewage from the town of Carlisle, noting that "the admixture of a very small proportion not only preventing all odour from the lands irrigated with the refuse material, but, … destroying the entozoa which usually infest cattle fed upon such pastures" (34). Carbolic acid enjoyed a brief but colourful tenure as the infection-reducing agent of choice in surgery. The mixture used for surgical purposes was hard on the skin, and Lister remarked that he could recognize fellow Listerians from their handshake, based on their hard, cracked skin and their brittle nails (35).

Over the remainder of the 19th century, antisepsis slowly gave way to asepsis as the dominant practice of infection reduction in surgery. By 1880, a Scottish surgeon named William MacEwen had introduced the practice of boiling surgical instruments and supplies such as gauze (36). MacEwen was strongly influenced by Lister and used carbolic acid early in his career, but gave up its use in 1879. By the 1890s he was boiling everything that touched the patient during surgery. Concurrently, Ernst von Bergmann, a German surgeon, developed steam sterilization for surgical instruments in 1886 and introduced a full aseptic technique by 1891 (37).

Surgical techniques were addressed as well. Emil Theodor Kocher, a Swiss surgeon, advocated the use of meticulous hemostasis during surgery. Kocher's attention to anatomy and the avoidance of bleeding in thyroid surgery reduced the mortality from about 30% in 1883 to less than 1% by the turn of the century (38). William Halsted, one of the "great four" original doctors of the Johns Hopkins Hospital, expanded Kocher's emphasis on careful technique. To meticulous hemostasis and strict asepsis, he added gentle handling of tissue, careful approximation of tissue planes when closing, obliteration of dead space and minimum tension across wounds. These concepts, in place by 1913 (39), became known as Halsted's principles (40), and were heavily espoused by Dr. Cruse (41).

Following World War II, Elek and Conen addressed the relationship between the host's natural defenses and the bacteria that overcome them in 1957 (42). Using intradermal injection of staphylococci bacteria into the forearms of volunteers (43), they determined that the number of cocci required to create a pustule was in the order of one million. Since such a large inoculum was felt to be implausible in the setting of a sterile operating room, other factors had to be at play. When a foreign body (a silk suture in this case) was introduced, the number of cocci required to form a pustule was reduced by 10,000 times. Howe and Marsten demonstrated in 1962 that if a piece of devitalized tissue was added to the suture, the number of organisms required could be reduced to as low as 300 (44).

Several decades after the discovery of penicillin by Alexander Fleming in 1928, the use of prophylactic antibiotics in surgery was validated. A large, well-designed trial by Hiram Polk and Juan Lopez-Mayor in 1969 demonstrated a clear benefit from the use of prophylactic antibiotics. It also began to delineate the surgeries for which antibiotic prophylaxis was beneficial, such as large bowel resection, from those for which it was not, such as inguinal hernia repairs.

In the years leading up to Cruse's work on surgical infection control, more and more attention began to be paid to nosocomial infections in general, and systematic attempts at reducing them began. In 1941, the UK's Medical Research Council released a recommendation on the prevention of hospital infection of wounds. It was driven by wartime concerns over surgical sepsis in hospitals (46). The report endorsed the appointment of full-time special officers charged with controlling infection in hospitals. In 1958, the American Hospital Association went one step further and recommended that all hospitals establish infection control committees (47). These committees were to track infections and take measures to reduce them, but were not instructed to report the infections or rates back to individual surgeons, thus failing to, "close the loop" as Cruse would do. In 1964, a landmark study by Jay Ward Kislak and colleagues revealed the prevalence of nosocomial infection rate at the Boston City Hospital to be 13.5% – and for surgical patients the rate was 19.1% (48).

Dr. Cruse published the results of his 10-year study in stages, once at the halfway point (49) in 1973, once at the seven-year point in 1975 (50), and once at the end, in 1980 (51). At the time of publication of the five-year report, there were several similar prospective studies, but none as large as the Cruse study. In fact, the next largest study at the time was the 1964 National Research Council study (52), with 15,613 wounds. Cruse has been cited as the first to use the NRC categories clinically to identify infection risk (53). In a similar endorsement in 1980,

FIGURE 3. Dr. Cruse in the OR. 1986.

Image Courtesy of the University of Calgary Archives (84.005_51.29_86-0003).

Jonathan Meakins cited the Cruse study as clearly showing the link between NRC wound category and the risk of infection (54). Meakins went on to write the "Prevention of Postoperative Infection" chapter of *ACS Surgery: Principles & Practice*, where Cruse was credited similarly (55).

While Cruse was conducting surveillance at the Holy Cross and Foothills hospitals, the Centers for Disease Control (CDC) was organizing its own research into infection surveillance programs. Pilot projects were put in place in 1965 at six hospitals (56). Once they were deemed a success, the Comprehensive Hospital Infections Project (CHIP) was started (57). CHIP was set up to evaluate both the epidemiology of nosocomial infections (including surgical wound infections) and the sensitivity of existing surveillance programs. Personnel were trained by CDC to use uniform definitions of infections. When this gold standard was applied, the sensitivity of infection surveillance was found to be only 65% (58). CHIP confirmed the importance of hospital infection control committees that included infection control nurses and hospital epidemiologists. In 1970 the CDC recommended that they be established in all US hospitals (59).

Buoyed by these experiences, the CDC began two large-scale infection surveillance programs. The first, the National Nosocomial Infections Study (NNIS), began in 1969 with several hospitals voluntarily reporting their infection data to the CDC (60). More US hospitals were added to the program, bringing the total to nearly 300 in 2004 (61). Later renamed the National Nosocomial Infections Surveillance System (still with the acronym "NNIS"), the program was intended to be a definitive source of national data on the epidemiology of hospital-acquired infections. The second program, the Study of Efficacy of Nosocomial Infection Control (SENIC), was initiated in 1974 to evaluate the effectiveness of infection control programs in not only detecting, but reducing, infections. SENIC had as goals to determine whether infection surveillance and control programs (ISCPs) had lowered nosocomial infection rates, and also to gather and analyze data on infection risk (62). The project included collecting and analyzing infection data on 117,850 surgical patients in 338 US hospitals from 1970 to 1976 (63).

The SENIC project revealed that by 1976, 87% of US hospitals practiced some form of infection surveillance, and 50% of these reported their programs as "very active," but few reported infection rates back to surgeons (64). When the results came out in 1985, SENIC revealed that an effective surgical infection control strategy involved two components: a strong ISCP, and "establishing a system for reporting surgical wound infection rates … back to the hospital's practicing surgeons" (65). With both components in place, the overall reduction in surgical wound infection rates was 34.9%, and was even higher at 40.5% for low-risk patients (66). The authors of the report called this practice of reporting infections "a time-honored

FIGURE 4.
Peter Cruse circa 1995.
Image courtesy of Diana Cruse.

preventive technique that was reintroduced in the early 1970s" and attribute this reintroduction solely to Cruse (67).

The 1985 SENIC report also stated that "the impact of reporting the findings from surveillance to hospital personnel was clearly seen in the effects of reporting surgical wound infection rates to the hospital's practicing surgeons, a practice strongly indicated to be effective by previous studies" (68). The attributed studies included the Cruse study, and a chapter written by William Altemeier in *Hospital Infections*, where the Cruse study is the only cited source for surgeon-specific rate reporting (69).

The SENIC project data also led to the creation of a new system for stratifying surgical wound infection risk – one with more predictive power than the traditional classification scheme created by the NRC and popularized by Cruse (70). A scoring system was developed whereby four different indicator variables would be added together, giving a patient a score between zero and four that corresponded with their surgical wound infection risk. The system was called the simplified risk index. The indicator variables were: the presence of an abdominal operation, an operation lasting more than two hours, an operation meeting the criteria of contaminated or dirty using the NRC categories, and having more than two active diagnoses at discharge. A disadvantage of this system was that the final metric could not be known with certainty at the time of operation, limiting the usefulness of the risk index.

Other studies sought to replicate the Cruse results. In 1977, Richard Wenzel and colleagues published a 5,260 wound series from the University of Virginia Hospital (71), and three years later Wenzel published a Virginia-wide series of 44,687 wounds with Bruce Farber (72). In both instances, the Cruse study features heavily, serving as both a point of comparison for infection rates and as a model system with regards to the practice of reporting surgical wound infection rates back to practicing surgeons. In 1983, three years after the publication of the 10-year Cruse and Foord series, Robert Condon and colleagues published a similar study with 8,227 clean wounds from the Wood VA Medical Center in Milwaukee (73). Condon managed to replicate the Cruse study's effect of surveillance in reducing infection rates over the course of the study, and singled the Cruse study out as their comparator (74). A year later, Mary Olson and colleagues published a five-year study involving 20,193 wounds at the Minneapolis VA Medical Center (75). This program continued with five more years of surveillance, and the results were published by Olson and James Lee in 1990 (76). Their 10-year study involved 40,915 operations and remains the second-largest single-site prospective wound infection study to date. Again, the Cruse study featured prominently as a comparison point and as a positive example of the effect of surveillance (77). Olson, however, credits the Cruse study as "the most widely cited," and even refers to SENIC as a less-publicized study (78). Elsewhere, Lee has called the Cruse study a "widely publicized landmark effort" (79). In a historical summary paper, James Hughes identified three studies exemplifying the effect of surveillance on wound infections: the Olson study, the Condon study, and the Cruse study (80).

Meanwhile, the CDC was continuing to collect ongoing nosocomial infections data through the NNIS. Early findings were unsurprising from a surgical wound infection standpoint – the results largely confirmed previously discovered epidemiological observations (81). Once the SENIC results came out, interest in the data surged, and in the early nineties, the simplified risk index created with SENIC data was improved upon. The new risk index removed the abdominal operation variable, and replaced the active diagnoses variable with an American Society of Anesthesiologists (ASA) pre-operative assessment score of 3, 4 or 5 (82). The predictive power of the risk index was retained, while the inconvenient variable of active diagnoses at discharge was removed, allowing for easy peri-operative assessment of a patient's surgical infection risk. Since the NNIS data was national in scope and intended to be representative of all US hospitals, average surgical wound infection rates could be calculated for each new risk category, and surgeons could compare their infection rates to national averages. Several methods of calculating this expected rate have been proposed (83). As with the SENIC results, the 1991 NNIS results credit Cruse with the practice of surgeon-specific rate reporting (84).

The practice of surgeon-specific rate reporting has not been without its opponents. In 1988, William Scheckler released a critique of the practice, citing lack of statistically rigorous evidence (85). Additionally, the rate of adoption of the practice has been slow and the practice has even been discontinued in some cases. In 1985, a follow-up report to the SENIC project results showed a reduction in the percentage of US hospitals practicing surgeon-specific rate reporting from 19% in 1976 to 13% in 1983 (86). In spite of this, the recommendation from the SENIC results that this practice be undertaken by all hospitals was also released in 1985 (87). It was echoed one year later, in the CDC guidelines (88).

Robert Haley of the SENIC project attributed the lack of adoption mainly to logistical factors, including the difficulty of calculating the risk index by hand for each patient (89). James Lee attributed it primarily to surgeon attitudes and lack of enthusiasm from hospital decision makers (90). Whatever the reason, uptake remains sluggish and little published data exists on the topic over the past 20 years. One notable exception is the admonition from G. D. Taylor and colleagues from the University of Alberta in Edmonton that all Canadian hospitals institute surgeon-specific rate reporting (91).

In 1992, the CDC reported a change in the way post-operative infections were defined (92). The term "surgical wound infection" was deprecated in favor of "surgical site

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infection", and deep infections such as organ or space infections were explicitly included. Because of this change, as well as changes in procedures used, the Cruse data is unlikely to be used in any modern comparative studies. Nevertheless, it remains a monumental historical contribution to the fields of infection control and surgery alike.

CONCLUSION

From his humble beginnings, working at a new hospital in a city with a brand-new medical school, Dr. Cruse spearheaded work on surgical infection control that earned him an international reputation as an authority in the field. During his long career, Dr. Cruse held a panoply of positions, from Professor of Surgery at the University of Calgary in 1975, to Head of Surgery at the Foothills Hospital and the University from 1981 to 1988, to Professor Emeritus in 1999. He authored 17 book chapters and 27 journal articles.

Through his love of medicine, he initiated the History of Medicine course at the University of Calgary in 1971. In 1992, he founded the History of Medicine Days, a conference attended by medical students from across Canada each year. He was awarded the Neilson Canadian Historian of the Year award in 1989. Peter Joseph Erasmus Cruse passed away in 2006 at the age of 79, and is survived by his wife Diana Cruse and their four children.

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ORIGINAL ARTICLE

Comparison of a fluorescent marker monitoring system versus environmental sampling as a method of evaluating the removal of Vancomycin Resistant Enterococci (VRE) from environmental surfaces

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KEYWORDS
Vancomycin resistant enterococci; fluorescent markers; environmental monitoring

ABSTRACT

Background: Although the environment is an important factor in the transmission of vancomycin resistant enterococci (VRE) and the monitoring of the effectiveness of environmental cleaning procedures is recommended, the most appropriate monitoring method has not been determined.

Objectives: To determine whether a fluorescent marker monitoring system was equivalent to environmental sampling in ensuring adequate environmental cleaning of hospital rooms utilized by patients colonized or infected with VRE.

Methods: From June 1 2013 to May 31 2014 fluorescent marker monitoring was added to the terminal cleaning procedure, in addition to environmental microbiologic specimens for VRE, utilized for all inpatient hospital rooms of patients colonized or infected with VRE. The proportion of rooms designated as clean by each monitoring method was compared.

Results: 108/199 (54%) of eligible rooms received fluorescent marker monitoring. 3% of rooms from which fluorescent markers were determined to have been removed had environmental microbiologic specimens positive for VRE after terminal cleaning.

Conclusions: Monitoring environmental cleaning is an important component in controlling transmission. Fluorescent marker monitoring is equivalent to environmental microbiologic sampling in measuring the effectiveness of terminal environmental cleaning of rooms potentially contaminated with VRE.

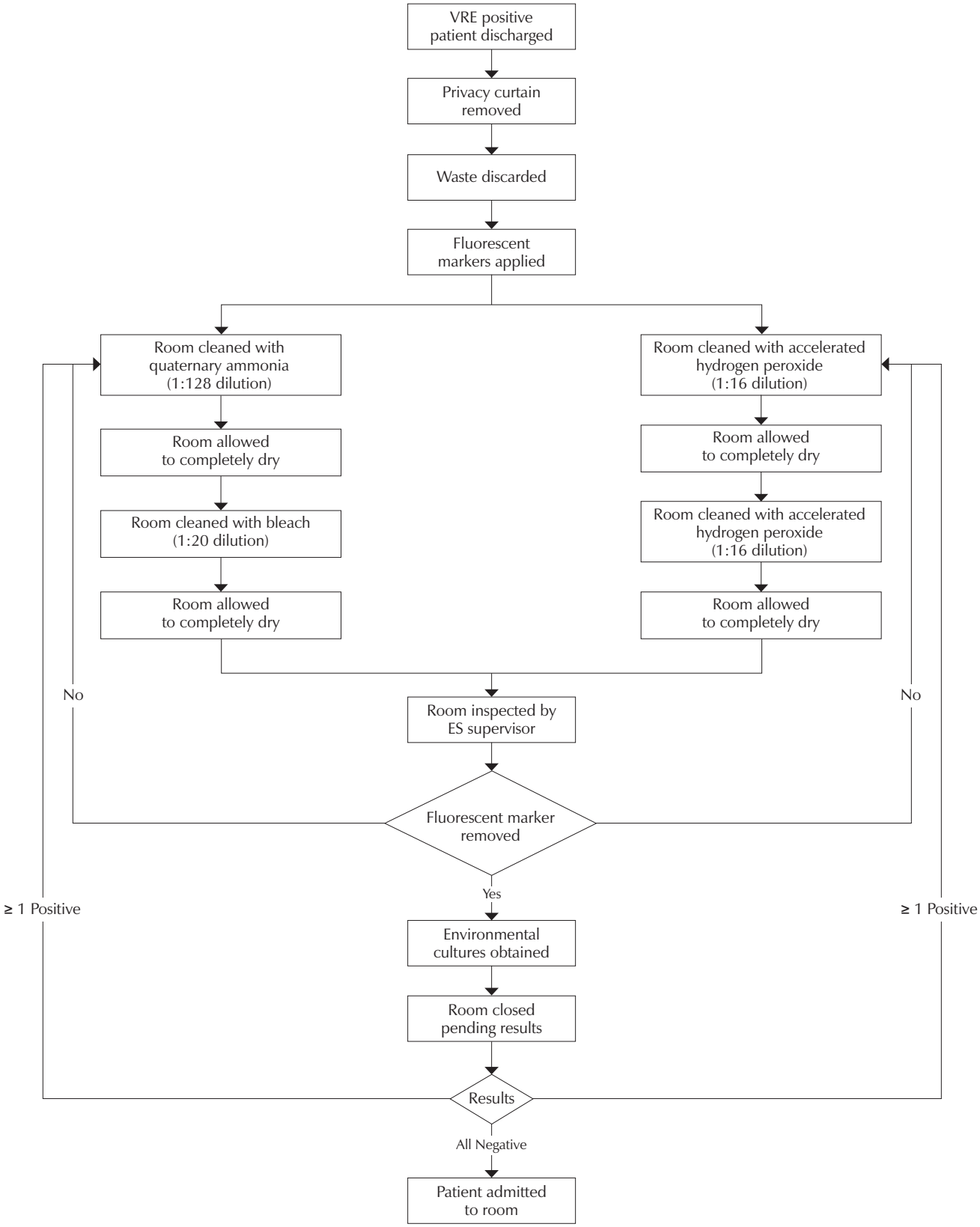
INTRODUCTION

Vancomycin resistant enterococcus (VRE) is an important nosocomial pathogen in Canada and worldwide. From 2007 to 2012 the incidence of VRE infection in Canadian acute care hospitals increased from 0.10 to 0.74 per 10,000 patient days while the incidence of VRE colonization increased from 3.24 to 8.65 per 10,000 patient days (1).

In a healthcare setting the most common mode of transmission of VRE is via the transiently colonized hands of healthcare workers (2). Healthcare workers hands become colonized through direct contact with a colonized or infected patient or after handling contaminated material or equipment (2). The ability of VRE to remain viable on surfaces for an extended period of time makes environmental contamination with the organism a particular concern (3,4). Previous studies have demonstrated that, in the intensive care setting, an increased risk of acquisition is associated with placement in a room previously occupied by a patient infected or colonized with VRE or a room with a history of environmental contamination (5-7). The monitoring of adherence to, and effectiveness of, environmental cleaning and disinfection procedures is an important factor in controlling the transmission of VRE and improvement in the thoroughness of cleaning has been shown to be associated with decreased surface and hand contamination with VRE and a reduction in VRE transmission (8,9).

Although visual assessment has been the traditional indicator of cleanliness this is an unreliable method for determining if a surface is free of microbiologic or chemical contamination (10,11). Other methods for assessing environmental cleaning include those that detect the presence of bioburden such as environmental microbiologic sampling and adenosine triphosphate (ATP) bioluminescence, and surrogate marking systems. Routine environmental microbiologic sampling is not recommended as part of terminal cleaning due to the cost of processing and the delay

FIGURE 1: Terminal Cleaning Procedure for Hospital Rooms of Patients Testing Positive for VRE (ES, environmental services)



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in obtaining results (12-14). Also failure to detect microbial growth is not confirmation of the absence of pathogens (13,14). ATP is a substance present in all living cells and ATP bioluminescence tests provide a quantitative measure of the amount of organic matter on a surface based on the amount of light produced when environmental swabs are subject to an enzymatic reaction (12). Although ATP bioluminescence tests provide immediate information on the physical cleanliness of a surface it cannot discriminate between sources of ATP, microbial versus other organic debris or viable versus non-viable bioburden, and the technology has a sensitivity and specificity of only 57% (12,15). Environmental marking with a surrogate substance such as a fluorescent marker involves the application of a colourless solution to high touch and other surfaces expected to have a heavy bioburden followed by evaluation after environmental cleaning for any residual marker (13). Programs that have introduced fluorescent markers into their environmental cleaning programs have reported improvements in the level of cleaning, as well as a decrease in the presence of microbial pathogens on surfaces and the nosocomial acquisition of methicillin resistant *Staphylococcus aureus* (MRSA) and VRE.(16-18).

Sunnybrook Health Sciences Centre has historically utilized environmental microbiologic sampling to assess effectiveness of terminal cleaning of rooms previously occupied by patients colonized or infected with VRE. This practice is associated with significant costs in terms of patient flow, microbiologic laboratory costs, and workload. The objective of this study was to determine whether a fluorescent marker monitoring system was equivalent to environmental sampling in ensuring adequate environmental cleaning of hospital rooms utilized by patients colonized or infected with VRE.

METHODS

Setting and Study Population

The study was conducted at Sunnybrook Health Sciences Centre, a 1,200-bed tertiary-care university affiliated teaching hospital located in Toronto, Canada. All acute care inpatient units were included in the study. Rooms occupied by patients colonized or infected with VRE on that admission were eligible for inclusion. Rooms of patients with a known history of VRE colonization or infection and a negative rectal swab for VRE on the current admission were excluded from the study.

Study Period

Monitoring of environmental cleaning with the use of fluorescent markers was introduced on June 1 2013 and the study period continued until May 31 2014. Results of environmental microbiologic sampling for VRE were recorded from June 2012, continued for the duration of the study period and were used as a pre-intervention comparison.

Environmental Cleaning and Specimen Collection

Upon discharge or transfer of a patient colonized or infected with VRE the room was closed, a sign was posted on the door and environmental services (ES) was contacted to begin the cleaning and disinfection process according to the specific terminal cleaning procedure of the facility (Figure 1). Contact precautions were maintained by ES staff throughout the cleaning process. Prior to beginning cleaning, the privacy curtain was removed, contaminated supplies, waste and sharps were disposed of and the mattress and pillows were inspected and discarded if not intact. The ES supervisor applied the fluorescent marking gel (Ecolab Dazo®) on high touch surfaces within the patient room. A two-stage cleaning procedure was followed throughout the facility although the disinfectant(s) used depended on the area of the hospital. According to one procedure the first cleaning step was performed using a liquid quaternary ammonium compound, (A-456-N®), followed by a second cleaning with a 1:20 dilution of bleach after surfaces had been allowed to dry completely. The other procedure involved two consecutive cleanings with a 1:16 dilution of accelerated hydrogen peroxide (Oxivir®). In each case a new cleaning cloth was used for each entry into the disinfectant solution and a contact time of 10 minutes was maintained. Cleaning was done in a clockwise direction from top to bottom and included the surfaces of all furniture and medical equipment within the room ending with a wet mop of the floor. A similar process was repeated in the patient bathroom.

Once cleaning was complete the ES supervisor inspected the room with the use of a black light to ensure that the fluorescent marker had been completely removed from all application sites. If evidence of the fluorescent marker was visible during the inspection the room was deemed to have failed and cleaning was repeated. The room was considered to have passed inspection if all traces of the fluorescent marker were removed at which point environmental microbiologic specimens were obtained by either an infection prevention and control (IP&C) professional or a trained ES supervisor. Environmental specimens were obtained from the sites summarized in Table 1. Specimens 4-7 were obtained from each patient bedspace in multi-bed rooms such that a minimum of 7, 11 and 15 specimens were obtained from each private, semi-private and ward room, respectively.

At each step in the terminal cleaning process the responsible ES or IP&C staff member signed and dated the cleaning completion sign affixed to the door. In addition, the ES supervisor provided a report to IP&C describing the date/time of cleaning, the ES staff member responsible for cleaning, the disinfectant used, and the removal of fluorescent markers. The room remained closed to subsequent admissions pending negative environmental specimen results. If one or more environmental specimens tested positive for VRE the cleaning process was repeated.

Microbiological Methods

Environmental specimens were collected by rubbing sterile gauze moistened with saline over the surface followed by immersion in Letheen broth and incubation for 16-18 hours prior to being inoculated onto chromogenic media (Oxoid Brilliance® VRE media) which was incubated at 37ºC for

TABLE 1: Environmental Specimens Obtained from Hospital Rooms of Patients Testing Positive for VRE

Swab Number	Environmental Site	Specifications
1	Toilet Area	To include flusher, call bell, safety rail and toilet seat
2	Bathroom Sink	To include taps
3	Door Knobs and Light Switches	All within the room
4	Bed	To include rails and mattress
5	Bedside Cabinet and Overbed Table	To include handles and levers and anything on the surface (e.g., telephone)
6	Head Wall	To include oxygen supply, suction canister, call bell and television
7	Chair, Wheelchair and/or Walker	As available
8	Other	

22-24 hours. Polymerase chain reaction (PCR) was performed on presumptive positive colonies to determine the presence of the vanA, vanB, or vanC1-C3 genes (19,20).

Data Collection and Analysis

Data collected on all eligible rooms included: unit, room number, type of bed, dates room closed, cleaned, environmental specimens obtained, results reported and room opened to admission, disinfectant(s) used, person collecting the specimens, number obtained and number positive. In the event that the date the room was closed was not available it was assumed to be the same as the date cleaning occurred or the date the environmental specimens were obtained, whichever was earliest. Similarly, if the date the room was opened was not recorded it was assumed to be the date that specimen results were reported as negative by the microbiology laboratory.

The proportion of rooms with environmental microbiologic specimens positive for VRE was calculated on a monthly basis as well as for the aggregate periods before and after the introduction of fluorescent markers. In the period after the introduction of fluorescent markers the proportion of rooms that had positive environmental microbiologic specimens with and without the use of the environmental marker was also calculated. All comparison of proportions was done using Chi-square and Fisher's exact test with $P<0.05$ being considered statistically significant. Statistical analyses were performed with SPSS statistical software, version 21 (SPSS Inc, Chicago, IL, USA).

RESULTS

From June 1 2013 to May 31 2014, 199 inpatient rooms with 241 beds were identified as having been occupied by a patient colonized or infected with VRE and eligible for inclusion in the study. 108 (54%) rooms had fluorescent markers applied and successfully removed from all application sites as part of the environmental cleaning procedure; fluorescent markers were not applied in the remaining 91 rooms. All rooms received environmental microbiologic sampling for VRE. Positive environmental specimens were obtained from a total of eight (4%) rooms; three (3%) from the 108 rooms that received fluorescent marker monitoring and five (5.5%) from the 91 rooms that did not ($p=0.473$). Among the eight rooms from which VRE was recovered from the environment after cleaning, six (75%) had only one specimen test positive for VRE. The remaining two (25%) rooms had specimens positive for VRE obtained from two separate environmental surfaces. The bed was the most common site from which VRE was recovered, with environmental microbiologic specimens positive from this site in three (38%) of the eight rooms.

The application of fluorescent makers differed by type of unit, occurring more frequently on medical units (51% vs. 35%) and less likely in intensive care settings (13% vs. 25%) as compared to rooms that did not receive fluorescent marker monitoring ($p=0.030$) (Table 2). Single bedrooms predominated in the study population and accounted for a similar frequency among those that did and did not receive fluorescent marker monitoring (87% vs. 85%; $p=0.665$). ES supervisors were more likely to obtain environmental microbiologic specimens, but this was not influenced by the use of fluorescent markers (60% vs. 52%; $p=0.624$).

The 199 inpatient rooms were closed for a total of 478 days with a mean of 2.4+/-1.1 days per room. Considering individual beds within the affected rooms, the facility experienced 609 bed closure days during the one-year study period.

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TABLE 2: Characteristics of Hospital Rooms of Patients Colonized or Infected with VRE from June 1 2013 to May 31 2014

Room Characteristic	Fluorescent Marker Monitoring (n=108)	No Fluorescent Marker Monitoring (n=91)	p-value
Unit Type (%)			0.030
Medical	55 (51)	32 (35)	
Surgical	39 (36)	36 (40)	
ICU	14 (13)	23 (25)	
Room Type (%)			0.665
Private (1-bed)	94 (87)	77 (85)	
Semi (2-beds)	8 (7)	6 (7)	
Ward (3-beds)	6 (6)	8 (9)	
Specimens Obtained by (%)			0.624
ES Supervisor	65 (60)	47 (52)	
IP&C	37 (34)	22 (24)	
Not Recorded	6 (6)	22 (24)	

ICU - Intensive Care Unit; ES - Environmental Services; IP&C – Infection Prevention and Control

The frequency of detection of VRE from environmental specimens decreased after the introduction of fluorescent marker monitoring (Figure 2). From June 1 2012 to May 31 2013, 31 (18%) of 171 rooms had VRE detected from at least one environmental microbiologic specimen as compared to 4% in the one year period after the introduction of fluorescent marker monitoring ($p<0.001$).

DISCUSSION

This study demonstrates that a fluorescent marker monitoring system is equivalent to environmental microbiologic sampling in measuring adherence to appropriate environmental cleaning and disinfection of hospital rooms occupied by patients colonized or infected with VRE. Of the 108 rooms that had fluorescent markers applied and reported as removed from all surfaces, only three (3%) had VRE detected through environmental microbiologic monitoring. Therefore, there was close agreement in the assessment of the effectiveness of environmental cleaning between microbiologic sampling and fluorescent marker monitoring in 97% of the rooms in which the two methods were utilized concurrently. Previous studies have differed in their findings regarding the comparison of fluorescent marker monitoring and environmental microbiologic specimens. In comparison to culture for aerobic colony counts as a method to assess the effectiveness of post-discharge cleaning, both Snyder et al. and Luick et al. reported a low sensitivity (51% and 68%) and specificity (56% and 50%) for fluorescent marker monitoring (21,22).

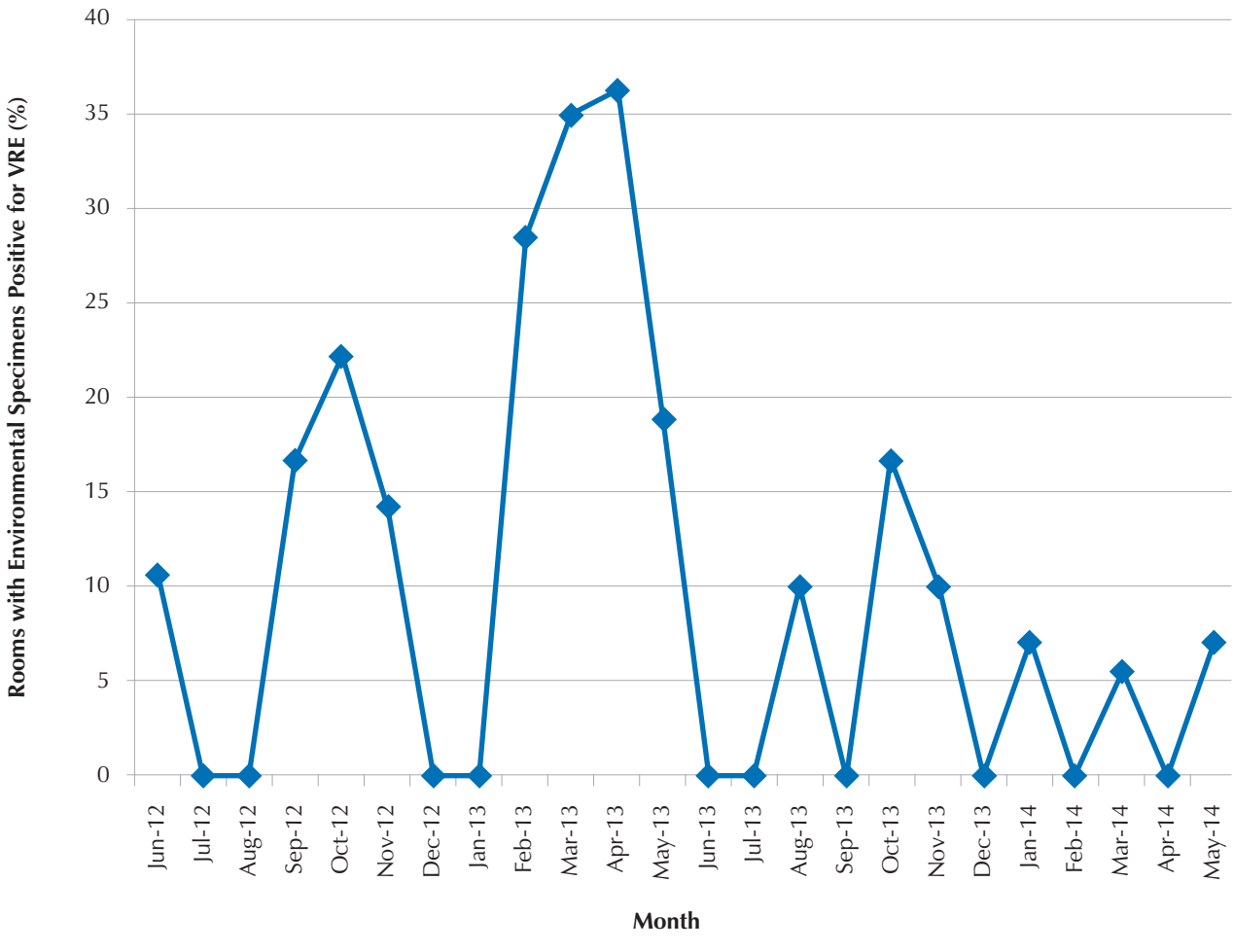
Although not a primary objective of the study, it was noted that the proportion of rooms with environmental microbiologic specimens positive for VRE decreased from 18% to 4% overall during the intervention period when fluorescent marker monitoring was added to the environmental cleaning protocol. This decrease in environmental contamination with VRE was reported in both those rooms where fluorescent markers were applied to environmental surfaces (3%) and those where it was not (5.5%). This suggests that fluorescent marker monitoring was an education tool for environmental services staff in addition to its direct application in identifying surfaces that had not received adequate cleaning and disinfection. Goodman et al. found that an environmental cleaning intervention that included fluorescent marking in addition to an educational campaign and feedback led to a corresponding decrease in the proportion of environmental cultures positive for MRSA and VRE (45% to 27%) when the proportion of surfaces from which the fluorescent marker was removed increased (44% to 71%) (18). While Blue et al. did not perform environmental microbiologic sampling, they did report a decrease in the nosocomial incidence of VRE in the setting of increased prevalence in the community concurrent with an increase in cleaning compliance, 80% of target sites cleaned versus 23% at baseline, once fluorescent marker monitoring was introduced as a part of a cleaning improvement initiative (23). Similarly, Datta et al found a decreased risk of nosocomial VRE acquisition (3.0% to 2.2%, $P<0.001$) following a cleaning intervention that included fluorescent markers (9).

Given the results of this study, the facility plans to replace environmental microbiologic specimens with fluorescent marker monitoring to measure the effectiveness of cleaning in rooms previously occupied by patients colonized or infected with VRE. This aligns with the Ontario Agency for Health Protection and Promotion (OAHPP) and Healthcare Infection Control Practices Advisory Committee (HICPAC)

recommendations against the routine use of environmental microbiologic monitoring (13,14). While ensuring compliance with environmental cleaning protocols, this change in practice will decrease microbiology laboratory costs and eliminate the need to keeps rooms closed to patient admissions while awaiting laboratory results, thereby improving patient flow. Therefore, the number of bed closures attributed to VRE should decrease dramatically from the 609 bed closure days reported during the study period. While continuing to use fluorescent marker monitoring to assess environmental cleaning following the discharge of patients colonized or infected with VRE, this practice will also be incorporated into the environmental cleaning protocol following discharge of a patient with *Clostridium difficile* infection given the role of the environment in transmission of this organism. Sitzlar et al. reported that monitoring with fluorescent markers and feedback on thoroughness of cleaning reduced the prevalence of rooms positive for *C. difficile* by 14% compared to baseline and in conjunction with automated ultraviolet radiation and enhanced standard disinfection of rooms of patient with CDI decreased the proportion of rooms with positive cultures to 7% (24).

There are a number of limitations to this study. It was a single centre study performed in large acute care facility and may not be applicable in other settings. The sample size was small due to a low prevalence of VRE in the facility. Also, only 54% of the rooms that were eligible for the intervention received fluorescent markings in addition to environmental microbiologic sampling due to a number of factors including the inavailability of the fluorescent marker product for a period of time and the absence of ES supervisors trained in the procedure during certain shifts or in particular areas. This may be reflected in the increased frequency of application of fluorescent markers to rooms located on medical units. Bias may have been introduced by the involvement of multiple ES supervisors in the application of the fluorescent markers and the assessment of its removal as well as different ES supervisors and IP&C professionals obtaining the environmental specimens. The existence of a standard protocol and training for both practices should have

FIGURE 2: Proportion of Hospital Rooms with VRE Detected from Environmental Microbiologic Specimens by Month



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mitigated any variation attributable to multiple participants.

In conclusion, VRE has the ability to contaminate the rooms of patients who are colonized or infected with the organism and monitoring environmental cleaning is an important component in controlling transmission. As fluorescent marker monitoring has been shown to be equivalent to environmental microbiologic sampling in measuring the effectiveness of terminal environmental cleaning of rooms potentially contaminated with VRE while having fewer associated costs it is an appropriate alternative.

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ORIGINAL ARTICLE

Length of surgery and intra-operative best practices determine surgical site infection risk in operations of prolonged duration

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KEYWORDS
general surgery, surgical wound infection, operative time, postoperative complications, **surgical site infection**

ABSTRACT

Background: Prolonged operative time is a well-known risk factor for surgical site infections (SSI). There remains limited literature regarding correlates of SSIs specific for general surgery procedures of longer duration. This study aims to identify potential risk factors of SSIs for colorectal and hepatobiliary surgeries of prolonged duration.

Methods: A retrospective chart review was performed for elective colorectal and hepatobiliary procedures of prolonged operative duration (≥ 4 hours) from 2008-2011 at Sunnybrook Health Sciences Centre. Patient and procedural characteristics and compliance with local guidelines for main SSI prevention practices were evaluated. Multivariate analysis was performed to identify independent risk factors of SSI development.

Results: There were 547 patients with operations ≥ 4 hours and 57 (10%) SSI cases - 43 (75%) deep/ superficial and 14 (25%) organ/space. Average age was 62, BMI 27.3, weight 77.1 kg, and operative time 366 minutes. Less than 40% of all patients received intra-operative antibiotic prophylaxis measures in accordance with local guidelines. Multivariate logistic regression identified operative time (OR 1.22, 95% CI = 1.09-1.36, $P < 0.001$) as associated with the development of SSIs. Multivariate analysis demonstrated a non-significant association for increasing odds of SSIs when intra-operative antibiotic re-dosing was not in accordance with local guidelines (OR 1.54, 95% CI = 0.82-2.89, P=0.177).

Conclusions: Healthcare providers should anticipate a greater likelihood for SSIs following lengthy operations regardless of patient characteristics or procedural factors. There is a need to target the improvement of antibiotic re-dosing practices as a means to decrease SSIs.

INTRODUCTION

Surgical site infections (SSIs), defined as infections involving the incision site occurring within thirty days after a surgical operation, are a source of significant clinical burden and healthcare resource use (1). A recent US nation-wide cost-utilization study found that SSIs, on average, extended length of hospital stay by 9.7 days while increasing costs by $20000-30000 per hospital stay (2). Patients with SSIs require longer post-operative recovery, and are at greater risk for re-admission to hospital, transfer to an intensive care unit, and post-operative mortality (3).

The incidence of SSIs varies between hospitals, procedures, and patients. The National Healthcare Safety Network (NHSN) data indicate that SSIs are the third most common nosocomial infection and account for more than one third of such infections for surgical patients (4). To reduce the rate of SSIs, the Surgical Infection Prevention Project was implemented as a nation-wide initiative through the implementation of evidence-based processes targeting normothermia, blood glucose control, appropriate hair removal, and peri-operative antimicrobial prophylaxis (5). Similar best practices in general surgery guidelines for the prevention of SSIs exist at the University of Toronto across university-affiliated hospitals (6).

Along with other factors, prolonged operative duration has been consistently identified as an independent risk factor for the development of SSIs across a wide range of general surgery procedures (7-11). Prolonged operative duration is commonly defined as procedure duration greater than the 75th percentile of the distribution of procedure duration calculated for each category of surgical procedure (12). General surgery procedures such as colorectal and hepatobiliary surgery are known to

have high incidences of SSIs and are often of longer duration. Colorectal surgery has the highest incidence of SSIs for elective procedures and published infection rates range from 4-10% for surgeries involving the colon and 3-27% for surgeries involving the rectum (13-17). For elective hepatobiliary surgeries, reported SSI incidences range from 4-20% for hepatectomies, and 6-23% for pancreaticoduodenectomies at high volume centers within the past decade (18-24). According to the NHSN, colorectal and hepatobiliary surgeries are defined as of prolonged duration at 3 hours and 4 hours, respectively (12).

Operations of prolonged duration are unique as the duration is a reflection of the combined complexity of the patient, the technique, and the procedure. Although the length of a procedure is not an easily modifiable risk factor for SSIs, there remains limited literature regarding correlates of SSIs specific for general surgery procedures of prolonged duration. Determining the risk factors for surgeries of prolonged duration can guide the targeted application of care processes to improve SSI prevention. The purpose of this study is to identify potential risk factors, from both patient characteristics and intra-operative measures, of SSIs for colorectal and hepatobiliary surgeries of prolonged duration at a single institution affiliated with the University of Toronto.

METHODS

Study Design and Patient Population

This retrospective cohort study was performed at Sunnybrook Health Sciences Centre (SHSC), a busy quaternary oncology and trauma center in Toronto, Ontario with a volume of 2472 elective general surgery operative cases in 2012-2013. Approval for this study was obtained from the Sunnybrook Research Institute Research Ethics Board.

Patients who underwent colorectal or hepatobiliary surgery (as classified by operative room (OR) record procedure codes) between January 1, 2008 and December 31, 2011 were identified from the institution OR records. Patient data was included for analysis if they met the following criteria: 1) age ≥ 18; 2) surgery classified as an elective case. Patients were excluded if they were: 1) admitted from the emergency department; 2) presented with clinical symptoms of infection of any kind within 30 days prior to their surgery; 3) did not receive pre-operative antimicrobial prophylaxis in accordance with hospital guidelines; 4) received other intra-abdominal surgery within 6 months prior to their surgery; 5) died peri-operatively (<30 days post-operatively); or 6) had missing OR records.

From the eligible study population, we identified all patients undergoing procedures with operative time ≥4 hours in duration. Operative time was defined as the interval from the beginning of skin incision to the end of skin closure. We defined operative time to be of prolonged duration at ≥4 hours due to re-dosing protocols for peri-operative antibiotic prophylaxis according to the University of Toronto Best Practices in General Surgery (BPIGS) SSI prevention guidelines, which specify that re-dosing should occur every 3 to 12 hours depending on the antibiotic used (6). Patients with a diagnosis of SSI were identified through records from Infection Prevention and Control at SHSC. Infection Prevention and Control records all SSI cases for elective colorectal and hepatobiliary surgeries as part of quality evaluation measures at SHSC. A diagnosis of SSI was given according to the standard Centre for Disease Control criteria: an infection within 30 days post-operatively and one of the following criteria was fulfilled: 1) organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial or deep incision or in the organ/space; 2) one of the following signs or symptoms of infection-pain or tenderness; localized redness and swelling, purulent drainage from the incision or drain placed through the incision, abscess involving the deep incision or organ/space; or 3) a diagnosis of superficial or deep or organ/space SSI by the attending surgeon (1). Superficial SSI was defined as infection of the surgical site that involved the skin or subcutaneous tissue; deep infection was defined as infection of the surgical site that involved the fascial and muscle layers; organ/space infection was defined as infection that involved the organ or spaces beneath the incision (1).

Both patient and procedure-related variables were assessed as potential predictors for SSIs. Patient characteristics of interest were age, body mass index (BMI), diabetes mellitus, corticosteroid use, and smoking. Procedure-related variables included operative procedure (colorectal or hepatobiliary), operative time, procedure classification (clean-contaminated or dirty-contaminated), pre-op hair removal by shaving, skin preparation agent (chlorhexidine-alcohol or providone-iodine), surgical approach (laparoscopic, open, or lap converted to open), blood loss volume, transfusion volume, antimicrobial regimen (no β-lactam allergy or β-lactam allergy), and antimicrobial prophylaxis re-dosing not in accordance with local guidelines. The routine antibiotic regimens used were cefazolin alone and cefazolin plus metronidazole for hepatobiliary and colorectal surgeries respectively (6). The β -lactam allergy antibiotic regimens used were clindamycin plus gentamicin and gentamicin plus metronidazole for hepatobiliary and colorectal surgeries, respectively (6). Antibiotic dose and recommended dosing interval were as follows: 1) cefazolin 2g IV, 4h; 2) clindamycin 600mg IV, 8h; 3) gentamicin 2mg/kg IV, 6h; 4) metronidazole 500mg IV, 8h (6). Patients were classified as receiving appropriate antimicrobial prophylaxis re-dosing administration if they received the correct antimicrobial and dosage at the correct time interval. Patients were classified as receiving inappropriate antimicrobial prophylaxis re-dosing administration if they met one of the following criteria: 1) did not receive an intra-operative re-dose of antimicrobial; 2) received an incorrect dosage of antimicrobial; or 3) received an intra-operative re-dose of antimicrobial after an inappropriate (>4h/6h/8h) time interval. The rate of patients receiving appropriate antimicrobial prophylaxis re-dosing for surgery of ≥ 4 hours per year was determined.

Statistical Analysis

Standard descriptive statistics and incidence rates of SSIs were calculated for our study population. Baseline demographic information and clinical characteristics were tabulated. Categorical variables were summarized with frequencies and proportions and compared between groups using Chi-square tests. Continuous variables were summarized with averages and

TABLE 1: Patient and Procedure Characteristics of Surgeries of Prolonged Duration Cohort (N = 547)

Characteristic		Summary Value (%)
Patient Characteristics		
Average Age (SD)		62 years (12), range 19 - 90
Sex	Male	225 (41)
	Female	322 (59)
BMI Category	<18.5	8 (1.5)
	18.5-24.9	187 (34)
	>24.9	346 (63)
	Missing	6 (1.5)
Average BMI score (SD)		27.3 (5.5) range: 15.6 - 67.5
Average Weight (SD)		77.1kg (18) range: 37.2 - 152.5
Smoking Status	Non-Smoker	493 (90)
	Smoker	54 (10)
Diabetes Mellitus	Yes	94 (17)
	No	453 (83)
Systemic Corticosteroid Use	Yes	10 (2)
	No	537 (98)
Operative Characteristics		
Operation	CRC	250 (46)
	HPB	297 (54)
Average Operative Time (SD)		366 minutes (123), range 240 - 1 200
Year of Operation	2008	94 (17)
	2009	155 (28)
	2010	148 (27)
	2011	150 (27)
Procedure Classification	Clean	47 (9)
	Clean-contaminated	490 (90)
	Contaminated	7 (1)
	Dirty	3 (<1)
Surgical Approach	Open	483 (88)
	Laparoscopic	42 (8)
	Converted	22 (4)
Average Blood Loss Volume (SD)		1 283mL (1 697mL),range 50 - 19 000
Blood Transfusion Provided	Yes	120 (22)
	No	427 (78)
Average Volume of Blood Transfused (SD)		218mL (624mL), range 0 - 6 500
Pre-operative Hair Removal	Clipping	161 (29)
	Shaving	0 (0)
	None	386 (71)
Skin Preparation Agent	Chlorhexidine	292 (53)
	Providone-iodine	255 (47)
Antibiotic Regimen	B-lactam allergy	30 (5)
	No B-lactam allergy	517 (95)
Antibiotic Intra-op Dosing	In accordance with BPIGS guidelines	202 (37)
	Not in accordance with BPIGS guidelines	345 (63)
	No intra-op re-dose	175 (51)
	Re-dose at time interval greater than recommended	73 (21)
	Antibiotic dose lower than recommended	97 (28)
Superficial/Deep Infections		43 (8)
Organ/Space Infections		14 (3)

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standard deviations (SD) and compared between groups using Wilcoxon signed-rank tests.

The primary outcome measures included the odds ratio and associated 95% CI of developing SSIs. Univariate analysis was performed to determine predictors for SSIs. Variables from univariate analysis with p-values below 0.05 were considered statistically significant and were included in the multivariate analysis. Multi-variate modelling was then performed including predictors of statistical significance from univariate analysis to determine if independent risk factors exist for the development of SSIs after surgery of prolonged duration. Univariate and multivariate analyses were performed using multiple logistic regression. The odds of surgical site infection were modeled, and the odds ratio and 95% confidence intervals reported. Using the *a priori* list of potential patient and procedural predictors of surgical site infection, multivariate regression using backward selection and a p-value of <0.05 for statistical significance was used to identify those characteristics that independently predicted the outcome. Age, operative time, blood loss, transfusion volume, body mass index and weight were modeled as continuous variables. The decision was made to include weight and blood loss, and to exclude body mass index and transfusion volume from the multivariate regression to avoid problems with collinearity in the model. Statistical analysis was performed using SAS version 9.1 (SAS Inc., Cary, NC).

RESULTS

From January 1, 2008 to December 31, 2011, 1435 patients underwent elective colorectal or hepatobiliary surgery at Sunnybrook Health Sciences Center. Of these operative procedures, 597 cases were of duration ≥4hours. Fifty-three patients were excluded from analysis: 19 died peri-operatively, 22 received inappropriate pre-operative antibiotic dosing, and 12 had missing OR records. In this cohort, there were 57 (10%) SSI cases: 43 (75%) deep/ superficial and 14 (25%) organ/space.

The demographic and operative characteristics of our study cohort are shown in Table 1. Average age was 62 (SD 12), BMI 27.3 (SD 5.5), and weight 77.1 kg (SD 18). The average operative time was 366 minutes (SD 123). Twenty-two percent of all patients received blood transfusions; average blood loss was 1283mL (SD 1697). Most patients received a prophylactic antibiotic regimen of cefazolin alone or cefazolin with metronidazole. Less than 40% of all patients received intra-operative antibiotic re-dosing in accordance with local guidelines. There was 100% compliance with local guidelines regarding hair removal.

Univariate logistic regression analysis identified operative time per 60 minute increase (OR 1.22, 95% CI = 1.10-1.36, $P < 0.001$) and blood loss volume per 250ml (OR 1.04, 95% CI = 1.01-1.07, $P = 0.009$) as significantly associated with the development of SSIs (Table 2). Multivariate logistic regression identified operative time per 60-minute increase (OR 1.22, 95% CI = 1.09-1.36, $P < 0.001$) as associated with the development of SSIs (Table 3). As identified by univariate analysis, there was borderline association of increasing rates of SSIs when intra-operative antibiotic re-dosing was not in accordance with local guidelines (OR 1.73, 95% CI = 0.93-3.20, P=0.08) (Table 2). A similar trend was noted in the multivariate analysis for increasing rates of SSIs when intra-operative antibiotic re-dosing was not in accordance with local guidelines (OR 1.54, 95% CI = 0.82-2.89, P=0.177) (Table 3).

DISCUSSION

In our cohort of colorectal and hepatobiliary procedures of prolonged duration, increases in length of operating time was significantly associated with the development of SSIs. A potential association between intra-operative antibiotic re-dosing not being performed according to existing guidelines for SSI prevention and increasing SSI rates was identified.

Various observational studies have documented the association of SSIs with longer operative times (25-27). Our study found that even for surgeries of already prolonged duration, increasing increments in operative time was still associated with increases in SSI rates, implying that the microorganism exposure that leads to SSIs occurs throughout the surgical procedure and does not occur within a specific duration. Furthermore, although it was expected that prolonged operative duration was associated with an elevated risk, other patient factors and intra-operative characteristics were not found to be significantly associated with SSIs. This finding may reflect the fact that the operative duration can be a result of the complexity of the procedure, the technique, and the patient (28-29). As the operative duration is not an easily modifiable factor, our findings suggest that intra-operative processes of care may be especially important in the prevention of SSIs for procedures of prolonged duration.

To further assess the effect of intra-operative practices, our study evaluated the patterns of adherence to best practice guidelines for evidence-based processes of care for SSI prevention. There was 100% compliance found with pre-operative hair removal guidelines. Chlorhexidine-alcohol was specified as the skin preparation agent of choice from 2010 onwards after Dairouiche et al. demonstrated its greater efficacy for surgical site antisepsis (30). In the two year period after mandated chlorhexidine-alcohol use, compliance for skin preparation agent choice was 84%. However, we were unable to arrive at a statistically significant association between skin preparation agent choice and SSIs risk, which is consistent with new data that suggests that prep choice may not affect risk (31). As SSI risk is multi-factorial in nature, there may not have been a sufficient sample size in our study to detect a statistically significant association between chlorhexidine-alcohol or providone-iodine use and SSI rates.

Of particular interest in our study was the pattern of antibiotic prophylaxis re-dosing and the adherence to established guidelines specific for surgeries of prolonged duration. A longer operative time increases the likelihood of exposure to microorganisms and infection (28). To protect against infection, prophylactic antibiotics are given prior to the first skin incision, but the concentration of drug decreases over time. The goal of intra-operative re-dosing of antibiotics for longer surgeries is to maintain effective drug

TABLE 2: Univariate Correlates of SSIs

Characteristic		SSI Rate (%)	Odds Ratio (95% CI)	P-value
Patient Characteristics				
Age (per 10 year increase)		--	1.1456 (0.9086-1.4445)	0.2503
Sex				
	Male	11.8	1.00 (reference)	0.2082
	Female	8.4	0.689 (0.386-1.230)	
BMI Category				
	<18.5	0	<0.001->999.999	0.3192
	18.5-24.9	7.9	0.621 (0.335-1.152)	
	>24.9	12.1	1.00 (reference)	
BMI score (per unit increase)		--	1.028 (0.981-1.077)	0.2488
Weight (per 10 kg increase)		--	1.0708 (0.9242-1.2407)	0.3625
Smoking Status				
	Non-Smoker	11.0	1.00 (reference)	0.2276
	Smoker	5.6	0.478 (0.144-1.585)	
Diabetes Mellitus				
	No	9.9	1.00 (reference)	0.4144
	Yes	12.8	1.327 (0.673-2.618)	
Systemic Corticosteroid Use				
	No	10.4	1.00 (reference)	0.9656
	Yes	10.0	0.955 (0.119-7.674)	
Operative Characteristics				
Operation				
	HPB	9.4	1.00 (reference)	0.4082
	CRC	11.6	1.261 (0.728-2.183)	
Operative Time (min) (per 60 minute increase)		--	1.2244 (1.1013-1.3612)	0.0002
Year of Operation				
	2008	8.5	0.632 (0.265-1.507)	0.3925
	2009	7.7	0.570 (0.266-1.219)	
	2010	12.8	1.00 (reference)	
	2011	12.0	0.926 (0.465-1.844)	
Procedure Classification				
	Clean	6.4	0.574 (0.172-1.915)	0.4171
	Clean-contaminated	10.6	1.00 (reference)	
	Contaminated/Dirty	20.0	2.106 (0.436-10.182)	
Surgical Approach				
	Converted/Open	10.9	1.00 (reference)	0.2262
	Laparoscopic	4.8	0.409 (0.096-1.740)	
Blood Loss Volume (per 250mL)		--	1.0401 (1.0099-1.0714)	0.0091
Blood Transfusion Provided				
	No	9.8	1.00 (reference)	0.3996
	Yes	12.5	1.310 (0.699-2.454)	
Pre-operative Hair Removal				
	None	10.4	1.00 (reference)	0.9452
	Clipping	10.6	1.021 (0.61-1.860)	
Skin Preparation Agent				
	Providone-iodine	9.4	1.00 (reference)	0.4711
	Chlorhexidine	11.3	1.226 (0.7042.136)	
Antibiotic Regimen				
	No B-lactam allergy	10.3	1.00 (reference)	0.5919
	B-lactam allergy	13.3	1.347 (0.453-4.008)	
Antibiotic Intra-op Dosing				
	In accordance with BPIGS guidelines	7.4	1.00 (reference)	0.0823
	Inappropriate	12.2	1.728 (0.932-3.203)	

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Table 3: Multi-variate Correlates of Deep/Superficial SSIs		
Characteristic	Adjusted Odds Ratio* (95% CI)	P-value
Patient Characteristics		
Age (per 10 years)	1.1838 (0.9288-1.5088)	0.1729
Operative Characteristics		
Operative Time (min) (per 60 minute increase)	1.2183 (1.0939, 1.3567)	0.0003
Antibiotic Intra-op Dosing		
Appropriate	1.00 (reference)	0.1771
Inappropriate	1.542 (0.822-2.891)	

**Adjusted for all variables in the model (age, operative time, intra-operative antibiotic re-dosing)*

concentrations throughout the procedure duration. Effective antibiotic concentrations may not be maintained because an intra-operative dose can be missed, delayed, or given at an inadequate dose. Local guidelines for intra-operative re-dosing are provided to ensure that the re-dosing occurs and is given at the correct time and dose. If an intra-operative dose was not given according to guidelines, theoretically, there would be a period during which the protective effect of antibiotics would be lost and the risk of infection elevated.

Compliance with intra-operative antibiotic re-dosing best practices was found to be poor in our cohort. Less than 40% of patients received antibiotic re-doses in complete accordance with local guidelines, and of these, 51% had a missed intra-operative dose. Previous studies have found similar patterns of re-dosing errors (32-34). Self-reported reasons for re-dosing errors include forgetting to administer the antibiotics given concurrent tasks, lack of verbal communication between staff, and disagreement between who is most responsible for antibiotic administration (35). Increased length of procedure has also been associated with inadequate peri-operative antibiotic administration (36). Therefore, multiple factors appear to govern the pattern of administration of peri-operative antibiotics and there exists a need to improve compliance with re-dosing guidelines.

As our cohort consisted entirely of cases that had appropriate pre-operative antibiotic dosing, we were further able to evaluate the association between non-adherence to intra-operative re-dosing guidelines and SSIs. Although a trend in SSIs was found for procedures during which antibiotic re-dosing was not in compliance with local guidelines, no statistical difference was seen in comparison with procedures during which re-dosing was in compliance. However, the trend in our results is supported by existing literature. Using data from the INCISO Surveillance Network in Northern France, Milani et al. have reported a lack of intra-operative antibiotic re-dosing when recommended as the only practice associated with increased SSI risk in a population including 1730 patients undergoing digestive tract surgery (34). Young et al, in an analysis of 216 elective surgeries, found that two or more individual errors in antibiotic dosing including inappropriate intra-operative antibiotic dosing was predictive of greater SSI rates (32). Given the trend towards statistical significance and the support from existing literature, we believe that non-adherence to best practice guidelines for antibiotic re-dosing is a risk factor for SSIs in operations of prolonged duration.

A key limitation of our study was the sample size. SSI cases were a relatively uncommon event with only 57 cases within our cohort. As the guidelines at the University of Toronto for SSI prevention only became well established in 2008, we were not able to include a larger sample in our retrospective analysis. Our study may not have been powered sufficiently to arrive at a statistically significant association between inappropriate antibiotic re-dosing or other intra-operative processes of care and SSIs. However, there was a sufficient sample size to meet our objectives of assessing patterns of intra-operative care and to evaluate trends for potential risk factors for SSIs. Another limitation was that this study only included a single centre, and thus may have lacked enough variability in the risk factors and/or outcome of interest to find true associations. Finally, the highly specialized nature of the centre chosen to carry out the study, along with its complex caseload, may make it difficult to generalize the results beyond large specialized academic institutions.

In conclusion, our study is the first to evaluate the risk factors for SSIs in elective general surgery operations of prolonged duration. We found the duration of the operation as the only significant SSI risk factor. There is an indication for healthcare providers to anticipate a greater likelihood for SSIs following lengthy operations regardless of patient characteristics or procedure factors. Our findings also emphasize the need to further understand why antibiotic re-dosing best practices are not being met, and target interventions in policy and guidelines as a means to decrease SSIs. As seen by the pattern of antibiotic re-dosing practices in our study, there is a role for quality improvement measures targeting the administration of intra-operative antibiotics. In particular, missed intra-operative doses should be addressed as it is the most common re-dosing error and may have the most significant effect on SSI risk. Previous studies have

demonstrated improved compliance with antibiotic dosing and re-dosing guidelines through the use of new practice algorithms, audible and visual reminders on the OR computer consoles, and electronic messenger reminders (8, 37-39). However, these studies have not further evaluated the effect of improved antibiotic administration on SSI risk and are not all specific for general surgery procedures. Our findings provide the background for future prospective studies to evaluate the effect of improved antibiotic re-dosing on SSI risk for general surgery procedures.

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ORIGINAL ARTICLE

Comparison of terminal cleaning of a medical surface repair patch on hospital mattresses

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KEYWORDS

hospital-acquired infections; infection prevention and control; environmental contamination; hospital mattresses; terminal cleaning; bed repair

ABSTRACT

Background: Hospital mattresses with damaged covers are a potential source of healthcare-acquired infections when they are not restored to an intact state that enables effective cleaning.

Methods: CleanPatch™, a medical surface repair patch that can restore a damaged mattress surface to an intact and cleanable state was evaluated over three months. A total of 120 patches were placed on the centre topside and the mid-bed side of 60 intact Hill-Rom VersaCare® mattresses Cultures were taken from the patches' surface and edge and the adjacent mattress before and after terminal cleaning. The severity and incidence of microbial growth of Methicillin-sensitive *Staphylococcus aureus*, Methicillin-resistant *Staphylococcus aureus*, *Enterococcus* spp., Vancomycin-resistant *Enterococci*, Gram negative enteric bacilli, non-fermenting Gram negative bacilli, and *Clostridium difficile* on CleanPatch™ and the mattress were compared before and after terminal cleaning.

Results: Microbial growth on CleanPatch™ were comparable to the mattress surface. There were no significant differences in the severity of microbial growth between CleanPatch™ and mattress surface, before and after terminal cleaning.

Conclusion: CleanPatch™ may be an application to extend the life of hospital mattresses, as it did not harbor more bacteria than the mattress it was placed on and could be cleaned as effectively in this study.

INTRODUCTION

The spread of healthcare-acquired infections (HAI) is of serious concern; annually in Canada, there are an estimated 220,000 HAI and approximately 8,000 deaths are attributed to these infections (1). A recent report from the Centers for Disease Control and Prevention estimated the annual direct cost of HAI in the United States to be between $35.7 to $45 billion (2).

It has been established that environmental contamination contributes to the transmission of several healthcare-acquired pathogens. Bed rails and surfaces, supply carts, over-bed tables, and intravenous pumps have been identified as "high-touch" (i.e., frequently touched) surfaces, increasing their likelihood for microbial transmission (3). The hospital mattress can act as a fomite for pathogens, and be a source of cross-contamination. Wear-and-tear and punctures from sharp objects such as needles negate the barrier capabilities offered by mattress covers and allow contamination of the mattress' inner core. Thus, the mattress can act as an environmental reservoir for pathogens, facilitating cross-infection, outbreaks, and in some cases patient death (4-10). These same studies showed that returning the mattress to an intact state enabled proper cleaning and disinfection, resulting in a decrease in pathogen transmission (4). As a result, current infection prevention and control (IP&C) guidelines and procedures in some jurisdictions stipulate that an intact mattress is required in order to effectively and properly clean the mattress surface and decrease the incidence of HAI (11). While effective for IP&C purposes, replacing damaged mattresses can be cost prohibitive, even reducing the number of patient beds available, as there are currently no approved repair practices in place.

To address this issue, Surface Medical developed CleanPatch™, a medical surface repair patch that can restore

Acknowledgements

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a damaged mattress surface to an intact state. This study was undertaken with the aim of independently evaluating CleanPatch™ in a clinical setting to see how well the product performed. The primary objective of this study was to compare microbial growth on hospital mattresses with those on the CleanPatch™, both before and after terminal cleaning. A secondary objective was to assess the physical performance of CleanPatch™ in a clinical setting over the duration of the study.

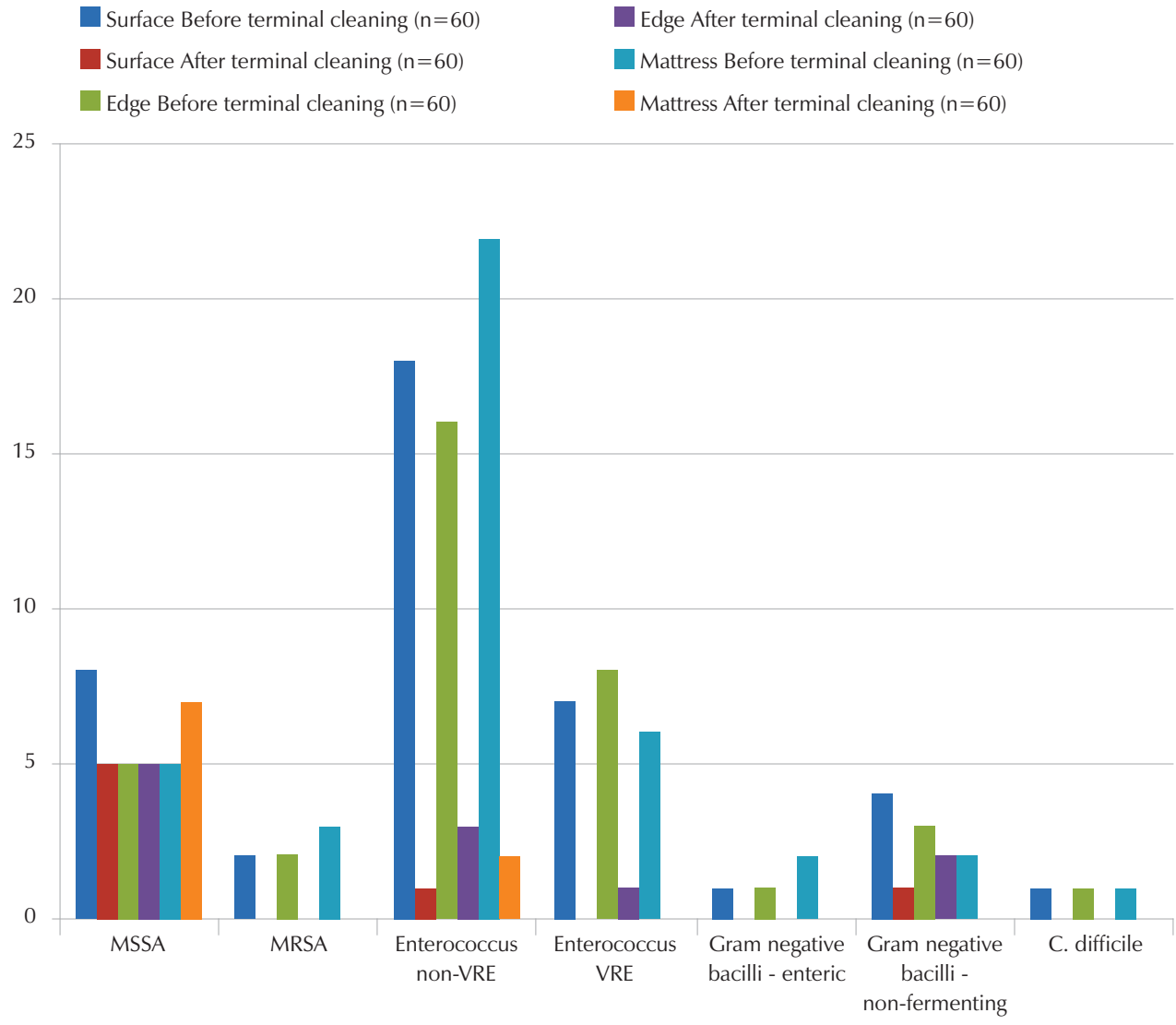
METHODS

This study was conducted between October 28, 2012 and January 28, 2013, on two high-risk medical inpatient units at a tertiary, acute care hospital in western Canada. A total of 120 CleanPatch™ were applied to 60 Hill-Rom VersaCare® mattresses across the two units. CleanPatch™ was applied to two locations on each mattress: 1) centre on the topside, an area prone to fecal contamination ("mattress top") and 2) mid-bed of the side ("mattress side"). The Conjoint Health Research Ethics Board at the University of Calgary was consulted during the planning phases of this project. Ethics approval was not required for the project as patient or provider information was not gathered as part of the research.

Physical performance assessment

Visual assessments of CleanPatch™ on mattress top and mattress side were conducted weekly by two individuals to evaluate its physical performance in the clinical setting. Photographs were taken of CleanPatch™ before and after

FIGURE 1: Total Number of CleanPatch™ Surface, CleanPatch™ Edge, and Mattress Surface with Microbial Growth from Broth or Solid Agar Cultures Before and After Terminal Cleaning by Microbial Organism – Mattress Top



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terminal cleaning for each CleanPatch™ swabbed during the study. These assessments continued for 12 months from the start of the study.

Culture collection

During the study period, the surface and edge of CleanPatch™ ("CleanPatch™ surface" and "CleanPatch™ edge," respectively) as well as the adjacent mattress surface ("mattress surface") were swabbed immediately before and immediately after a terminal clean post-patient discharge with a sterile cotton-tipped swab applicators pre-moistened with Amies liquid in a transport tube. Each discharge resulted in 12 samples, totaling 720 samples for 60 discharges over the course of the study. Microbial testing and identification of select pathogens (i.e., Methicillin-sensitive *Staphylococcus aureus,* Methicillin-resistant *S. aureus*, *Enterococcus* spp., Vancomycin-resistant Enterococci, Gram negative enteric bacilli, non-fermenting Gram negative bacilli, and *Clostridium difficile*) were carried out according to standard widely used protocols and procedures in clinical microbiology.

Swabs were placed into one ml of tryptic soy broth (TSB) and vortexed vigorously for 10 seconds. Columbia Blood Agar (CBA) plates were uniformly inoculated with 100 μl of this suspension and incubated at 37°C in O2. Another 100ul of this TSB was inoculated to ½ MacConkey agar (MAC) plate and spread as BA. The remaining 800ul of TSB was split. Half was added to 3ml Brain Heart Infusion Broth (BHI) broth containing cefoxitin (8ug/ml), ciprofloxacin (1ug/ml), 5mg/ml yeast extract, 0.1% L-cysteine and 0.1% taurocholate. This broth was incubated anaerobically at 37°C for 96 hours.

FIGURE 2: Total Number of CleanPatch™ Surface, CleanPatch™ Edge, and Mattress Surface with Microbial Growth from Broth or Solid Agar Cultures Before and After Terminal Cleaning by Microbial Organism – Mattress Side

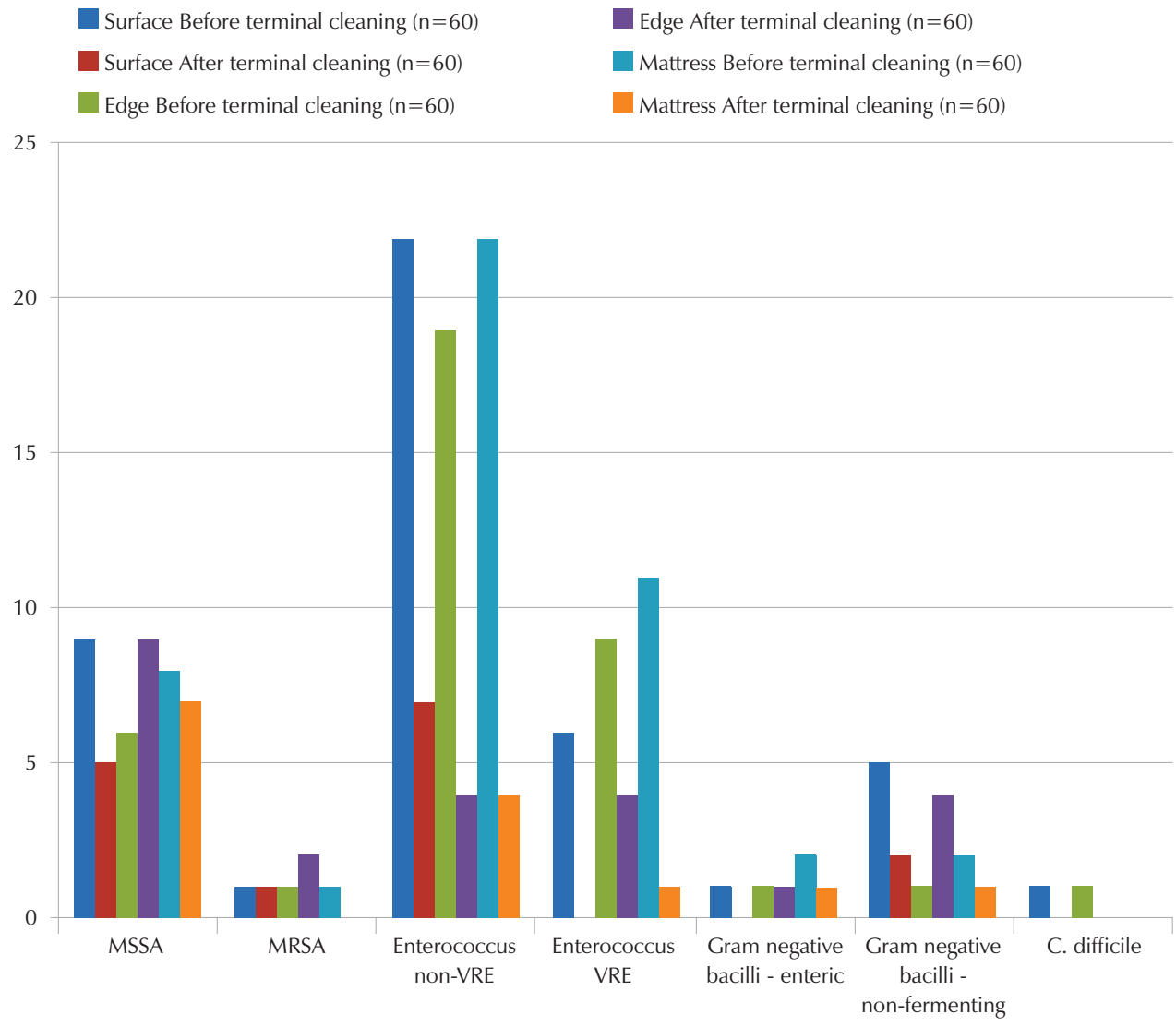

TABLE 1: Scoring Scale of the Amount of Microbial Growth for Each Pathogen*

Score	Amount of microbial growth	Growth on Plate	Growth in Broth	Number of Colonies
0	No growth	No	No	0
1	Growth in broth only	No	Yes	Trace
2	Trace growth (+/-)	Yes	Yes	10-15
3	+ Growth	Yes	Yes	15-50
4	++ Growth	Yes	Yes	50-250
5	+++ Growth	Yes	Yes	250-1000
6	++++ Growth	Yes	Yes	>1000

**MSSA, MRSA, Enterococcus spp – non-VRE, VRE, gram negative enteric bacilli, non-fermenting gram negative bacilli, C. difficile*

TABLE 2: Overall Incidence of Microbial Growth* Alone or in Combination from either Broth or Solid Agar Cultures Before and After Terminal Cleaning

	CleanPatch™ surface (incidence (%))		CleanPatch™ edge (incidence (%))		Mattress surface (incidence (%))	
Mattress location	Before terminal cleaning (n=60)	After terminal cleaning (n=60)	Before terminal cleaning (n=60)	After terminal cleaning (n=60)	Before terminal cleaning (n=60)	After terminal cleaning (n=60)
Mattress top	31 (51.67)	7 (11.67)	28 (46.67)	11 (18.33)	31 (51.67)	9 (15.00)
Mattress side	34 (56.67)	13 (21.67)	30 (50.00)	18 (30.00)	33 (55.00)	13 (21.67)

**MSSA, MRSA, Enterococcus (non VRE and VRE), Gram negative bacilli (enteric and non-fermenting), and C. difficile*

TABLE3: Severity of Microbial Growth

		Mattress Top				Mattress Side			
Location		Mean	SEM	Max	p-value*	Mean	SEM	Max	p-value*
Comparing before and after terminal cleaning on CleanPatch™ surface, CleanPatch™ edge, and mattress surface									
CleanPatch™ surface	Before	1.1	0.22	10	<0.001	1.05	0.18	6	<0.001
	After	0.13	0.05	2		0.37	0.12	6	
CleanPatch™ edge	Before	0.83	0.18	9	0.002	1.02	0.23	10	<0.009
	After	0.23	0.07	2		0.53	0.14	6	
Mattress surface	Before	1.18	0.24	9	<0.001	1.28	0.29	13	<0.001
	After	0.27	0.09	2		0.32	0.09	3	
Comparing CleanPatch™ surface to mattress surface before and after terminal cleaning									
Before terminal cleaning	CleanPatch™	1.1	0.22	10	0.8	1.05	0.18	6	<0.491
	Mattress	1.18	0.24	9		1.28	0.29	13	
After terminal cleaning	CleanPatch™	0.13	0.05	2	0.181	0.37	0.12	6	<0.738
	Mattress	0.27	0.09	2		0.32	0.09	3	
Comparing CleanPatch™ edge to mattress surface before and after terminal cleaning									
Before terminal cleaning	CleanPatch™	0.83	0.18	9	0.254	1.02	0.23	10	<0.469
	Mattress	1.18	0.24	9		1.28	0.29	13	
After terminal cleaning	CleanPatch™	0.23	0.07	2	0.761	0.53	0.14	6	<0.182
	Mattress	0.27	0.09	2		0.32	0.09	3	

SEM = Standard error of mean; Min value for all locations = 0

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CBA plates were read at 24 and 48 hours and any organisms suspected of being *S. aureus*, *Enterococcus*, coliform or non-fermenter, fungus or yeast, were subcultured to appropriate media. MAC plates were read at 24 and 48 hours, working up isolates as necessary. Using tube coagulase, Denim Blue agar (DB) and oxacillin and cefoxitin discs, *S. aureus* were determined to be MRSA or MSSA**.** Using bile esculin, m-Enterococcus media with and without Vancomycin (4ug/ml), and Vanco disc confirmed VRE and Enterococcus not VRE. Growth on MAC and MAC with ceftriaxone was used to determine coliforms and NFB. Tests including oxidase, triple sugar iron (TSI) and other pertinent tests were used to presumptively identify these organisms. Yeast and fungus were sub cultured for presumptive identification.

The *C. difficile* Spore Recovery Broth was subbed to taurocholate cycloserine cefoxitin fructose agar (TCCFA) and read after incubation anaerobically for 72 hours, providing vegetative *C. difficile* cells. The remaining BHI broth went back to the anaerobic chamber for further 96 hours of incubation. Then, an equal amount of absolute ethanol was added and the broth was shocked for one hour. The broth was centrifuged, supernatant removed, and the pellet inoculated to TCCFA. This plate was incubated anaerobically for 72 hours, providing the *C. difficile* spores. The other half of the TSB had 2ml of additional TSB added to it. This broth was incubated at 37°C in O2 for 24 hours (or 48 hours) then subbed to CBA, phenylethyl alcohol blood agar, DB, m-*Enterococcus* agar, m-*Enterococcus* agar with 4ug/ml, MAC and MAC with ceftriaxone. These plates were read at 24 and 48 hours and work-up done as stated above. All significant isolates were frozen in BHI with 20% glycerol at -86°C.

Statistical analysis

Each culture was analyzed for incidence and severity of microbial growth. For incidence, each culture was scored twice to either have (1) or not have (0) any microbial growth and microbial growth of each of the pathogens listed above. For severity, each culture was scored according to the amount of microbial growth by each of the same pathogens recovered from each swab. The scoring was conducted by the Medical Laboratory Technologist as per the scoring scale in Table 1. Two-sample, two-tailed t-test was used to determine whether there were any differences between the areas swabbed. Incidence and severity of microbial growth were summarized using descriptive statistics. Statistical analysis was performed using Microsoft Excel 2010 for Windows.

RESULTS

There were 720 samples collected over the course of three months. The vast majority (118/120) of the CleanPatch™ remained intact and did not show any wrinkling, bubbling, flagging or tearing over the duration of the study. Of the other two patches, one showed excessive wrinkling less than two months after placement, and the other CleanPatch™ showed flagging at approximately two months of placement. Longer-term durability of a sub-set of CleanPatch™ (72) continued to be evaluated for oneyear from the start of the study with all 72 have remained adhered, showing no visible signs of physical damage or tear.

Severity of Microbial Growth

The descriptive statistics of the severity of microbial growth before and after terminal cleaning, and on CleanPatch™ surface and CleanPatch™ edge relative to the mattress surface, are provided in Table 2.

The average of the total severity of microbial growth on CleanPatch™ surface, CleanPatch™ edge and the mattress surface were reduced after terminal cleaning on both mattress top and mattress side. There were significant differences in the severity of microbial growth before versus after terminal cleaning on both areas of CleanPatch™ and mattress surface among the mattress top cultures and mattress side cultures. Of both the mattress top cultures and mattress side cultures, no significant difference in the severity of microbial growth was found between CleanPatch™ surface and mattress surface, nor CleanPatch™ edge and mattress surface, before and after terminal cleaning.

Incidence of Microbial Growth

An overview of the overall incidence of any microbial growth from either broth or solid agar cultures before and after terminal cleaning from CleanPatch™ surface, CleanPatch™ edge, and mattress surface for both mattress top and mattress side is provided in Table3. For both the mattress top and mattress side, the microbial growth on CleanPatch™ surface and CleanPatch™ edge, and mattress surface was reduced after terminal cleaning.

Incidence of Microbial Growth by Pathogen

There were slight differences in the incidence of microbial growth across the different organisms between mattress top and mattress side; however, the patterns of growth before and after terminal cleaning were comparable between the two mattress locations (Figures 1 & 2). In both mattress areas sampled, the incidence rate of growth of enteric Gram-negative bacilli and *C. difficile* were the lowest while *Enterococcus* spp, including strains of VRE, was the highest.

The incidence of growth was primarily reduced or remained unchanged in the majority of the locations after terminal cleaning; however, there was an increase in non-fermenting Gram-negative bacilli and MSSA recovered from some of the areas on the mattress top and the mattress side after terminal cleaning.

DISCUSSION

In this independent evaluation of CleanPatch™, the incidence of bacterial growth was comparable between CleanPatch™ and the adjacent mattress, before and after terminal cleaning. Also, pathogenic growth decreased in all three areas after terminal cleaning, with the exception of MSSA, and enteric

Gram-negative bacilli, and non-fermenting Gram-negative bacilli. There are several possible explanations for these findings: housekeeping staff could be carriers of the organisms, sanitization equipment could be contaminated by the microbes, the order in which the surfaces have been cleaned may impact the spread of the potential pathogens, or some of the pathogens were simply missed in the pre-terminal clean swab. Despite these increases and the uncertainty of their cause, it is important to note that cleaning effectively reduced the frequency of the majority of the organisms. This indicates that the CleanPatch™ does not harbor any more (or less) organisms than the hospital mattress, and is comparable in cleanability. CleanPatch™ performed well in the clinical setting over the three-month duration of the study and remained intact for one year since the start of the study.

While this study shows promising results for CleanPatch™, there were limitations to the study. First, while it was intended that CleanPatch™ be placed on all mattresses on both units observed in this study, there were mattresses occupied by bed-ridden patients and could not have CleanPatch™ applied to them. Second, as the primary objective was to assess whether microbial growth on CleanPatch™ is comparable to a hospital mattress surface, CleanPatch™ was only placed on undamaged mattresses. Third, this study did not use random sampling, as the research associate (RA) was limited to collecting data on specific days of the week due to laboratory capacity. Data collection was facilitated by a unit clerk who was responsible for paging the RA when a patient was discharged. However, due to the busy nature of the environment, there were instances when unit clerks were unable to notify the RA, who was then unable to collect samples from those particular mattresses. Finally, the clinical setting of the study resulted in various uncontrolled factors that may have affected the results. For example, while housekeepers are required to follow standard cleaning procedures, there remains variability in their cleaning practices; Pearce and Conly (13) found that the average time of cleaning ranged from 37.96 minutes during the day shift, to 38.5 minutes during the afternoon shift, to 26.5 minutes during the night shift. Some of the housekeepers were concerned that their workflow would be affected by the study, and some had questions about how the results from the study would be used to assess the quality of their work; these concerns may have resulted in variations from typical cleaning practices. However, the authors believe that the sample size was sufficient to account for these uncontrolled factors.

This study, testing an innovative way to repair the damaged surface of a hospital mattress, shows promising results. CleanPatch™ could be a cost effective solution to repair the damaged surface of a hospital mattress, as it can be applied within minutes without skilled training or practice, eliminating mattress downtime for damage repair.

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Everybody Loves a Story

Suzanne Rhodenizer Rose, RN, BScN, MHS, CIC
President, IPAC Canada

I love hearing stories. I love the tales from my Blanding's turtle research friends at Kejimukujik National Park, from my barn girls about how the horses are "going," and about the adventures of several colleagues who selfishly gave time and shared expertise to protect healthcare workers in Sierra Leone from Ebola virus disease. There are countless patient experience stories, as well as provider stories, that humble us as healthcare professionals and push us to continually work ever so diligently to improve patient safety. No matter what the topic, I am mesmerized by the passion and emotion that comes from stories of personal experience.

I have often had a truly visceral reaction to these patient and provider stories. Sometimes I may not remember all of the details (I barely remember tying my shoes some days), but I always remember how it made me feel and perhaps how it has made me think and act differently. Storytelling in infection prevention and control can be an incredibly powerful tool. Stories place a human face to an issue.

Citing the *research* as to why, as a healthcare worker, you should get your flu shot is not a *story* and it is highly unlikely to stimulate a mass pilgrimage to the nearest occupational health flu clinic for a vaccine. However, what if you heard a story, told to me by a new staff nurse, and how I was moved by her particular experience? How I heard of a seemingly healthy post-operative four-year-old girl deteriorate unexpectedly, come into our ICU, and quickly and unexpectedly pass away; only to later learn that the cause of death was influenza B. How I heard of how the family sat in her room with tears welling up as they were given time to hold her, say their goodbyes and grapple with how this could possibly happen to their daughter? What if the mother of that child told you the story? Not to say that lack of healthcare worker influenza immunization was a causal factor, but it *could*, in theory, have played a role. I have never missed a flu immunization after that.

We are all motivated to do things and behave in certain ways for any number of vastly differing reasons. In our heart of hearts, we may admittedly recognize that benevolence and duty to provide safe care may not always be the real reason for compliance to best and expected practice. I believe storytelling can give healthcare workers a unique opportunity for self-reflection and evaluation of what motivates oneself on a daily basis. I do not feel personally or even professionally affronted (well, maybe professionally!) if research and continuous education does not turn the tide for some highly educated professionals; however, if there are other drivers, such as protecting oneself or their family, that will bring about positive behavioural changes, be it with influenza immunization, hand hygiene adherence, or what have you, I am good to go. I will take it.

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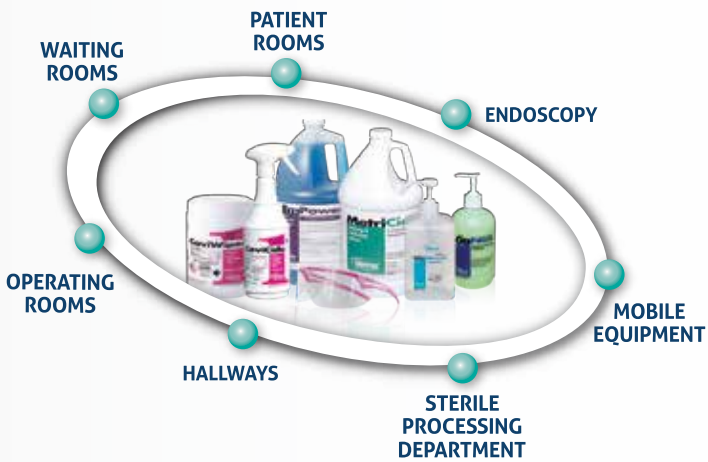

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Qui n'aime pas **une bonne histoire?**

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

J'adore les histoires. J'adore entendre mes amis m'expliquer leurs recherches sur la tortue mouchetée dans le parc national Kejimkujik, les filles de l'écurie me dire comment se portent les chevaux et mes collègues bénévoles me faire part de leur expertise et des moyens pris pour protéger les travailleurs de la santé en Sierra Leone de la maladie à virus Ebola. Il y a d'innombrables histoires à raconter sur l'expérience des patients et celle des prestataires de soins. Des histoires qui suscitent le respect et nous incitent à redoubler d'efforts pour améliorer la sécurité des patients. Peu importe le sujet, je suis subjuguée par la passion et l'émotion qui se dégagent des récits de l'expérience des uns et des autres.

J'ai souvent une réaction carrément viscérale à entendre l'histoire de ces patients et de ces prestataires de soins. Je ne retiens pas nécessairement tous les détails (il m'arrive parfois d'oublier d'attacher mes chaussures) mais je me rappelle toujours comment leur récit m'a fait sentir et comment, parfois, il a changé ma façon de penser et d'agir. Dans le domaine de la prévention et du contrôle des infections, le récit est souvent un outil incroyablement efficace. Il donne un visage humain à un sujet.

Expliquer à une personne pourquoi elle devrait se faire vacciner contre la grippe en citant des rapports de recherche, ce n'est pas raconter une histoire. Il est d'ailleurs très probable que vous ne déclencherez pas un pèlerinage en masse vers la clinique de santé de santé au travail à la prochaine campagne de vaccination. Qu'en serait-il en revanche si vous entendiez l'histoire que m'a rapportée une recrue de notre personnel infirmier et si je vous disais à quel point son expérience m'a émue? Si je vous racontais ce qu'on m'a dit de cette fillette de quatre ans, qui se portait très bien après une intervention chirurgicale jusqu'à ce que son état se détériore inopinément, qu'elle arrive aux urgences, qu'elle meure subitement et que nous apprenions ensuite qu'elle a été victime d'une grippe de type B. Si je vous racontais comment les membres de sa famille, dans sa chambre, pleuraient en l'enlaçant pour lui dire adieu tout en se demandant comment une telle chose avait pu lui arriver? Qu'en serait-il si la mère de la fillette vous racontait elle-même cette histoire? Sans compter que le fait que les travailleurs de la santé n'ayant pas été vaccinés aurait pu jouer un rôle dans l'affaire (mais n'était finalement pas en cause). Depuis, je n'ai plus jamais passé outre à la vaccination contre la grippe.

Qu'est-ce qui motive nos gestes et nos comportements? Beaucoup de choses. Reconnaissons que ce n'est pas nécessairement la bienveillance ou le devoir de prodiguer des soins sûrs qui nous poussent à adopter les pratiques éprouvées et attendues. Je crois qu'en racontant une histoire vraie, les prestataires de soins se donnent l'occasion d'une réflexion unique et d'une évaluation de leur motivation au quotidien. Je ne me sens pas personnellement ou professionnellement insultée (hmm, professionnellement, peut-être!) si certains professionnels bardés de diplômes ne modifient toujours pas leur comportement malgré la recherche et la formation continue. J'accueille toutefois avec plaisir tout autre facteur de motivation susceptible d'améliorer les comportements, en ce qui concerne le vaccin antigrippal ou le lavage des mains, entre autres, ne serait-ce que de la volonté de se protéger ou de protéger sa famille.

On se souvient bien mieux d'une histoire que des résultats de la recherche ou d'un PowerPoint.

Allez-y! Racontez vos histoires et… écoutez celles des autres.

« Il y a d'innombrables histoires à raconter sur l'expérience des patients et celle des prestataires de soins. Des histoires qui suscitent le respect et nous incitent à redoubler d'efforts pour améliorer la sécurité des patients. Peu importe le sujet, je suis subjuguée par la passion et l'émotion qui se dégagent des récits de l'expérience des uns et des autres. »

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Chapter Task Force

Gerry Hansen, BA
Executive Director, IPAC Canada

In 2014, a Chapter Task Force was appointed to address issues impacting the membership and sustainability of IPAC Canada Chapters. Those issues were identified in a brainstorming session of Chapter presidents and board members during the 2014 Chapter Presidents meeting held at the annual conference.
The mandate of the task force was to deliberate on the identified pressing issues and provide recommendations for both IPAC Canada and its chapters to strengthen and maintain chapters. The task force met throughout the remainder of 2015 and submitted its report to chapters in January 2015. Chapter presidents were requested to review the recommendations and advise if their chapter was implementing or planning to implement the recommendations.

The first report from chapters was received and reported to the board in June 2015. A second report from chapters is anticipated in October 2015.

In summary:
Management Support: Buy-in from senior management was found to be lacking and resulted in low chapter and conference attendance. The reasons for low management support were mainly non-recognition of IPAC Canada and its chapters as the national association for infection prevention and control, and concerns around the value of chapter attendance for networking and education. The task force recommended that chapters review the content of in-person meetings to focus on education and peer networking, finding other methods to bring the business of IPAC Canada to members' attention. Many chapters responded to this recommendation with information on how they are making their meetings engaging, and how they are encouraging members to attend meetings and conferences. Chapters suggested utilizing the chapter web page for business reports that can be accessed by all members prior to meetings. IPAC Canada now provides chapters with free access to its web designer and FluidSurvey for canvassing members on their chapter wish list and other questions. Interest groups and committees have access to a free Adobe Connect platform and IT support for special presentations and project work. The latter platform will be provided to chapters in late 2015.

Executive Succession: A major concern is the sustainability of chapter governance and the recruitment of volunteers to accept executive positions. IPAC Canada was encouraged to provide policy, terms of reference and job position templates for chapter executives as well as a chapter executive support area on the website. A mentor program was strongly encouraged and IPAC Canada has addressed this through the development of a program to be launched in 2016. Support of members wishing to achieve certification has also been addressed through a CIC® Study Preparatory Workshop held at the 2015 conference and discussion with CBIC around web-based study preparation.

Finance and Resources: As a result of Task Force discussions, a Fee Structure Review Committee was appointed in 2015. The committee reviewed the current membership fee structure of IPAC Canada and similar organizations. It also addressed different membership scenarios. A report on the findings of the committee was published in the spring 2015 journal.

Communication and Messaging: Communication and messaging from IPAC Canada to chapters, from chapters to its members, and to the public cannot be emphasized enough. Chapters were encouraged to increase member communication through the use of its webpage, newsletters, and web-based meetings. Members should be encouraged to share practice scenarios, research and innovative learnings. IPAC Canada will build on its current letter to administrators template (*http://www.ipac-canada.org/links_human_resources_icp.php*) by preparing a brief for decision makers around the value of membership in IPAC Canada. IPAC Canada has also made a concerted effort to increase its presence on social media.

Chapter Practices and Policies: It is vital for chapters to understand the needs of their members. It is necessary to accept the change that healthcare budgets and technology advancements create within our association. IPAC Canada will continue to provide communication and resources to chapters to ensure strong, engaging, and sustainable chapters.

It should be noted that the 2016-2018 Strategic Plan includes an objective of the creation of a Chapter Council to represent IPAC Canada's 21 chapters in liaison with the Board and administration of IPAC Canada. This will be addressed by IPAC Canada later in 2015.

The full report on chapter responses has been posted to the Chapter Presidents webpage.

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Distance Education Graduates

IPAC Canada congratulates the graduates of the 2014-2015 Distance Education Online Novice Infection Prevention and Control Course. The following group of graduates has successfully completed the course. This course also provides IPAC Canada members with the opportunity to share their expertise in the roles of coordinators, instructors and discussion facilitators. Many thanks go to the faculty of the course and to the families and colleagues of the students for making it all possible for students to strengthen their knowledge and skills. We know that they are ready and eager to apply them to practice.

Congratulations and best wishes to:

- **Sarah Alexander** – *Dartmouth, NS*
- **Frederick Akintade-Oluway** – *Saskatoon, SK*
- **Jennifer Barris** – *Cottam, ON*
- **Rachelle Breen-Wilson** – *Mattawa, ON*
- **Amanda Brizard** – *Thunder Bay, ON*
- **Coleen Brooks** – *Prince Albert, SK*
- **Tracey Candy** – *Sussex, NB*
- **Sandy Chapman** – *Hamilton, ON*
- **Blanda Chow** – *Calgary, AB*
- **Dawn Clare** – *Frankford ON*
- **Fred Cundict** – *Edmonton, AB*
- **Diane Deveau** – *Windsor, ON*
- **Kelly Dutiaume** – *LaSalle, MB*
- **Kristina Eadie** – *Winnipeg, MB*
- **Kelly Elliot** – *Winnipeg, MB*
- **Tabish Gill** – *Pakistan*
- **Doreen Hawco-Mahoney** – *Goose Bay, Labrador*
- **Louna Jalbout** – *Ajax, ON*
- **Saad Mubas Jalili** – *Toronto, ON*
- **Janice Karasevich** – *Winnipeg, MB*
- **Melissa Kastelic** – *Edmonton, AB*
- **Annette Lafontaine** – *Ottawa, ON*
- **Cecil Lebbi** – *High Level, AB*
- **Suzann McKeon** – *Calgary, AB*
- **Candida McRae-Williams** – *St. Maarten*
- **Beth Anne Miller** – *Calgary, AB*
- **Mandeep Minhas** – *Hinton, AB*
- **Kristy O'Keefe** – *Winnipeg, MB*
- **Karina Popowich** – *Geraldton, ON*
- **Shanela Regales-Pieterne** – *Curacao*
- **Charina Rivas** – *Surrey, BC*
- **Andrea Rosner** – *Winnipeg, MB*
- **Lindsay Samoila** – *Tecumseh, ON*
- **Ravneet Sandhu** – *Edmonton, AB*
- **Yoshie Shimura** – *Nanaimo, BC*
- **Julita Sienkiewicz** – *Vancouver, BC*
- **Leona Storch** – *Hanna, AB*
- **Bruce Tufford** – *Victoria, BC*
- **Leo Viray** – *Calgary, AB*
- **Ellie Zeidi** – *Etobicoke, ON*
- **Sergio Zschuschen** – *Curacao*

2014-2015 Faculty

- **Heather Candon**, BSc, MSc, CIC *Course Coordinator*
- **Jane Van Toen**, MLT, BSc, CIC *Course Coordinator*
- **Jill Richmond**, BA, RN, BN, CIC *Practicum Coordinator*
- **Tara Leigh Donovan**, BHSc, MSc *Instructor*
- **Laura Fraser**, RN, BScN, CIC *Instructor*
- **Leila Kipke**, MLT *Instructor*
- **Sue Lafferty**, RN, BScN, CIC *Instructor*
- **Lesley McLeod**, BSc, MSc, CIC *Instructor*
- **Deb Paton**, RN, BScN, CIC *Instructor*
- **Anne Augustin**, MLT, CIC *Facilitator*
- **Kimberley Miller**, MLT *Facilitator*
- **Tina Stacey-Works**, MLT, CIC *Facilitator*
- **Jill Richmond**, BA, RN, BN, CIC *Facilitator*

For more information on upcoming course offerings, see IPAC Educational Opportunities on the website.

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2016 Award Opportunities

Criteria for each of the following awards have been posted to the Opportunities section of the website.

Moira Walker Memorial Award for International Service

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

NOMINATION GUIDELINES

Preferred: Current IPAC Canada members in good standing

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

Who May Nominate

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

How to Nominate

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

Selection Process

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

Award

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

Deadline

The deadline for nominations is March 31, 2016.

Announcement and Presentation

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

Award Sponsor

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

SAGE® PRODUCTS

2016 Champions of Infection Prevention and Control

3M

In collaboration with 3M Canada, IPAC Canada established the Champions of Infection Prevention and Control Award in 2009. The Award recognizes IPAC Canada members who have demonstrated innovative initiatives to prevent infection, raise awareness, and improve the health of Canadians. The candidate may also be nominated for lifetime achievement. The nomination may be made by a member of IPAC Canada or by an IPAC Canada chapter. Formal presentation of the Award will be made at the Opening Ceremonies of the 2016 National Education Conference (Niagara Falls, May 15, 2016).

Deadline for 2016 nominations is **March 1, 2016.**

Award Opportunities

Criteria for each of the following awards have been posted to the Opportunities section of the website.

2016 SealedAir Diversey Scholarship

IPAC Canada and SealedAir Diversey have partnered to provide a conference scholarship opportunity to IPAC Canada members. The objective of the scholarship is to provide financial assistance to eligible infection prevention and control practitioners in the form of a scholarship to attend the IPAC Canada annual national conference.

Deadline for 2016 online application is **January 31, 2016.**

2016 Sage International Attendee Scholarship

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

Deadline date for applications is January 31, 2016.

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Announcement of
Sage International Attendee Scholarship

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

The amount of $5,000 will be set aside for the Scholarship by IPAC Canada and Sage Products LLC. The maximum amount granted to each recipient per award year would be the equivalent of five thousand dollars ($5000.00 CAD). Applicants will not necessarily receive the full amount. The award will include registration for the entire conference, including both pre- and post-conference education sessions, economy air travel, and a maximum of five (5) nights' accommodation, and meals.

DEADLINE FOR APPLICATIONS: January 31, 2016

Criteria and application guidelines available at *http://www.ipac-canada.org/opps_sage_international_scholarship.php*

In additional support of international colleagues, Sage Products LLC and Webber Training supported the attendance of Dr. Jean-Paul Ngandu Mbanga from Namibia at the 2015 national education conference.

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

2016 **ECOLAB poster contest**

An annual poster contest is sponsored by Ecolab and supported by a chapter of IPAC Canada to give infection prevention and control professionals (ICPs) an opportunity to put their creative talents to work in developing a poster which visualizes the infection Control Week theme. 2016 National Infection Prevention and Control Week is October 17-21.

2016 is IPAC Canada's 40th anniversary, and the selected theme reflects the important job that infection prevention and control professionals do in all healthcare sectors.

THEME: ICPs – The Core of Infection Prevention and Control

PRIZE: Waived registration to 2016 IPAC Canada National Education Conference or $500.

REMINDER: Posters should have meaning for the public as well as all levels of staff across the continuum of care. The poster should be simple and uncluttered, with strong visual attraction and minimal text.

Judging will be on overall content. Artistic talent is helpful but not necessary. The winning entry will be submitted to a graphic designer for final production. Your entry will be become the property of IPAC Canada.

HOST CHAPTER: IPAC Simcoe-Muskoka

SUBMISSION: Submissions will only be accepted by email. Send submission to *info@ipac-canada.org*.
Email title: 2016 Ecolab Poster Contest
Submission format:

- Electronic file in Word or PDF format only.
- Files less than 5 MB preferred.
- File Size – must print out to 8.5"x11" paper.
- Name, address and telephone number must be included in the covering email.
- DO NOT include identifiers in the poster submission.

DEADLINE: January 31, 2016

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Kristin Vondrak, Vice President and Chief Quality Officer, Baptist Health System, Jacksonville, FL

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- ✔ 57% reduction in MRSA infection rates.[3]

1. Nagaraja A, et al., Westchester Medical Center in AJIC 2015, *C. diff* reductions in ICU.
2. Levin J, et al., Cooley Dickinson in AJIC 2013, 41:746-748.
3. Simmons S, et al., Cone Health System in JIP 2013.

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Bring in a **new member**

NEW DEADLINE DATE! NEW AWARD!

Membership has its benefits – education, collaboration and representation. The IPAC Canada website (*www.ipac-canada.org*) has so much information on the benefits of being a member. The annual member resource guide for finding other IPAC Canada members, links to infection control sites, audit tools...the list is extensive. Tell another infection prevention and control professional (ICP), tell an infection control or ID physician, tell your medical laboratory technologist, tell environmental services, tell EMS, tell your designate, and tell your director about the benefits of joining our national organization.

If that person joins IPAC Canada by **March 15, 2016**, both you and the new IPAC Canada member will be eligible to win a complimentary 2016 conference registration (Monday-Wednesday, value $625). You are eligible for the draw with every new IPAC Canada member that you get to sign up from June 1, 2015 to March 15, 2016. Should the winning members have already paid their 2016 conference registration, a refund will be made to the person or the institution which has paid the fee. The New Member Contest form is available from *www.ipac-canada.org* or by contacting the IPAC Canada office. An announcement of the winners of this offer will be made by March 30, 2016. Membership applications can be found at *www.ipac-canada.org/about_join.php*.

New member name _____

Email address _____

Sponsoring member _____

Email address _____

Send this form by fax or email to: IPAC Canada Membership Services Office | *info@ipac-canada.org* | Fax: 204-895-9595

September 21, 2015

Dear IPAC Canada members and colleagues,

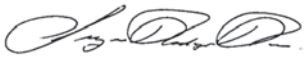
If you work in an acute care hospital with 50 or more beds, you (or another Infection Prevention and Control Professional (ICP) at your hospital) will receive an e-mail invitation from the study investigators, Dr. Andrew Simor, Dr. Philippe Martin, Dr. Oscar Larios, Dr. Karl Weiss, Dr. Allison McGeer and IPAC Canada representatives Kathryn Bush, Myrna Dyck and Zahir Hirji to participate in a follow-up ARO point-prevalence survey to be done in February 2016. This survey is not funded and depends entirely on the interest and goodwill of IPAC Canada members, such as you and your colleagues.

IPAC Canada is a co-investigator in this initiative because we believe the results of this point-prevalence survey will provide important information that will help hospital-based ICPs understand and manage the risks of infection caused by these organisms.

As a small incentive for your participation in this survey next February, IPAC Canada and the Principal Investigators (Dr. A. McGeer and Dr. A. Simor) are pleased to announce that there will be a draw from among all hospitals submitting data for the chance to win one of 3 free memberships in IPAC Canada for the year 2016-2017.

As an organization, IPAC Canada strongly supports and endorses your active participation in this point-prevalence survey in February 2016. If you have any questions or concerns about this project, please do not hesitate to contact either Vicki Williams (*Victoria.williams@sunnybrook.ca*), Dr. Philippe Martin (*philippe.martin@USherbrooke.ca*), Dr. Allison McGeer (*amcgeer@mtsinai.on.ca*), Dr. Andy Simor (*Andrew.simor@sunnybrook.ca*), or any of the IPAC Canada representatives Kathryn Bush (*kathryn.bush@albertahealthservices.ca*), Myrna Dyck (*mdyck5@wrha.mb.ca*), or Zahir Hirji (*zhirji@tsh.to*).

Thank you for your assistance with this project.



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Hygiene Performance Solutions	178, 192	905-361-8749	www.hygieneperformancesolutions.com
Medco Equipment	141	800-717-3626	www.medcoequipment.com
Medline Canada Corporation	182	800-396-6996	www.medline.ca
Metrex Corp.	180	800-841-1428	www.metrex.com
Process Cleaning Solutions	194	877-745-7277	www.processcleaningsolutions.com
Retractable Technologies, Inc.	136	888-703-1010	www.vanishpoint.com
Sage Products, LLC	175	800-323-2220	www.sageproducts.com/preventinfection
SciCan Ltd.	173	800-667-7733	www.scican.ca
Sealed Air Diversey Care	174, 176	800-558-2332	www.sealedair.com
The Stevens Company Limited	199	800-268-0184	www.stevens.ca
STERIS Canada Inc.	172	800-661-3937	www.steris.com
Surface Mdical Inc.	171	888-623-7085	www.cleanpatch.ca
Vernacare Canada Inc.	186	800-268-2422	www.vernacare.com
Virox Technologies Inc.	IFC, 139	800-387-7578	www.virox.com
Wood Wyant	197	800-361-7691	www.woodwyant.com
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