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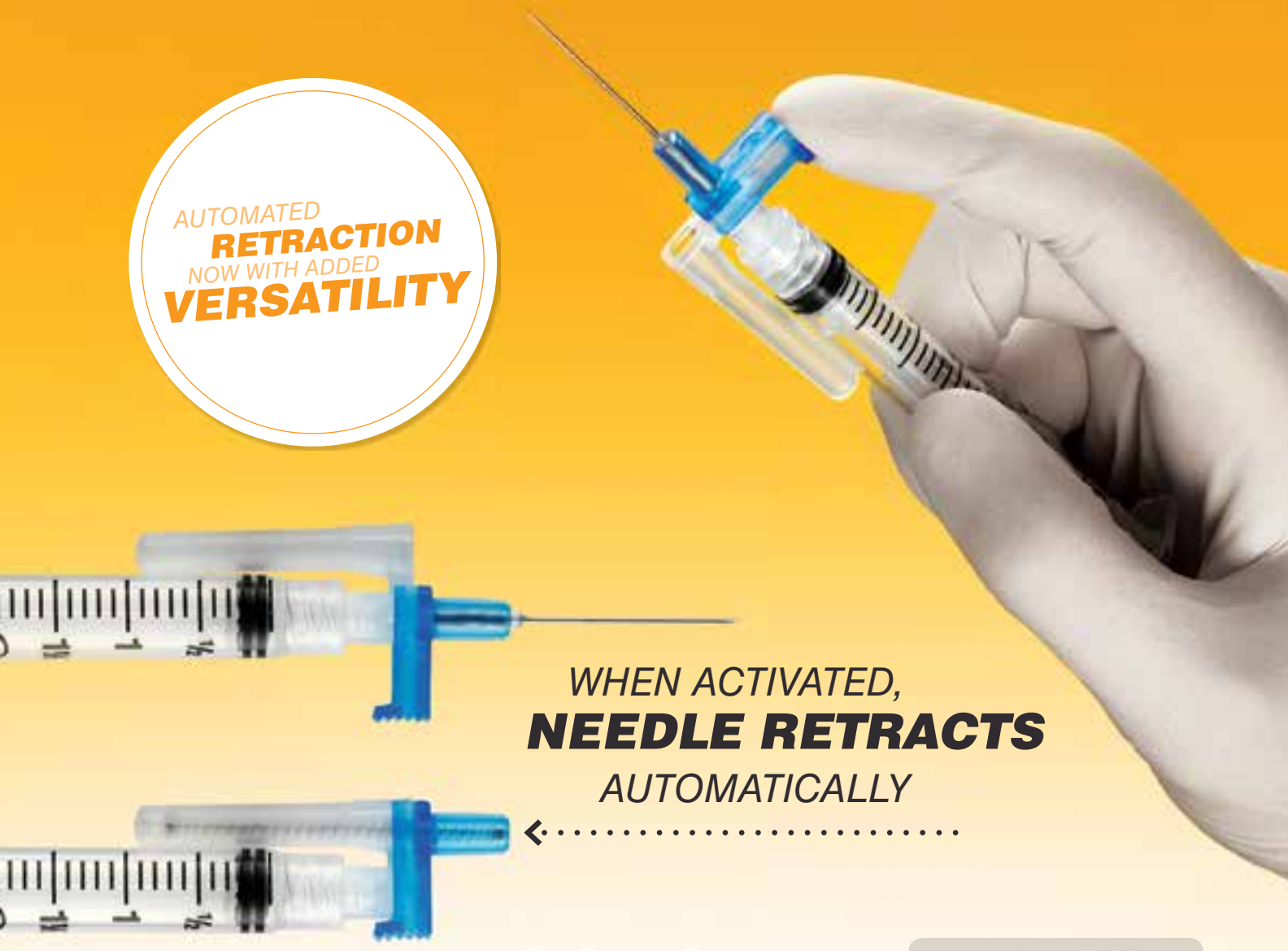

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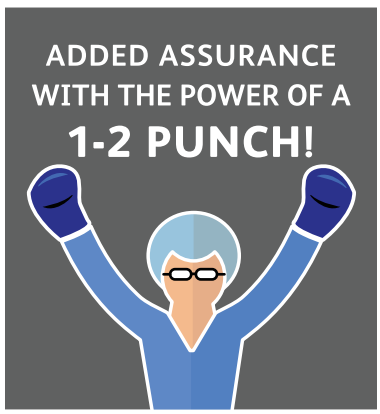

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“Widely Used Benzalkonium Chloride Disinfectants Can Promote Antibiotic Resistance”

No Residue

Residue

Neutral pH PCS 250 Oxidizing Disinfectant/Disinfectant Cleaner

Use to clean frequently touched surfaces.

Apply to surface and wipe dry with microfibre cloth or other clean dry absorbent cloth.

Cleaning

- PCS 250 Oxidizing Disinfectant/Disinfectant Cleaner
- Apply with pre moistened wipe and wipe dry with PCS microfibre cloth

Versus

- 1.4 % Hydrogen Peroxide wipes
- Quaternary disinfecting wipe containing alcohol
- Cleaning and disinfecting one wipe used to clean and a second wipe applied to disinfect

CREM CO Quantitative Carrier Test QCT-3

Vegetative Bacteria (S. aureus and S. marcescens)
Average CFU per square centimetre

	CFU/cm2			Chemical Residue	Average Percent
Product	Control	After Wiping	Transfer		Reduction
PCS 250	26,900	0.25	0	NO	99.999
1.4% HP	14,000	1.27	0	YES	99.991
QUAT/ALC	34,400	2.54	0	YES	99.993

C. difficile spores
Average CFU per square centimetre

	CFU/cm2			Chemical Residue	Average Percent
Product	Control	After Wiping	Transfer		Reduction
PCS 250	3330	15.15	2.44	NO	99.53
1.4% HP	1150	14.33	15.3	YES	98.75
QUAT/ALC	750	263	161	YES	60.39

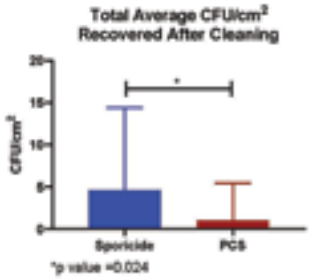
CLEANING PROCESS vs. SPORICIDAL DISINFECTION

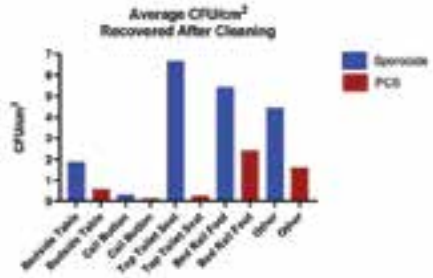
Objectives: To evaluate the efficacy of using an “apply and dry” cleaning process of microfiber combined with a low concentration of non-caustic, non-toxic, neutral pH, sodium hypochlorite solution against the efficacy of using a sporicidal daily disinfection with air dry.

Methods: This study was conducted in the GI ward of a large university hospital in the U.S.

- Microbiological swab samples were collected for 3 days, pre (n=30) and post (n=60) daily cleaning of patient rooms with a sporicidal disinfectant that was allowed to air dry at least 5 minutes before sampling.
- Cleaning staff were then trained on applying the PCS product with immediate drying using a microfiber cloth.
- Microbiological samples were again collected before (n=45) and after (n=60) daily cleaning of patient rooms with the PCS product.
- All swab samples were taken and analyzed by NSF International. Samples were analyzed for Total Aerobic Colony Counts (ACC) and presence/absence of *Clostridium difficile*.

Results: All 180 samples were negative for the presence of *C. difficile*.





Conclusions: The use of a low concentration of non-caustic, non-toxic, neutral pH, sodium hypochlorite solution that was applied using a disposable wipe followed by immediate drying with a microfiber cloth demonstrated equal or better efficacy than applying a sporicidal that was allowed to air dry.

Author: C. Greene, MPH, PhD., NSF International, Ann Arbor, MI.

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POSITION PAPER: Reprocessing of Critical Foot Care Devices

This position statement was developed by IPAC Canada's Reprocessing Interest Group:

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BACKGROUND

Foot care devices have been associated with healthcare-associated infections and outbreaks [1-6]. The goal of this document is to provide infection prevention and control recommendations for the management of critical foot care equipment and/or devices. This will include cleaning, disinfection, sterilization, transportation, and storage.

POSITION STATEMENT

Clients expect and require safe care regardless of where the procedure is performed. Therefore, each client interaction requires a sterile set of foot care equipment/devices.

1. Reusable foot care equipment/devices are considered critical devices [7-13].
2. All healthcare providers:
   - Shall have a sufficient number of foot care equipment/devices/kits to ensure sterile equipment, either single-use or properly reprocessed, for each individual client treatment.
   - Are responsible to ensure that the client is not placed at risk of infection when reusing any foot care equipment/devices during the provision of care.
3. Reprocessing of reusable foot care equipment/devices shall meet the manufacturer's instructions for use (MIFU) and current national guidelines such as those of the Canadian Standards Association (CSA) and the Public Health Agency of Canada (PHAC/Health Canada), as well as provincial standards [9, 13].
   - Reusable equipment/devices are sold with MIFU, including for proper cleaning and sterilization, and shall not be purchased, used, or reprocessed without these. Determine reprocessing methods in advance of purchase. Single-use medical equipment/devices do not have such instructions and shall not be reprocessed [7, 8, 13, 14].
   - Critical medical equipment/devices shall be sterile for use and MIFU for parameters for sterilization shall be followed.
   - If the process used for reprocessing cannot meet the current standards, single-use disposable items shall be used and discarded after use.
   - Nail clippers should be deemed single-use if no MIFU are available or if the MIFU do not meet recognized standards.
4. Medical equipment/devices used to provide foot care should be used according to the MIFU (i.e., for the intended purpose and following instructions for use, as per the manufacturer) and designed for use on humans, specifically feet (e.g., rotary sanding device and accessories). Medical equipment/devices that are designated as Class II or higher require a medical device licence. Health Canada's Medical Devices Active Licence Listing (MDALL)/Medical Devices Establishment Licence Listing (MDEL) are resources to verify if the equipment or establishment is approved in Canada.
5. Options to achieve a *sterile set of foot care equipment/devices for each client interaction* include:
   Option 1: Use single-use sterile disposable equipment/devices and discard appropriately after use [10, 11].
   Option 2: Multi-client reusable foot care equipment/devices reprocessed using the contracted services of a centralized Medical Device Reprocessing Department (MDRD). The contracted MDRD meets CSA standards and has qualified technicians to perform the reprocessing (cleaning and steam sterilization) [10].

- This equipment requires thorough decontamination (cleaning and disinfection), packaging, and steam sterilization between each client use and shall follow CSA standards for storage of sterile supplies to ensure they maintain sterility.
- Best practices for transportation and storage of soiled and reprocessed equipment/devices shall be incorporated and meet current CSA standards.
- There shall be a robust process for recall of reprocessed equipment/devices in the event of reprocessing failure. Load records, proper labelling, and chemical and biological indicators are required.

Option 3: The healthcare provider chooses to reprocess reusable equipment/devices themselves, with the following considerations incorporated into practice:

- Follow current pertinent CSA standards documents [13, 15] for reprocessing practices and purchasing and follow these, along with provincial reprocessing guidelines.
- The healthcare provider shall have written procedures based on current standards [13, 15].
- Education: "Personnel involved in all medical device reprocessing functions shall be prepared for the tasks that they are required to perform through formal education and training" [13], including, at minimum:
  - Following national and provincial guidelines [9, 13].
  - Education and competency related to all equipment/devices used in the process; maintenance, quality testing, and monitoring of the sterilization process; packaging, storage, and transportation of reprocessed equipment/devices, including chemicals; and sterilization equipment.
  - Training to a level required for the volume and complexity of the equipment [7, 8].
- Reprocess equipment following the MIFU for the device and the sterilizer.
- Ensure the MIFU for each piece of equipment meet recognized accepted standards for reprocessing.
- Steam sterilization is required for foot care instruments and the sterilizer requires a printout or electronic record for each cycle [13].
- Follow quality assurance recommendations, including monitoring and documentation of mechanical, chemical, and biological indicators [15].
- There shall be a robust process for recall of reprocessed equipment/devices in the event of reprocessing failure, including labelling of all packages with the sterilization date, load, sterilizer number, name of the medical device, and initials of the person packaging the device.
- Best practices for transportation and storage of soiled and reprocessed equipment/devices shall be incorporated. If using event-related sterility, a quality system is required with policies and procedures for the storage process.
- Incorporate a preventative maintenance schedule according to equipment MIFU, including maintenance procedures, cleaning frequency of autoclave and reprocessing area, and annual autoclave calibration by a certified technician.
- There shall be a procedure outlining actions to be taken if parameters of cleaning and sterilization are not met, including documentation of steps taken to remediate.
- The foot care provider shall follow occupational health and safety guidelines (e.g., Routine Practices and Additional Precautions, appropriate personal protective equipment, safe sharps management, hand hygiene, and the procedure for staff exposures that occur during reprocessing) [7].

Note: The use of liquid chemicals for sterilization of instruments is not recommended for critical equipment/devices that are used for sterile procedures due to the limitations in maintaining sterility to point of use [16]. "Devices cannot be wrapped or adequately contained during processing in a liquid chemical sterilant to maintain sterility following processing and during storage" [14].

Unacceptable methods of sterilization include Immediate-Use Steam Sterilization, formerly referred to as flash sterilization; glass bead sterilizer; microwave oven; boiling; Chemiclave; steam sterilizers without printouts or electronic recording; dry heat (in this setting); and ultraviolet irradiation [8].

STAKEHOLDERS

Healthcare providers performing foot care in any healthcare setting, which includes but is not limited to care provided in private homes, clinics, and healthcare settings. (See "healthcare setting" definition.)

GLOSSARY

As per the Canadian Standard Association:

"SHALL" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard;

"SHOULD" is used to express a recommendation or that which is advised but not required; and

"MAY" is used to express an option or that which is permissible within the limits of the standard, an advisory or optional statement.

Class II equipment/devices: All invasive devices that penetrate the body through a body orifice or that come into contact with the surface of the eye are classified as Class II. See Classification Rules for Medical Devices (https://health-products.canada.ca/mdall-limh/index-eng.jsp).

Client: Includes patient, client, and resident.

Critical medical equipment/devices: Medical equipment/devices that enter sterile tissues, including the vascular system (e.g., biopsy forceps, foot care equipment, dental hand pieces, etc.). Critical medical equipment/devices present a high risk of infection if the equipment/device is contaminated with any microorganism, including bacterial spores. Reprocessing critical equipment/devices involves meticulous cleaning followed by sterilization [8].

Foot care: Routine care includes a clinical assessment of the feet, education for the client, and care that only involves the epidermal layer of the skin or nails. Routine care may include the filing of corns or calluses, the filing or trimming of nails, and skin care. Invasive foot care includes contact with non-intact skin and surgical interventions with entry into or contact with the epidermal, dermal, deep fascial, and osseous structures. Foot care is performed by healthcare providers (e.g., chiropodists, podiatrists, nurses, advanced independent practice nurses) within their defined scope of practice.

Healthcare provider: Any healthcare professional delivering foot care service to a client as well as those performing reprocessing duties.

Healthcare setting: Any location where healthcare is provided, including home healthcare, offices of other health professionals, outpatient clinics, emergency care, hospitals, complex continuing care, rehabilitation hospitals, long-term care homes, mental health facilities, community health centres and clinics, physician offices, dental offices, independent health facilities, out-of-hospital premises, and public health clinics.

Manufacturer's instructions for use (MIFU): The written instructions for use provided by the manufacturer or distributor of a product that contain the necessary information for the safe and effective use of the product [13]. The manufacturer's validated instructions for use must be followed to ensure proper and safe use of a product regardless of other guidelines.

Medical Devices Licences:

Medical Devices Active Licence Listing (MDALL): Reference tool for licensed medical devices in Canada by Health Canada, accessible at https://health-products.canada.ca/mdall-limh/index-eng.jsp.

Medical Devices Establishment Licence Listing (MDEL): List of holders of an active medical devices licence by Health Canada, available at https://health-products.canada.ca/mdel-leim/index-eng.jsp.

Single-use/disposable: A term given to medical equipment/devices designated by the manufacturer for single-use only. Single-use equipment/devices must not be reprocessed.

Sterilization: The level of reprocessing required when processing critical medical equipment/devices. Sterilization results in the destruction of all forms of microbial life [13], including bacteria, viruses, spores, and fungi. Equipment/devices must be cleaned thoroughly before effective sterilization can take place.

REFERENCES

1. Centers for Disease Control and Prevention (CDC). (2018, September). *Healthcare-associated hepatitis B and C outbreaks (≥ 2 cases) reported to Centers for Disease Control and Prevention (CDC) 2008-2017*. Retrieved from https://www.cdc.gov/hepatitis/outbreaks/pdfs/HealthcareInvestigationTable.pdf
2. Wise, M. E., Marquez, P., Sharapov, U., Hathaway, S., Katz, K., Tolan, S., Beaton, A., Drobeniuc, J., Khudyakov, Y., Hu, D. J., Perz, J., Thompson, N. D., & Bancroft, E. (2012). Outbreak of acute hepatitis B virus infections associated with podiatric care at a long-term care facility. *American Journal of Infection Control, 40*(1), 8-21. doi: 10.1016/j.ajic.2011.04.331
3. Wenger, J. D., Spika, J. S., Smithwick, R. W., Pryor, V., Dodson, D. W., Carden, G. A., & Klontz, K. C. (1990). Outbreak of *Mycobacterium chelonae* infection associated with use of jet injectors. *JAMA, 264*(3), 373-376. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/2362334
4. Rutala, W. A., Weber, D. J., & Thomann, C. A. (1987). Outbreak of wound infections following outpatient podiatric surgery due to contaminated bone drills. *Foot Ankle, 7*(6), 350-354. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/3301597
5. Wise, M. E., Bancroft, E., Clement, E. J., Hathaway, S., High, P., Kim, M., Lutterloh, E., Perz, J. F., Sehulster, L. M., Tyson, C., White-Comstock, M. B., & Montana, B. (2015). Infection prevention and control in the podiatric medical setting: Challenges to providing consistently safe care. *Journal of the American Podiatric Medical Association, 105*(3), 264-272. doi: https://doi.org/10.7547/0003-0538-105.3.264
6. Hathaway, S., Marquez, P., & Bancroft, E. (2008). *Hepatitis B outbreak in a skilled nursing facility*. In Acute Communicable Disease Control Program, *Special studies report 2008* (pp. 43-46). Retrieved from http://publichealth.lacounty.gov/wwwfiles/ph/dcp/acd/2008SpecialStudies.pdf
7. Ontario Agency for Health Protection and Promotion (Public Health Ontario). (2015, April). *Infection prevention and control for clinical office practice* (1st rev.). Retrieved from www.publichealthontario.ca/en/eRepository/IPAC_Clinical_Office_Practice_2013.pdf
8. Ontario Agency for Health Protection and Promotion (Public Health Ontario). (2013, May). *Best practices for cleaning, disinfection and sterilization of medical equipment/devices in all health care settings* (3rd ed). Retrieved from http://www.publichealthontario.ca/en/eRepository/PIDAC_Cleaning_Disinfection_and_Sterilization_ 2013.pdf
9. Public Health Agency of Canada. (1997, December). Infection control guidelines: Foot care by health care providers. *Canada Communicable Disease Report, 23S8*. Retrieved from http://publications.gc.ca/collections/collection_2016/aspc-phac/HP3-1-23-S8-eng.pdf
10. Alberta Health Services. (2013, July). *Infection prevention and control (IPC) best practice guidelines for foot care devices*. Retrieved from https://www.albertahealthservices.ca/ipc/hi-ipc-footcare-bpg.pdf
11. Winnipeg Regional Health Authority. (2013, October). *Community infection prevention & control manual: Nursing foot care infection prevention & control management in community health services*. Retrieved from http://www.wrha.mb.ca/extranet/ipc/files/manuals/community/2.2.6.pdf
12. College of Podiatrists of Manitoba. (2007, November). *Schedule B: Standards of practice. Standard 4: Infection control guidelines*. Retrieved from http://www.copom.org/legislation/4_Practice_Standards_iv-Infection-Control-Guidelines.pdf

13. Canadian Standards Association (CSA). (2018). *CAN/CSA-Z314-18 Canadian medical device reprocessing*. Rexdale, ON: Canadian Standards Association.
14. Centers for Disease Control and Prevention (CDC). (2019, May). *Guideline for disinfection and sterilization in healthcare facilities, 2008*. Retrieved from https://www.cdc.gov/infection-control/pdf/guidelines/disinfection-guidelines-H.pdf
15. IPAC Canada. (2014, January). *Infection prevention and control audit for foot care. Audit Toolkit Version 2*. Retrieved from https://ipac-canada.org/ipac-canada-products-2.php
16. Canadian Association of Foot Care Nurses (CAFCN). (2017). *National competencies for advanced nursing foot care in Canada*. Retrieved from https://cafcn.ca/wp-content/uploads/CAFCN-National-Competencies-for-Advanced-Nursing-Foot-Care.pdf

APPENDIX: FOOT CARE EQUIPMENT

In the delivery of foot care services, equipment often intentionally or unintentionally comes into contact with blood, body fluids, or non-intact skin, requiring sterilization. Therefore, **it is imperative to manage all equipment as if it has been contaminated. Soil is not always readily visible. Infection prevention and control best practices indicate there should be one reprocessing system for all equipment from any client.**

Reprocessing of reusable foot care equipment/devices must meet manufacturer's instructions for use (MIFU) and current national guidelines such as those of the Canadian Standards Association (CSA) and the Public Health Agency of Canada (PHAC/Health Canada), as well as provincial standards [9, 13].

TABLE 1: Adapted from the Spaulding Classifications.

Class	Use	Minimum Level of Reprocessing	Examples
Critical	Equipment/devices that enter sterile body site (e.g., below the epidermis), including the vascular system.	Thorough cleaning followed by sterilization.	• Scalpel handle • Scissors • Callus parer • Halstead mosquito forceps • Probe • Nail splitter • Curette • Nail elevator • Debris evacuator • Double-ended Black's file • Barrel nail nipper • Diamond Deb file • Single-ended Black's file • Stainless steel foot paddle handle **Note:** These are examples and not an inclusive list for foot care.

Single-use equipment/devices (these examples are not an inclusive list):

- Scalpel blades
- Callus parer blade
- Foot paddle sanding pad
- Monofilament
- Nail clipper (unless the MIFU state otherwise)
- Toenail nipper (unless the MIFU state otherwise)
- Ingrown nail nipper (unless the MIFU state otherwise)
- Nail files/emery board/orange stick

Management of burrs

- Burr/disk on rotary sanding tools – Rotary Sanding Tools: Equipment/devices used to provide foot care must be approved for medical use and designed for use on humans, specifically feet (e.g., rotary sanding device and accessories). If used, it should be purchased from an authorized medical manufacturer. The burr/disk (unless stated otherwise by the manufacturer) must be considered a single-use device and cannot be reprocessed.
- Burrs deemed reusable by the manufacturer may be reprocessed following the MIFU, and the MIFU must meet current national guidelines such as those of the CSA and PHAC/Health Canada, as well as provincial standards [9, 13].

ORIGINAL ARTICLE

Household hygiene advice for patients with *Clostridium difficile*: Summary of hospital practice in Ontario, Canada

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ABSTRACT

Background: While *Clostridium difficile* infection is a significant concern in healthcare settings, there is increasing evidence that transmission does not solely occur in hospitals and long-term care homes. Hospital patients are regularly discharged home following or during treatment, and it is likely that many excrete spores into their household environment, posing risks of reinfection to themselves and transmission of spores to others. Hence, recommendations on household hygiene might be important for control of *C. difficile*. The objective of this study was to investigate the information provided by Ontario hospitals to patients who have laboratory-confirmed symptomatic *C. difficile* infection with respect to household hygiene advice once they are discharged from hospital.

Methods: This cross-sectional study was conducted between January and August 2018 and included an anonymous online survey, a website scan of Ontario hospitals, and a content analysis of information provided to patients on discharge. The survey was distributed to practicing infection control professionals in Ontario hospitals through the IPAC Canada listserv. One response per hospital corporation was accepted.

Results: Responses were obtained from 46/145 (32%) Ontario hospital corporations. The majority (30/46; 65%) of respondents indicated they personally believed the household environment was important or very important in the transmission of *C. difficile*. Almost half (22/46; 48%) of respondents reported that their hospital had a policy to provide household hygiene advice to patients when discharged home. However, analysis of 31 hospital information sheets from the website scan identified that 27/31 (88%) contained a statement that suggested there is little risk of transmission in households, and only 2/31 (6.5%) provided the specific dilution of bleach that is known to be sporicidal.

Conclusion: The household hygiene advice provided by Ontario hospitals downplayed the likelihood of transmission of *C. difficile* spores in household environments and described a level of hygiene that is likely inadequate to prevent transmission of *C. difficile* spores in the home. This may contribute to recurrent infection and colonization of household contacts.

KEYWORDS

Clostridium difficile; hygiene; household; home; environmental cleaning; decontamination

INTRODUCTION

Clostridium difficile infection (CDI) has been recognized as the leading cause of antimicrobial-associated diarrhea in healthcare settings for decades [1]. Transmission also occurs in community settings through the same mechanisms as healthcare settings, namely directly via patients with symptomatic CDI [2], asymptomatic carriers [3-5], and indirectly by contaminated environmental surfaces [6]. It is estimated that community-associated CDI represents approximately 30% of overall CDI cases in the United States [7] and Canada [8], and community-based transmission of *C. difficile* from people with CDI to their household contacts has been identified [9].

Of particular concern with CDI is recurrent disease, with recurrence in 25% to 87.5% of cases following treatment [10]. Recurrence of clinical disease is thought to be a result of relapse or reinfection [11]. It is challenging to distinguish between these two courses, as it is difficult to identify the specific acquisition of the organism and the mechanism of recurrence (persistent *C. difficile* in the intestine or ingestion of spores from the environment) [12].

People with CDI may excrete spores for at least five weeks following treatment [13, 14]. Spores can persist in the environment for several months [15], if not years [16], and are difficult to destroy, as they are resistant to many interventions, including several disinfectants [10]. Environmental cleaning practice in hospitals includes consideration of the type of disinfectant, contact time required, compatibility of cleaning

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equipment (wipes/cloths) with disinfectants, training for staff, as well as monitoring for efficacy [17]. These aspects are generally not considered in household cleaning routines [18].

On average, CDI increases a patient's length of stay in hospital by seven days [19] and since shedding of spores can persist for weeks after clinical resolution, it is likely that many patients with CDI are discharged from hospital before the infectious period has lapsed. Testing of patients at the time of discharge for *C. difficile* shedding is not routinely performed and is not recommended [20]. *C. difficile* spores have been found in households of those with recurrent CDI, with one study finding *C. difficile*-positive samples in nine out of ten households [12]. Patients with CDI may have contamination of their skin (groin, chest, abdomen, forearms, hands) [21] and their household environment [22-24], even if they were asymptomatic [25] or did not meet the clinical criteria to be tested for CDI [26]. A positive correlation has also been demonstrated between the presence of *C. difficile* on healthcare workers' hands and the level of spore contamination of the hospital environment [27, 28]. *C. difficile* spores also may be present in households without a person with CDI, as the spores have been isolated from retail food, animals, soil, and water [29]. Thus, it is likely that *C. difficile* spores are an important source of reinfection (recurrence) or transmission through high-touch surfaces in households [9, 30, 31].

Current infection prevention and control advice for the home is based on the assumption that transmission of infection or colonization is rarely investigated in households of CDI patients [32]. Infection with *C. difficile* occurs after two events: exposure to *C. difficile* spores and disruption of the gastrointestinal (GI) microbiota [33]. Disruption of the GI tract does not always occur at the time of exposure to the *C. difficile* spores and symptoms would not start until disruption occurs [34]. This makes it difficult to connect CDI in household contacts to exposure to an index case or contaminated environmental surfaces since the onset of symptoms occurs at a later time.

CDI is not a disease of public health significance in Ontario (as per Ontario Regulation 135/18 – Designation of Diseases), meaning that it is not reported to public health and individual cases are not tracked. Mandated reporting of CDI rates occurs as part of provincial patient safety indicator reporting for hospitals, and only outbreaks in public hospitals are classified as diseases of public health significance. Hospital outbreaks are declared based on exceedance of thresholds of nosocomial cases in a defined period based on the number of beds in the unit.

Specialized practices are required for decontamination of the environment to remove and kill *C. difficile* spores. Using a sporicidal agent such as bleach at an appropriate concentration and contact time (1,000 to 5,000 ppm for ten to 30 minutes, depending on concentration) is necessary to control *C. difficile* [20].

The objective of this study was to investigate the information provided by Ontario hospitals to patients with laboratory-confirmed symptomatic *C. difficile* infection with respect to household hygiene advice once they are discharged from hospital.

METHODS

This cross-sectional study was conducted between January and August 2018 and included an anonymous online questionnaire, a website scan, and a content analysis of patient information documents. The online questionnaire was approved by the Research Ethics Board at the University of Guelph (REB# 17-11-005) and was pre-tested by three infection control professionals (ICPs). The questionnaire was distributed through the IPAC Canada listserv in order to target ICPs working at all hospitals in Ontario. The online questionnaire was open from March 29, 2018 to May 1, 2018, and weekly reminders were sent through the listserv.

The questionnaire used closed-ended questions (rating scales, multiple choice, yes/no questions) to confirm the employment position and professional experience of the respondent and to gather data on hospital size, infection prevention and control resources at each hospital, hospital practice for providing patient information on household hygiene for patients with CDI, barriers to providing information on household hygiene, and hospital experience with CDI (monthly rates of CDI and outbreaks in 2017). Respondents were invited to submit copies of patient information sheets. Nine hospitals voluntarily shared patient information sheets with their survey results.

A scan of Ontario hospital websites was conducted between January and August 2018 with the intent of identifying household hygiene advice for patients with *C. difficile*. A list of Ontario hospitals was compiled from Local Health Integration Network (LHIN) websites. The website of each hospital was searched by the primary author for "*C. difficile*" or "*Clostridium difficile*" through the website search function. If no results were found, the same search terms were used to search the Patient Safety area of the website.

Content analysis as per Erlingsson & Brysiewicz (2017) [35] was conducted on the patient information sheets and Web pages by comparing and sorting text into the categories of the patient information sheets provided by the Ontario Ministry of Health and Long-Term Care (MOHLTC) [36] and Public Health Ontario's Provincial Infectious Diseases Advisory Committee (PIDAC) [20]. These categories were: general statement of risk of transmission in the home, hand hygiene, cleaning practice, and cleaning fabric (laundry). The goal of this analysis was to determine how many patient information sheets were aligned with MOHLTC and PIDAC guidelines and, if deviations from these guidelines occurred, what they were.

RESULTS

78 responses to the questionnaire were attempted, 26 of which did not contain responses to any of the questions and were therefore deleted. Six responses were identified as duplicates in that there were responses from that same hospital corporation. Duplicates were managed by including only the most complete response. 46 responses remained, representing 32% of 145 Ontario hospital corporations. Responses were received from hospitals in each of the LHIN

areas in Ontario except for the North West area. Once the survey closed, all hospital names were deleted from the data to maintain confidentiality. Information about respondents, their experience and certification, and about hospitals and their experience with CDI is contained in Table 1.

TABLE 1: Characteristics of individual respondents and hospitals.

Individual Respondent Characteristics	Count (%) *N* = 46
ICP	44 (96)
Manager	2 (4)
Years as an ICP	
Less than one year	2 (4)
One to five years	14 (31)
Six to ten years	10 (22)
More than ten years	10 (22)
Managers not ICPs (not applicable)	2 (4)
Certificate of Infection Control and Epidemiology (CIC®)	
Yes	33 (72)
No	13 (28)
Hospital Characteristics	**Count (%)**
Number of physical sites in hospital corporation*	
One site	20 (44)
Two sites	12 (26)
More than two sites	14 (30)
Self-reported CDI rate compared to provincial average**	
Always above	6 (13)
Sometimes above	9 (20)
Sometimes below	4 (9)
Always below	21 (45)
No answer	6 (13)
CDI outbreak declaration	
No outbreak declared in 2017	42 (92)
CDI outbreak declared in 2017	2 (4)
No answer	2 (4)
Ratio of ICPs to number of hospital beds***	
< 0.01 ICP to bed	24 (52)
> 0.01 ICP to bed	20 (44)
No answer	2 (4)

ICP, infection control professional; CDI *Clostridium difficile* infection

*"Hospital corporation" is used to denote multiple hospital sites operating under one administrative structure.

**Ontario patient safety indicator: Number of *C. difficile* cases divided by the number of total patient days x 1,000. Note that these rates were not validated against reported rates.

***Ratio of ICPs to hospital beds calculated and categorized according to the recommended one ICP per 100 hospital beds [37].

Household hygiene information for patients with CDI

Almost half (22/46; 48%) of hospitals indicated that they had a policy to provide household hygiene advice to CDI patients when discharged home. ICPs were the position most commonly responsible (9/22; 40%) for providing information to patients on discharge (Table 2). All hospitals with policies indicated that they had written information for patients and 12/22 (55%) indicated they also had verbal conversations with patients about household hygiene. Despite having policies to do so, only 5/22 (23%) indicated that they always provide information (Table 2). The most common barriers cited to providing advice to patients were lack of staff time and a lack of knowledge about what information to provide (Table 2). Slightly more than half (24/46; 52%) of the hospitals reported that patients sometimes asked questions about household management for *C. difficile*; three of 46 hospitals (7%) indicated questions occur "often."

TABLE 2: Implementation of household hygiene information for patients with CDI provided by hospitals with policies.

Implementation Components	Count (%) *N* = 22
Source(s) used to develop patient information (respondents could select all that apply):	
Provincial advisory/committee	19 (86)
Local public health unit	19 (86)
Provincial government	8 (36)
Federal government	3 (14)
Peer organization	2 (9)
Most responsible person to provide information to patient:	
ICP	9 (41)
Nurse	5 (22)
No specific position is responsible	5 (22)
Other	3 (14)
Physician	1 (5)
Frequency with which information is provided to patients on discharge:	
Always	5 (23)
Most of the time	8 (36)
About half of the time	1 (5)
Sometimes	4 (18)
Do not know	4 (18)
Barriers to providing household hygiene advice on discharge (respondents could select all that apply):	
Not enough staff time to talk to each patient	8 (36)
Lack of knowledge about what information to provide	7 (32)
Lack of interest from patients to receive information	5 (23)
Lack of information about when CDI patients are discharged	4 (18)
Do not know	4 (18)
No barriers encountered	3 (14)

ICP: Infection control professional
CDI: *Clostridium difficile* infection

In addition to the 22 hospitals that indicated they have policies to provide information to patients with CDI who are being discharged home, ten of the 24 (42%) hospitals without policies indicated that information was provided, suggesting that the majority (32/46; 70%) of hospitals intend to provide some information to patients regardless of the existence of a formal policy.

Several reasons were selected for hospitals not having policies to provide household hygiene advice: hospitals are not responsible for activities that occur outside the hospital (2/24; 8%), CDI is an uncommon occurrence (1/24; 4%), patients are not interested (1/24; 4%), and uncertain as to what information to provide (1/24; 4%). Ten (42%) stated that although they do not have a policy, they do have information that may be provided; eight (33%) did not know why they do not have a policy, and one (4%) did not answer. No respondent indicated that it was because they did not think household hygiene was a concern.

Hospital information sheets on household hygiene for patients

A total of 31 patient information sheets from 31 separate hospital corporations were identified and used for analysis. Nine respondents to the online questionnaire voluntarily submitted copies of their information sheets, while 22 additional patient information sheets were identified through the searches of

TABLE 3: Comparisons of hospital patient information sheets by PIDAC and MOHLTC categories.

Category	Statement Frequency (%) *N* = 31	
General statement of risk of transmission in the household	**PIDAC** – "Generally speaking, people in the hospital are sicker and get more infections than people in the community. Once home, precautions are not as strict. Nonetheless, certain steps can help reduce the risk of spreading this germ to family members and other visitors." **MOHLTC** – "Healthy people like your family and friends who are not taking antibiotics are at very low risk of getting *C. diff* disease."	
	"Healthy people like your family and friends who are not taking antibiotics are at very low risk of getting *C. diff* disease."	20 (65%)
	"Generally speaking, people in the hospital are sicker and get more infections than people in the community. Once home, precautions are not as strict. Nonetheless, certain steps can help reduce the risk of spreading this germ to family members and other visitors."	3 (10%)
	"The chance of spreading the illness to healthy people is small."	1 (3%)
	"The risk is low that a healthy person will get *C. difficile*."	1 (3%)
	"There is a slight chance of spreading *C. difficile* to a family member, especially if one is sick."	1 (3%)
	"Once you are back home, you can return to your normal routine. Often, the diarrhea will be better or completely gone before you go home. This makes giving *C. diff* to other people much less likely."	1 (3%)
	No answer.	4 (13%)
Hand hygiene	**PIDAC** – "Wash hands for at least 15 seconds after using the toilet, before eating or before preparing food. Caregivers should wash their hands after providing care." **MOHLTC** – "Wash your hands for at least 15 seconds: after using the toilet, after touching dirty surfaces, before eating, before preparing meals."	
	"Wash your hands for at least 15 seconds after using the toilet, before eating or before preparing food."	25 (80%)
	"Practice good hand hygiene."	2 (7%)
	"Hand washing is the most important thing that you can do, especially after you use the washroom and before you eat."	2 (7%)
	"Everyone who might help you with personal care should wash his or her hands after contact with you."	1 (3%)
	No answer.	1 (3%)
Cleaning agents	**PIDAC** – "This germ can be destroyed by most household cleaning products or diluted household bleach." **MOHLTC** – "…all-purpose household cleaner."	
	"Use either a household cleaner diluted according to the instructions or diluted household bleach."	10 (33%)
	"Use an all-purpose cleaner."	11 (35%)
	"Diluted household bleach can kill this germ."	4 (13%)
	No answer.	6 (19%)

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TABLE 3: continued

Category	Statement Frequency (%) *N* = 31	
How to clean	**PIDAC** – "No special precautions are required to clean your home. Wet a clean cloth thoroughly with a properly diluted cleaning product or use a pre-packaged disinfectant wipe. Wipe surfaces starting from the cleanest area and moving towards the dirtiest area, paying special attention to areas such as the toilet and bathroom sink. Let the surfaces air dry. This will allow enough contact time with the cleaning product to kill the bacteria." **MOHLTC** – "Follow directions on label and wet surface well and clean using good friction, allow surface to air dry, pay special attention to areas that may be soiled with feces such as the toilet and sink. Remove any visible feces and then clean as described above."	
	"Wet surface well and clean using good friction; allow surface to air dry; pay special attention to areas that may be soiled with stool such as the toilet and sink. If you see stool remove first and then clean as described above."	11 (35%)
	"No special precautions are required to clean your home. Wet a clean cloth thoroughly with a properly diluted cleaning product or use a pre-packaged disinfectant wipe. Wipe surfaces starting from the cleanest area and moving towards the dirtiest area, paying special attention to areas such as the toilet and bathroom sink. Let surfaces air dry. This will allow enough contact time with the cleaning product to kill the bacteria."	7 (23%)
	"Frequent, thorough cleaning of the washroom is recommended."	3 (10%)
	"If you have 2 washrooms in your home, try not to share the toilet with another person until the C. *difficile* infection is gone. We know that this may not always be possible. If you must share the toilet with others, wipe down the toilet seat with a disinfectant (such as Lysol) after each use. Clean your toilet, commode or bedpan with a disinfectant at least once a day."	2 (7%)
	"Be sure to follow the instructions on the label and use good friction (rubbing) when cleaning a surface. Toilets and bathrooms need extra attention. If feces have splashed onto a surface, they must be removed first, and then cleaning done with the household cleaner. If it is possible, use your own bathroom until your diarrhea stops."	1 (3%)
	"Wet the surface and scrub with a damp cloth. Rubbing hard is the only way to get rid of spores; allow the surface to dry; take special care with areas that maybe soiled by stool (toilets, sinks and taps); wipe away any stool you see, then clean as above. Do not use the cleaning cloth for anything else – wash it in hot, soapy water, or if you use paper towels you can throw them away."	1 (3%)
	"Keep a regular cleaning schedule. The most important rooms to keep clean are the bathroom and the kitchen. If you are not able to do any cleaning, you will need to inform the people who plan your care when you return home. Wet the surface well and clean using good friction; allow the surface to air dry; pay special attention to areas that may be soiled with stool such as the toilet and sink; remove any stool and then clean as described above."	1 (3%)
	No answer.	5 (16%)
Fabrics/laundry	**PIDAC** – No statement. **MOHLTC** – "Wash clothes/fabric separately if they are heavily soiled with feces: rinse off feces, clean in a hot water cycle with soap, dry in dryer on high heat, dry clean where appropriate."	
	"Wash clothes/fabric separately if they are heavily soiled with stool: rinse stool off, clean in a hot water cycle with soap; dry items in the dryer if possible."	17 (55%)
	"Clothes and fabrics can be laundered as usual. A hot water wash with soap and hot dry are often recommended. [If] items are heavily soiled with feces, the feces should be rinsed off prior to washing."	1 (3%)
	"Wash clothes with household laundry detergent on a regular cycle; if your clothes are heavily soiled with body fluids, like poop or urine, pre-soak and then wash them separately with detergent."	1 (3%)
	No answer.	12 (39%)

PIDAC: Provincial Infectious Diseases Advisory Committee

MOHLTC: Ontario Ministry of Health and Long-Term Care

Ontario hospital websites. Table 3 contains guidelines from PIDAC and MOHLTC and the frequency with which they or alternate text appear in hospital information sheets organized by category.

Only 12/31 (39%) patient information sheets suggested a chemical agent that contained bleach, and only 2/31 (6.5%) provided the specific dilution of one part household bleach to ten parts water (approximately 5,000 ppm), which is sporicidal [20].

DISCUSSION

There is a large body of evidence that patients with CDI contaminate their hospital rooms with spores that survive for extended periods [38, 39], that contaminated environmental surfaces can be a reservoir for *C. difficile* in hospitals [38], and that environmental cleaning can disrupt transmission. The same risks exist in the household environment for patients recovering from CDI at home [40].

While the majority (30/46; 65%) of respondents to our questionnaire indicated that they personally believe the household environment is important or very important in the transmission of *C. difficile*, none of the patient information provided by hospitals clearly articulated the potential for a CDI patient to be excreting spores in their stool for several weeks and that the spores could survive for months in the environment, thus creating a possible reservoir in the home.

The responses to the online questionnaire indicated that questions from patients about household hygiene are infrequent. Patients may not ask questions about the type of household hygiene they should be practicing because they do not know they should be concerned about a risk of transmission in their home, or their questions may not be relayed to the ICPs in the hospital who were the respondents of the questionnaire.

General statement of risk

The patient information sheets contained statements indicating that patients with *C. difficile* do not pose a significant risk to household members. While it may be true that the risk of acquiring CDI is low, the risk of ingesting spores by household contacts and the CDI patient exists. It is reasonable to assume that patients with CDI are frequently discharged into households with other high-risk individuals, particularly elderly individuals, increasing the risk. A targeted hygiene process [18] that considers the pathogen (what agent would be effective to kill it, how long to continue the process, etc.) and the health status of the people (healthy or immunocompromised) in the household (including caregivers) should be used to determine the hygiene practices required [41]. In this context, hygiene refers to both decontamination of the environment and personal hygiene (toileting, hand hygiene, etc.) of the individuals living in the household.

Hand hygiene

Information on hand hygiene was provided by 30/31 (97%) hospitals. Most hospitals (25/31; 81%) indicated when hands should be washed and for how long; however, they did not specify that handwashing should be done with soap and water. Neither PIDAC nor MOHLTC provided specifics on the type of product to be used for hand hygiene.

Cleaning agent

Many (11/31; 35%) of the information sheets stated that an "all-purpose household cleaner" is sufficient for household cleaning when a patient with CDI is in the home. This is likely not accurate, given that "cleaners" are not necessarily bactericidal, and even bactericidal disinfectants may not be effective against hardy clostridial spores [42]. Sporicidal agents (along with physical removal) are necessary to eliminate *C. difficile* spores from the environment [43].

How to clean

Many patient information sheets made statements about cleaning using "thorough" and "regularly" to describe frequency or processes (i.e., "regular cleaning schedule" or "frequent thorough cleaning"). "Thorough" and "regular" were not defined and there was no explanation as to why thorough cleaning was necessary, given that it was stated that there was no risk to family members.

The general public tends to understand "clean" to mean "an absence of dirt," but solely removing visible dirt is an insufficient process to remove *C. difficile* spores [18]. Cleaning cloths and wipes must be handled and used carefully to avoid cross-contamination of surfaces [44], but specific information on how to handle cleaning equipment was lacking from the patient information sheets. Contact times for some agents are quite long (several minutes) and vary depending on the concentration of the active ingredient [45]; many of the information sheets may therefore be inaccurate, as they state that contact time will be sufficient without considering the specific cleaning product.

Fabrics/laundry

Advice on managing fecally contaminated fabrics (laundry) was fairly consistent in the documents for patients. However, there was no advice for how to manage soft furnishings such as mattresses despite the fact that they have been shown to be a source of contamination in healthcare settings [46]. Appropriate management of mattress and furniture covers or application of an appropriate agent to furniture and mattresses could reduce the microbial load, which can minimize exposure to spores [47, 48].

Limitations of this study

The response rate to the online questionnaire was low (32% of Ontario hospital corporations) and responses were not obtained from all areas of the province, indicating that the results may not be fully representative of all hospitals in Ontario. The analysis also did not consider the verbal conversations that were reported to have taken place between ICPs and patients, which may have contained additional information. Additionally, a variety of healthcare personnel have contact with patients and the range of advice that is given by different personnel in each facility was not identifiable.

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CONCLUSION

The majority of Ontario hospitals surveyed (67%) provided advice to patients with CDI when discharged home. However, the advice downplayed the likelihood of transmission of *C. difficile* spores in household environments and described a basic level of hygiene that may be inadequate to prevent the transmission of *C. difficile* spores in the home environment. This may result in colonization of household members or recurrence in CDI patients as well as the creation of a reservoir in the household environment. There is an opportunity to reduce the risk of transmission in the home by being more prescriptive with the household hygiene advice provided to patients, including clearly outlining the risk of transmission in households, an appropriate decontamination process, and the use of a sporicidal agent. It is also recommended that standardized patient information be developed and used at all hospitals across Ontario.

REFERENCES

1. McDonald, L. C., Gerding, D. N., Johnson, S., Bakken, J. S., Carroll, K. C., Coffin, S. E., Dubberke, E. R., Garey, K. W., Gould, C. V., Kelly, C., Loo, V., Shaklee Sammons, J., Sandora, T. J., & Wilcox, M. H. (2018). Clinical practice guidelines for *Clostridium difficile* infection in adults and children: 2017 update by the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA). *Clinical Infectious Diseases, 66*(7), e1-e48. doi: https://doi.org/10.1093/cid/cix1085
2. Donskey, C. J. (2010). Preventing transmission of *Clostridium difficile*: Is the answer blowing in the wind? *Clinical Infectious Diseases, 50*(11), 1458-1461. doi: https://doi.org/10.1086/652649
3. Longtin, Y., Paquet-Bolduc, B., Gilca, R., Garenc, C., Fortin, E., Longtin, J., Trottier, S., Gervais, P., Roussy, J. F., Levesque, S., Ben-David, D., Cloutier, I., & Loo, V. G. (2016). Effect of detecting and isolating *Clostridium difficile* carriers at hospital admission on the incidence of *C difficile* infections: A quasi-experimental controlled study. *JAMA Internal Medicine, 176*(6), 796-804. doi: 10.1001/jamainternmed.2016.0177
4. Blixt, T., Gradel, K. O., Homann, C., Seidelin, J. B., Schonning, K., Lester, A., Houlind, J., Stangerup, M., Gottlieb, M., & Knudsen, J. D. (2017). Asymptomatic carriers contribute to nosocomial *Clostridium difficile* infection: A cohort study of 4508 patients. *Gastroenterology, 152*(5), 1031-1041.e2. doi: https://doi.org/10.1053/j.gastro.2016.12.035
5. Riggs, M. M., Sethi, A. K., Zabarsky, T. F., Eckstein, E. C., Jump, R. L. P., & Donskey, C. J. (2007). Asymptomatic carriers are a potential source for transmission of epidemic and nonepidemic *Clostridium difficile* strains among long-term care facility residents. *Clinical Infectious Diseases, 45*(8), 992-998. doi: https://doi.org/10.1086/521854
6. Alam, M. J., Anu, A., Walk, S. T., & Garey, K. W. (2014). Investigation of potentially pathogenic *Clostridium difficile* contamination in household environs. *Anaerobe, 27*, 31-33. doi: https://doi.org/10.1016/j.anaerobe.2014.03.002
7. Lessa, F. C. (2013). Community-associated *Clostridium difficile* infection: How real is it? *Anaerobe, 24*, 121-123. doi: https://doi.org/10.1016/j.anaerobe.2013.01.006
8. Canadian Nosocomial Infection Surveillance Program (CNISP). (2017). *Summary report of healthcare associated infection (HAI), antimicrobial resistance (AMR) and antimicrobial use (AMU) surveillance data from January 1, 2013 to December 31, 2017*. Retrieved from https://ipac-canada.org/photos/custom/Members/CNISPpublications/CNISP%202013-2017%20Report_Final_EN.pdf
9. Loo, V. G., Brassard, P., & Miller, M. A. (2016). Household transmission of *Clostridium difficile* to family members and domestic pets. *Infection Control & Hospital Epidemiology, 37*(11), 1342-1348. doi: https://doi.org/10.1017/ice.2016.178
10. Oka, K., Osaki, T., Hanawa, T., Kurata, S., Okazaki, M., Manzoku, T., Takahashi, M., Tanaka, M., Taguchi, H., Watanabe, T., Inamatsu, T., & Kamiya, S. (2012). Molecular and microbiological characterization of *Clostridium difficile* isolates from single, relapse, and reinfection cases. *Journal of Clinical Microbiology, 50*(3), 915-921. doi: 10.1128/JCM.05588-11
11. Figueroa, I., Johnson, S., Sambol, S. P., Goldstein, E. J. C., Citron, D. M., & Gerding, D. N. (2012). Relapse versus reinfection: Recurrent *Clostridium difficile* infection following treatment with fidaxomicin or vancomycin. *Clinical Infectious Diseases, 55*(Suppl 2), S104-S109. doi: 10.1093/cid/cis357.
12. Shaughnessy, M. K., Bobr, A., Kuskowski, M. A., Johnston, B. D., Sadowsky, M. J., Khoruts, A., & Johnson, J. R. (2016). Environmental contamination in households of patients with recurrent *Clostridium difficile* infection. *Applied and Environmental Microbiology, 82*(9), 2686-2692. doi: 10.1128/AEM.03888-15
13. Sethi, A. K., Al-Nassir, W. N., Nerandzic, M. M., Bobulsky, G. S., Donskey, C. J., & Al-Nassir, W. N. (2010). Persistence of skin contamination and environmental shedding of *Clostridium difficile* during and after treatment of *C. difficile* infection. *Infection Control & Hospital Epidemiology, 31*(1), 21-27. doi: 10.1086/649016
14. Jinno, S., Kundrapu, S., Guerrero, D. M., Jury, L. A., Nerandzic, M. M., & Donskey, C. J. (2012). Potential for transmission of *Clostridium difficile* by asymptomatic acute care patients and long-term care facility residents with prior *C. difficile* infection. *Infection Control & Hospital Epidemiology, 33*(6), 638-639. doi: 10.1086/665712
15. Kim, K. H., Fekety, R., Batts, D. H., Brown, D., Cudmore, M., Silva, Jr., J., & Waters, D. (1981). Isolation of *Clostridium difficile* from the environment and contacts of patients with antibiotic-associated colitis. *Journal of Infectious Diseases, 143*(1), 42-50.
16. Rupnik, M., Wilcox, M. H., & Gerding, D. N. (2009). *Clostridium difficile* infection: New developments in epidemiology and pathogenesis. *Nature Reviews Microbiology, 7*(7), 526-536. doi: 10.1038/nrmicro2164
17. Otter, J. A., Yezli, S., Salkeld, J. A., & French, G. L. (2013). Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings. *American Journal of Infection Control, 41*(Suppl 5), S6-S11. doi: 10.1016/j.ajic.2012.12.004
18. Bloomfield, S. F., Carling, P. C., & Exner, M. (2017). A unified framework for developing effective hygiene procedures for hands, environmental surfaces and laundry in healthcare, domestic, food handling and other settings. *GMS Hygiene and Infection Control, 12*, Doc08. doi: 10.3205/dgkh000293
19. Gabriel, L., & Beriot-Mathiot, A. (2014). Hospitalization stay and costs attributable to *Clostridium difficile* infection: A critical review. *Journal of Hospital Infection, 88*(1), 12-21. doi: 10.1016/j.jhin.2014.04.011
20. Ontario Agency for Health Protection and Promotion, Provincial Infectious Diseases Advisory Committee (PIDAC). (2013). *Annex C: Testing, surveillance and management of Clostridium difficile in all health care settings*. Retrieved from https://www.publichealthontario.ca/-/media/documents/cdiff-testing-surveillance-management.pdf?la=en
21. Bobulsky, G. S., Al-Nassir, W. N., Riggs, M. M., Sethi, A. K., & Donskey, C. J. (2008). *Clostridium difficile* skin contamination

in patients with *C. difficile*-associated disease. *Clinical Infectious Diseases, 46*(3), 447-450. doi: 10.1086/525267
22. Biswas, J. S., Patel, A., Otter, J. A., van Kleef, E., & Goldenberg, S. D. (2015). Contamination of the hospital environment from potential *Clostridium difficile* excretors without active infection. *Infection Control & Hospital Epidemiology, 36*(8), 975-977. doi: https://doi.org/10.1017/ice.2015.79
23. Warrack, S., Duster, M., Van Hoof, S., Schmitz, M., & Safdar, N. (2016). *Clostridium difficile* in a children's hospital: Assessment of environmental contamination. *American Journal of Infection Control, 42*(7), 802-804. doi: 10.1016/j.ajic.2014.03.008
24. Blakney, R., Gudnadottir, U., Warrack, S., O'Horo, J. C., Anderson, M., Sethi, A., Schmitz, M., Wang, J., Duster, M., Ide, E., & Safdar, N. (2015). The relationship between patient functional status and environmental contamination by *Clostridium difficile*: A pilot study. *Infection, 43*(4), 483-487. doi: 10.1007/s15010-015-0770-1
25. Hung, Y.-P., Lee, J.-C., Lin, H.-J., Liu, H.-C., Wu, Y.-H., Tsai, P.-J., & Ko, W.-C. (2015). Clinical impact of *Clostridium difficile* colonization. *Journal of Microbiology, Immunology and Infection, 48*(3), 241-248. doi: 10.1016/j.jmii.2014.04.011
26. Kundrapu, S., Sunkesula, V., Tomas, M., & Donskey, C. J. (2015). Skin and environmental contamination in patients diagnosed with *Clostridium difficile* infection but not meeting clinical criteria for testing. *Infection Control & Hospital Epidemiology, 36*(11), 1348-1350. doi: 10.1017/ice.2015.191
27. Davies, A., Pottage, T., Bennett, A., & Walker, J. (2011). Gaseous and air decontamination technologies for *Clostridium difficile* in the healthcare environment. *Journal of Hospital Infection, 77*(3), 199-203. doi: 10.1016/j.jhin.2010.08.012
28. Samore, M. H., Venkataraman, L., DeGirolami, P. C., Arbeit, R. D., & Karchmer, A. W. (1996). Clinical and molecular epidemiology of sporadic and clustered cases of nosocomial *Clostridium difficile* diarrhea. *American Journal of Medicine, 100*(1), 32-40.
29. Gould, L. H., & Limbago, B. (2010). *Clostridium difficile* in food and domestic animals: A new foodborne pathogen? *Clinical Infectious Diseases, 51*(5), 577-582. doi: 10.1086/655692
30. Scott, E. (2013). Community-based infections and the potential role of common touch surfaces as vectors for the transmission of infectious agents in home and community settings. *American Journal of Infection Control, 41*(11), 1087-1092. doi: 10.1016/j.ajic.2013.05.014
31. Shaffer, M., & Lozupone, C. (2018). Prevalence and source of fecal and oral bacteria on infant, child, and adult hands. *mSystems, 3*(1), e00192-17. doi: 10.1128/mSystems.00192-17
32. Pépin, J., Gonzales, M., & Valiquette, L. (2012). Risk of secondary cases of *Clostridium difficile* infection among household contacts of index cases. *Journal of Infection, 64*(4), 387-390. doi: 10.1016/j.jinf.2011.12.011
33. Tracey, L., Kirke, A., Armstrong, P., & Riley, T. V. (2015). From the hospital to the home – The rise and rise of *Clostridium difficile* infection. *Australian Family Physician, 44*(10), 712-717.
34. Durovic, A., Widmer, A. F., & Tschudin-Sutter, S. (2018). New insights into transmission of *Clostridium difficile* infection-narrative review. *Clinical Microbiology & Infection, 24*(5), 483-492. doi: 10.1016/j.cmi.2018.01.027
35. Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine, 7*(3), 93-99. doi: 10.1016/j.afjem.2017.08.001
36. Ministry of Health and Long-Term Care (MOHLTC). (2006). Clostridium difficile – *Fact sheet*. Retrieved from http://www.hqontario.ca/portals/0/Documents/pr/ps-fact-sheet-c-diff-en.pdf
37. Ontario Agency for Health Protection and Promotion, Provincial Infectious Diseases Advisory Committee (PIDAC). (2012). *Best practices for infection prevention and control programs in Ontario in all health care settings* (3rd Ed.). Retrieved from https://www.publichealthontario.ca/-/media/documents/bp-ipac-hc-settings.pdf?la=en
38. Weber, D. J., Anderson, D. J., Sexton, D. J., & Rutala, W. A. (2013). Role of the environment in the transmission of *Clostridium difficile* in health care facilities. *American Journal of Infection Control, 41*(Suppl 5), S105-S110. doi: 10.1016/j.ajic.2012.12.009
39. Dubberke, E. R., Reske, K. A., Noble-Wang, J., Thompson, A., Killgore, G., Mayfield, J., Camins, B., Woeltje, K., McDonald, J. R., McDonald, L. C., & Fraser, V. J. (2007). Prevalence of *Clostridium difficile* environmental contamination and strain variability in multiple health care facilities. *American Journal of Infection Control, 35*(5), 315-318. doi: 10.1016/j.ajic.2006.12.006
40. Girotra, M., Abraham, R. R., & Pahwa, M. (2013). *Clostridium difficile* infection: How safe are the household contacts? *American Journal of Infection Control, 41*(11), 1140-1141. doi: 10.1016/j.ajic.2013.06.011
41. Aiello, A. E., Larson, E. L., & Sedlak, R. (2008). Personal health: *Bringing good hygiene home*. *American Journal of Infection Control, 36*(Suppl 10), S152-S165. doi: 10.1016/j.ajic.2008.09.009
42. Ontario Agency for Health Protection and Promotion, Provincial Infectious Diseases Advisory Committee (PIDAC). (2012). *Best practices for environmental cleaning for prevention and control of infections in all health care settings* (2nd Ed.). Retrieved from http://www.ontla.on.ca/library/repository/mon/26011/318661.pdf
43. Rutala, W. A., Gergen, M. F., & Weber, D. J. (2012). Efficacy of different cleaning and disinfection methods against *Clostridium difficile* spores: Importance of physical removal versus sporicidal inactivation. *Infection Control & Hospital Epidemiology, 33*(12), 1255-1258. doi: 10.1086/668434
44. Cadnum, J. L., Hurless, K. N., Kundrapu, S., & Donskey, C. J. (2013). Transfer of *Clostridium difficile* spores by nonsporicidal wipes and improperly used hypochlorite wipes: Practice + product = perfection. *Infection Control & Hospital Epidemiology, 34*(4), 441-442. doi: 10.1086/669871
45. Canadian Agency for Drugs and Technologies in Health (CADTH). (2014). *Non-manual technique for room disinfection in healthcare facilities: A review of clinical effectiveness and guidelines*. Retrieved from https://www.cadth.ca/sites/default/files/pdf/htis/nov-2014/RC0545%20Room%20Disinfection%20Final.pdf
46. Creamer, E., & Humphreys, H. (2008). The contribution of beds to healthcare-associated infection: The importance of adequate decontamination. *Journal of Hospital Infection, 69*(1), 8-23. doi: 10.1016/j.jhin.2008.01.014
47. Sexton, J. D., Wilson, A. M., Sassi, H. P., & Reynolds, K. A. (2018). Tracking and controlling soft surface contamination in health care settings. *American Journal of Infection Control, 46*(1), 39-43. doi: 10.1016/j.ajic.2017.08.002
48. Hooker, E. A., Bochan, M., Reiff, T. T., Blackwell, C., Webb, K. W., & Hart, K. W. (2015). Decreasing *Clostridium difficile* healthcare associated infections through use of a launderable mattress cover. *American Journal of Infection Control, 43*(12), 1326-1330. doi:10.1016/j.ajic.2015.07.002

CONCISE REPORT

Using scent detection dogs to identify environmental reservoirs of *Clostridium difficile*: Lessons from the field

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ABSTRACT

Environmental reservoirs have been implicated in transmission of *Clostridium difficile* infections. Scent detection by canines has demonstrated promising ability to rapidly triage hospital surfaces and equipment. 18 months of data collected post-implementation of the canine scent detection project at Vancouver Coastal Health were used to identify key environmental reservoirs for *C. difficile* and possible mitigation strategies.

KEYWORDS

Canine; *Clostridium difficile*; environmental reservoir; scent detection

INTRODUCTION

Clostridioides difficile (CD) remains one of the most common causes of nosocomial infections with significant morbidity and cost [1]. In addition to direct physical transmission via contact with colonized surfaces, environmental reservoirs have been implicated and the ability to rapidly triage surfaces for this organism could greatly enhance infection prevention efforts [2, 3]. Building upon a proof of concept article that used a beagle to detect CD in patients, a Springer Spaniel was trained to detect CD odour on equipment and environmental surfaces rather than on patients [4]. Previous evaluation of the dog revealed an overall sensitivity of 92.3% and specificity of 95.4% for both odour recognition and search capability using gauze exposed to CD odour, and a canine scent detection program was established at the Vancouver General Hospital (VGH) [5]. The objective of this article is to describe the operational aspects of the canine scent detection program and present the findings and lessons learned from 18 months (May 1, 2017 to October 31, 2018) of environmental detection in a tertiary care facility.

METHODS

Qualification and training of the certified handler and dog

The canine scent detection program based at VGH in Canada currently consists of two canine/handler teams. The second validated canine team joined the program in December 2017 (13 months after the first team was introduced) and consists of a four-year-old Springer Spaniel and a handler with over ten years of experience raising, training, and handling narcotic and explosive detection dogs. The handler had previously been validated through the Justice Institute of British Columbia's security dog program and holds a diploma in Canine Behavior Science and Technology through the Companion Animal Sciences Institute. Additional information on the original canine team and the annual validation process are detailed in a previous paper [5].

The scent detection program

The team searches every clinical unit and area in the hospital on a monthly basis but also focuses on areas of higher risk, as follows: a) clinical areas with the highest rates of CD; b) any unit with new CD cases; c) any unit with a previous history of high number of canine alerts; and d) units that have had recent cluster events with antibiotic-resistant organisms (e.g., Methicillin-resistant *Staphylococcus aureus*).

Each day, before the canine teams begin their searches, a quality control assessment is performed using scent pads from known positive CD fecal samples and from CD cultures. These are hidden by a third party and the team is evaluated for its ability to find the sample. The canine team then proceeds to the identified units/clinical areas for that day. Details of each search and alert are entered into an Access database for analysis and report generation. Alerts by the canine team have been categorized into a) general environmental; b) patient

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room; and c) washroom alerts. General environmental alerts include areas accessible to the general public, patients, and healthcare workers (HCWs) (e.g., hallway, waiting rooms), while patient room alerts are those occurring in unoccupied rooms (including en-suite washrooms). The canine team does not search occupied patient rooms. Washroom alerts include shared patient, public, and staff washrooms.

RESULTS

Between May 1, 2017 and October 31, 2018, 659 clinical areas at VGH were searched over 115 search days (5.7 clinical areas/day). Each area took approximately 30 minutes to be searched, depending on the complexity of the area and the number of positive alerts – this did not include report generation, notification, and actionable events. During this time, there were 391 alerts on items for an average of 0.6 alerts per clinical area. Statistical results of these clinical sweeps, as well as subcategories of alerted items based on various environments and locations, are detailed in Table 1. Table 2 details the results of the general, patient room, and washroom alerts. A total of 82.1% (321/391) of all positive alerts occurred in the general environment, with 192/321 (59.8%) alerts on items (e.g. carts, DINAMAP™, staff lockers) that were almost exclusively handled by HCWs.

DISCUSSION

The canine team alerts confronted our presumptions of where CD reservoirs lie and challenged us to re-examine the way we approach infection prevention. The results highlight the impact of cross-transmission not only by HCWs, but also by patients and the public, as evidenced by the alerts in public washrooms and both patient/family as well as staff lounges and lockers. Hallway items alone accounted for 219/391 (56%) of all alerts, emphasizing the importance of decluttering to permit effective cleaning. Other alerts highlighted items that could be addressed by re-engineering or a systems change. For example, the insides of toilet paper dispensers were positive (likely from individuals with contaminated hands reaching up for toilet paper). Changing the dispenser design and/or the quality of the toilet paper could address this issue. Alerts on the tube system (used to transport patient specimens) resulted in the purchase of cleanable "landing" mats and a review of the protocols for regular tube cleaning.

TABLE 1: Canine search statistics.

Areas Searched and Alerts	Counts (%)
Search days	115
Areas searched*	659
Areas with positive alerts	317 (48.1% of all areas searched)
Number of items with positive alerts	391 (1.2 positive items/area)
General environment alerts	321 (82.1% of all alerts)
Patient room alerts	40 (10.2% of all alerts)
Washroom alerts	30 (7.7% of all alerts)

*Areas = clinical units and patient support services (e.g. radiology).

TABLE 2: Alerts in the general environment, patient room, and shared washroom environments.

Alert Environment	Count (% of Total Alerts)
General environment	321 (82.1%)
Hallway	219 (56.0%)
Clean storage area	35 (9.0%)
Staff lounges/lockers	33 (8.4%)
Patient lounges/common areas	18 (4.6%)
Nursing station	9 (2.3%)
Miscellaneous	6 (1.5%)
Top ten items alerted on in general environment:	
Cart*	71 (18.2%)
DINAMAP™**	22 (5.6%)
Staff locker	19 (4.9%)
Chair	13 (3.3%)
Bed (frame, handrails, bedding, pillows)***	12 (3.1%)
Wheelchair	11 (2.8%)
Pillow (not on bed)	9 (2.3%)
Sling	9 (2.3%)
Patient chart	8 (2.0%)
Tube station	7 (1.8%)
Cabinets	7 (1.8%)
Supply bins	6 (1.5%)
Patient environment	40 (10.2%)
Items alerted on in patient bed area	31 (7.9%)
Items alerted on in washroom	9 (2.3%)
Top two items alerted on in patient room:	
Cart	8 (2.0%)
Bed (frame, handrails, bedding, pillows)	5 (1.3%)
Common washroom environment	30 (7.7%)
Shared patient bathrooms	26 (6.6%)
Staff washrooms	3 (0.8%)
Public washrooms	1 (0.3%)
Top two items alerted on in washrooms:	
Toilet paper holder	10 (2.6%)
Commode	5 (1.3%)

*Includes medication, personal protective equipment, resuscitation, glucometer, phlebotomy, housekeeping, and clean linen carts.

**DINAMAP™ is a machine that measures and monitors various vitals, including blood pressure, temperature, oxygen saturation, and pulses.

*** Some beds are located outside the patient environment (e.g., hallways).

Of note, the canine teams are not asked to search occupied rooms, including those that are known to house patients with CD, and empty rooms not yet cleaned and disinfected. A decision was made early in the program that the information would not be useful in terms of directing environmental cleaning efforts. Further, it could put the canine team at additional,

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unnecessary risk of exposure to CD. The majority of rooms that are searched have undergone terminal cleaning and disinfection and await new patient occupation. Similarly, while the dogs occasionally alert on the floors, they have been taught during training that searching floors and garbage is not of "value" for a reward. This is for both safety and pragmatic reasons: floors are considered dirty from an infection prevention perspective and for obvious reasons, having the dogs search garbage or floors is not practical. The dogs understand relative situational search environments. An example of this is that the dogs know the handler has a hide in their vest but does not continuously alert on that hide until it is placed and the search command is given.

The fact that the dogs are trained on the odour only of CD (rather than on fecal specimens) leads us to believe that the dogs alert on the volatile organic compound signature. This has been indirectly confirmed by the fact that, in clinical practice, the dogs often search the re-cleaned area and rarely alert. This also suggests that ultraviolet C light and/or hydrogen peroxide-based cleaning/disinfection are adequate for removing volatile organic compounds (and associated organisms) from the environment. The program is still at the formative stages of research into biological scent detection and these are questions that the program hopes to address in the future.

One of the difficulties with achieving compliance with infection prevention measures is the lack of visible cause and effect as well as the delayed presentation of infection, making accountability less visible [6]. A positive canine alert now results in immediate notification of unit staff and hospital environmental services (EVS) for priority cleaning/disinfection of the room or equipment and use of ultraviolet C light disinfection, as appropriate, to the item or space identified. Every positive alert is considered to be an opportunity for "in-the-moment" team discussion and feedback regarding routes of transmission and cleaning/disinfection efforts. Changing the collective norm is a very important aspect of behaviour change and engaging both HCWs and the public with the use of canine teams is a positive way of highlighting and reinforcing ideal behaviour [7]. The canine/handler team provides a visual reminder of the importance of environmental reservoirs in infection transmission and emphasizes the modes of transmission to HCWs in a non-punitive way. While it is difficult to prove that the scent detection program by itself decreases the incidence of CD, the highly visible presence of dog handlers and dogs likely improves compliance with infection prevention measures such as hand hygiene, disinfection of personal items, and appropriate use of personal protective equipment.

Limitations of the scent detection program include the potential bias introduced by the prioritizing protocol followed by the dog handlers. Furthermore, the distribution of alerts by item type is influenced by the total number of those items. Lastly, while the comparison of EVS cleaning protocols for different items was out of the scope of this study, the bias introduced by the cleaning personnel and the cleaning protocol itself could have had an impact on the number of positive alerts.

In conclusion, as a quality improvement initiative, the scent detection program studies the multifaceted interactions between the environment and key populations, highlighting the interactions between HCWs and the system with which they work, including the use of devices, the environment, and the complexities of patient care, in the context of CD transmission and prevention. It also allows us to address some key challenges in infection prevention, such as delayed feedback to HCWs, in a safe, non-punitive environment. The authors hope to shape the canine scent detection initiative into a sustainable quality improvement model from certification to implementation.

REFERENCES

1. Desai, K., Gupta, S. B., Dubberke, E. R., Prabhu, V. S., Browne, C., & Mast, T. C. (2016). Epidemiological and economic burden of *Clostridium difficile* in the United States: Estimates from a modeling approach. *BMC Infectious Diseases*, *16*(303), 1-10. doi: https://doi.org/10.1186/s12879-016-1610-3
2. Huang, S. S., Datta, R., & Platt, R. (2006). Risk of acquiring antibiotic-resistant bacteria from prior room occupants. *Archives of Internal Medicine*, *166*(18), 1945-1951. doi: https://doi.org/10.1001/archinte.166.18.1945
3. Shaughnessy, M. K., Micielli, R. L., DePestel, D. D., Arndt, J., Strachan, C. L., Welch, K. B., & Chenoweth, C. E. (2011). Evaluation of hospital room assignment and acquisition of *Clostridium difficile* infection. *Infection Control & Hospital Epidemiology*, *32*(3), 201-206. doi: https://doi.org/10.1086/658669
4. Bomers, M. K., van Agtmael, M. A., Luik, H., Vandenbroucke-Grauls, C. M. J. E., & Smulders, Y. M. (2014). A detection dog to identify patients with *Clostridium difficile* infection during a hospital outbreak. *Journal of Infection*, *69*(5), 456-461. doi: https://doi.org/10.1016/j.jinf.2014.05.017
5. Bryce, E., Zurberg, T., Zurberg, M., Shajari, S., & Roscoe, D. (2017). Identifying environmental reservoirs of *Clostridium difficile* with a scent detection dog: Preliminary evaluation. *Journal of Hospital Infection*, *97*(2), 140-145. doi: https://doi.org/10.1016/j.jhin.2017.05.023
6. Anderson, J., Gosbee, L. L., Bessesen, M., & Williams, L. (2010). Using human factors engineering to improve the effectiveness of infection prevention and control. *Critical Care Medicine*, *38*(8 Suppl), S269-S281. doi: https://doi.org/10.1097/CCM.0b013e3181e6a058
7. Singer, S. J., Benzer, J. K., & Hamdan, S. U. (2015). Improving health care quality and safety: The role of collective learning. *Journal of Healthcare Leadership*, *7*, 91-107. doi: https://doi.org/10.2147/JHL.S70115

CONCISE REPORT

Value of Certification in Infection Prevention and Control (CIC®)

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ABSTRACT

The Certification Board of Infection Control and Epidemiology, Inc. conducted a marketing research study to determine the perceived value of the Certification in Infection Prevention and Control (CIC®) among infection prevention professionals and other stakeholders. Four thematic categories were identified: certification process and standards; professionalism, competency, and career growth; patient care, safety, and infection prevention and control; and regulatory compliance. Respondents stated that certification demonstrated professional competency, increased career growth, improved regulatory compliance, was important in influencing legislation, and improved the practice of infection prevention and control. Opportunities were to re-evaluate eligibility criteria and exam difficulty; demonstrate how certification increases financial compensation and organizational recognition; and offer recertification through continuing education. Based on the study findings, strategic recommendations and next steps were incorporated into the strategic plan. This paper is an overview and summarizes the study findings.

KEYWORDS

Competency; certification; professionalism; career growth; patient safety; infection prevention; regulatory compliance

INTRODUCTION

Specialty certification demonstrates competency and commitment to the profession [1]. Certification validates knowledge using standardized testing methods. Accredited certification further demonstrates the quality and integrity of the certification process. The Certification Board of Infection Control and Epidemiology, Inc. (CBIC) administers the only national accredited Certification in Infection Prevention and Control (CIC®). CBIC is accredited by the National Commission on Certifying Agencies (NCCA), a member of the Institute for Credentialing Excellence. NCCA accredits certifying agencies to ensure the health, welfare, and safety of the public through accreditation. CIC® is one measure of competency and mastery of healthcare infection prevention and control knowledge. Competency defines the professional role [1]. There are over 7,000 individuals certified in CIC®. While a majority of certificants are from the United States and Canada, there is a growing need for certification outside North America, including Europe [2].

Infection preventionist (IP) competencies assessed during the CIC® examination are: identification of infectious disease process; surveillance and epidemiologic investigation; preventing and controlling the transmission of infectious agents and healthcare-associated infections; employee and occupational health; management and communication; education and research; environment of care; and cleaning, sterilization, disinfection, and asepsis [3]. The Association for Professionals in Infection Control and Epidemiology, Inc. (APIC) developed the IP Competency Model in 2012. That model states that the transition from novice toward proficiency is bridged once one passes the CIC® examination [4]. This statement supports the idea that certification is an important career milestone using the framework of the APIC Competency Model.

Certification represents both the individual's and their institution's commitment to continual improvement of infection prevention and control practices as well as the certificant's contribution to healthcare personnel and patient safety [5]. There are many ways to measure the value of certification. Bernard et al. (2018) described higher overall self-assessed competency among certified respondents ($p < 0.001$) [6]. Landers et al. (2017) reported the salary of those with the CIC® credential was 25% higher than those without ($85,911 vs $68,817; $p < 0.01$) [7]. Carrico et al. (2013) found that those with the CIC® credential scored significantly higher in overall program performance in five major program areas than respondents who were not certified (54% vs 43%; $p = 0.003$) [8]. The five major program areas were: immunization program management, vaccines provided to healthcare personnel,

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Conflicts of interest: James F. Marx, Sandra Callery, and Roy Boukidjian are members of CBIC.

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vaccine handling practices, training provided for the individual(s) responsible for the program, and quality indicators for the program. Krein et al. (2007) reported that hospitals with a certified IP on staff had a higher safety culture score. Hospitals with a CIC®-certified IP participated in infection prevention collaborations and were more likely to use evidence-based catheter-related bloodstream infection prevention practices [9]. Hospitals with a CIC®-certified IP director also had significantly lower incident rate ratio (IRR) of methicillin-resistant *Staphylococcus aureus* bloodstream infections (IRR = 0.32) [10]. Hospitals with a CIC®-certified IP supported evidence-based antimicrobial stewardship, device-associated and healthcare-associated infection interventions, nurse-initiated urinary catheters discontinue protocols, and ventilator-associated pneumonia prevention practices [11].

There are more job opportunities for those who hold the CIC® credential than there are for those without the credential. In 2007, Goldrick reported that 30% of employers required the CIC® credential to apply for or maintain employment [5]. To compare the changes for CIC® requirements, a review of job postings on LinkedIn done in 2018 showed the CIC® requirement had grown to 46% (16% increase) (see Table 1). In summary, the CIC® certification supports higher compensation, increases job satisfaction through a structured career development framework, improves patient outcome, advances evidence-based infection prevention practices, and is valued by the public and the healthcare industry.

TABLE 1: Comparison of changes for CIC® requirement in infection preventionist job postings.

	CIC® Required	CIC® Preferred	CIC® Not Mentioned
Goldrick, 2007 [5]	30%	38%	38%
LinkedIn, 2018	46%	31%	31%
Difference	+16%	-7%	-9%

OBJECTIVE

The purpose of this study was to determine the perceived value of the CIC® credential among North American IPs and healthcare executives. The target audiences were senior-level managers, public health officials, current and previous CIC® certificants, and those who were never certified. The results of the survey were to be used to reshape and update CBIC's five-year strategic plan.

METHODS

CBIC engaged the consulting company IMPAQ Strategy in February 2018. IMPAQ Strategy provides strategic consulting to non-profit organizations and associations. To prepare for this market research survey, an environmental scan was performed and current CBIC Board members were interviewed. Three primary question domains were developed: What is the current value of the credential? What are the barriers to attaining and maintaining the credential? How can the value of the credential be increased? These three primary domain questions were then divided into two to three secondary domain questions for a total of eight subdomains. The final questionnaire comprised 28 Likert scale multiple choice, two open-ended, and 21 demographic questions. Free text responses were reviewed for thematic information and, where possible, were mapped to pre-existing categories from the primary question in the survey.

A list of potential survey respondents was gathered through membership rosters provided by APIC, Infection Prevention and Control Canada (IPAC Canada), CBIC contact lists, and a purchased database from the IQVIA Institute for Human Data Science for healthcare executives. IQVIA coordinates alliances between life science companies, medical researchers, government agencies, payers, non-profit organizations, and other healthcare stakeholders to deliver insights and solutions using human data science. Eligible respondents were limited to those with a paid membership in APIC or IPAC Canada, contacts provided by CBIC, and the purchased mailing list from IQVIA. The survey/questionnaires were sent out by direct email to senior-level managers, public health officials, current and previous CIC® certificants, and those who were never certified. The survey response window was limited to 12 days. The survey was also available through CBIC's social media sites, including LinkedIn, Facebook, and Twitter. Market research techniques using both qualitative and quantitative methods were used to collect and analyze data.

Follow-up 15-minute telephone interviews were conducted on 12 randomly selected respondents from each of the following categories: executives and administrators; individuals with a lapsed CIC® credential; young professionals with > 10 years of professional experience; public health officials; Canadians; and individuals who have never held the CIC® credential. Unique questions were developed for each cohort. The interviews were used to dive deeper into opinions and interests regarding the CIC®'s role in infection prevention and control and the respondents' personal experiences with the credential.

RESULTS

A total of 34,778 surveys were distributed by email to potential respondents in mid-May 2018; 30,409 were sent to IP professionals and 4,369 were sent to health executives, senior-level managers, and public health officials. There was a 12-day response window from May 21 to June 1, 2018. A total of 4,372 surveys were returned (12.6% response rate). Of the 4,372 respondents, 2,032 (46%) currently hold a CIC®, 238 (5.5%) respondents previously held a CIC®, and 1,960 (45%) respondents never held a CIC®. Respondents' years of experience were: less than five years (28.6%); five to ten years (39.3%); 11 to 20 years (17.4%); 21 to 30 years (10.3%); and over 30 years (4.2%). The majority of respondents (62%) were between the ages of 30 and 60; 12.8% were under 30; and 25% were older than 60.

The majority of respondents support the value of a CIC®, particularly in the following types of organizations: Academic and Non-Academic Hospitals, Universities, Public Health Agencies, None/Retired, and Other. Responses from community-based hospices, dental practices, and freestanding Emergency departments and surgical centres were similar and tended to

be more negative. Respondents from the Long Term Care and Skilled Nursing Facilities types looked similar and tended to show mixed answers when compared to both groups of respondents noted above.

Four thematic categories were identified: certification process and standards; professionalism, competency, and career growth; patient care, safety, and infection prevention and control; and regulatory compliance.

Certification process and standards

The majority of respondents felt positively about the current standards, processes, and requirements. Eligibility and the certification process for both initial and recertification were clear. The study preparation process and time to complete the examination were also reported as clear, reasonable, and adequate. One opportunity was to re-evaluate eligibility criteria and exam difficulty.

Professionalism, competency, and career growth

Respondents reported that certification demonstrated professional competency and increased career growth; however, they were less positive as to whether certification would lead to monetary compensation and increased organizational recognition.

Patient care, safety, and infection prevention and control

Respondents reported that the certification improved the practice of infection prevention and control, patient care, and patient safety.

Regulatory compliance

Respondents stated that certification improved regulatory compliance and was important in influencing legislation. Other improvement recommendations were to offer specialized learning tracks, to increase CIC® brand awareness, for regulatory agencies to endorse certification, and to incorporate continuing education into the recertification process (Table 2).

The IMPAQ Strategy team conducted follow-up interviews with a randomly selected group of respondents at the conclusion of the survey. Key findings from the 12 interviews across the identified seven groups of respondents were as follows:

Executives and administrators

- Have an option to either take the exam after five years or do continuing education option. Most well-known certifications have this option.
- Need to add laboratory personnel as potential for certification.
- CIC® credential desired but not required: organization will pay for study materials and meetings but not the exam.
- CIC® credential is competing for professionals; is more difficult to attain and maintain due to amount of experience and study.

Never held a CIC® credential

- One interviewee stated she was denied participation in the exam prep class for having too much experience.
- Others wanted continuing education units instead of an examination option.
- The enrollment process is smooth and helpful.
- CBIC has a lot of information on its website.
- Many leaders do not support funding for a CIC® credential.
- Hospitals have the best support.
- Long-term care facilities, local public health levels, and outpatient facilities do not have support.
- Providing some test-taking tips would be helpful.
- Certification is cost prohibitive, especially toward end of career.
- One barrier is the requirement to have two years of experience prior to taking exam. It is a time-sensitive barrier.
- There is a need to be able to access resources and materials without having to pay for them, such as study guides and other infection prevention information.
- Recertification as either a very brief exam or continuing education units every two to three years instead of a full exam at five years.
- CBIC being at conferences is good for marketing, but would also market at educational institutions so that new graduates know this is a next step in career advancement.
- There is too much information on the exam.
- Would need more experience to be prepared to take the examination.

TABLE 2: Recommended ways to improve the CIC®.

Improvement Recommended	Currently Hold	Previously Held	Never Held
Specialized learning tracks.	816 (43.4%)	95 (48.7%)	1,003 (60.4%)
Greater brand awareness.	856 (45.5%)	76 (39.0%)	653 (39.3%)
Endorsement of CIC® by accrediting agencies.	1,050 (55.9%)	89 (45.5%)	603 (36.3%)
Incorporate CE/CEU for recertification.	805 (42.8%)	104 (53.3%)	722 (43.5%)
Increase published research supporting CIC® and its benefits.	611 (32.5%)	50 (25.6%)	513 (30.9%)
Incorporate CIC® into higher education curriculums.	367 (19.5%)	53 (27.2%)	575 (34.6%)
Meet legislative requirements (mandates for the CIC®).	626 (33.4%)	52 (26.7%)	356 (21.4%)
Partnerships with other certifying organizations.	356 (18.9%)	55 (28.9%)	480 (28.9%)
More rigorous certification requirements.	97 (5.2%)	5 (2.6%)	33 (2.0%)
More rigorous examination requirements.	56 (3.0%)	56 (3.0%)	42 (2.5%)

Legend
CE: continuing education
CEU: continuing education unit

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For those with a lapsed CIC® credential

- Many would like to see continuing education units for recertification.
- Many would like to drop the prerequisite of two years of experience for exam.
- The CIC® certification was not required for their position.
- CIC® certification is too expensive and is not reimbursed by employers.
- Consider those who work outside of hospitals and direct patient care.
- Lack of time to study.
- Failed the exam.
- Struggle to maintain continuing education units in smaller towns.
- Would not cover enough information for the infection preventionist.
- Getting close to retirement. Currently, CIC® certificant respondents who do not plan to recertify or who plan to let their certification lapse stated it was due to upcoming retirement.

DISCUSSION

The main takeaway from this study was an increased sense of professionalism, competency, and career growth associated with obtaining the CIC® credential, as well as improved patient safety. In addition, there were several opportunities identified for CBIC to consider incorporating into the upcoming strategic plan. Some main opportunities identified by the respondents include promoting the credential to accrediting agencies, increasing brand awareness externally and internally as familiarity of the credential grows and as individuals gain experience within the profession, considering continuing education credits for recertification, and offering specialized certification tracks across the continuum of care. Results were presented to the CBIC Board of Directors and staff in September 2018 and the CBIC strategic plan for 2019-2021 was updated in November 2018.

One limitation of the study was the sample population. Because the majority of respondents came from the CBIC, APIC, and IPAC Canada contact lists (95.6%), the results may only reflect the value of certification to those already familiar with certification and not the larger healthcare audience or the public. This marking research study was not able to assess the value of certification to the consumer, healthcare regulators, or senior healthcare leadership. Another limitation was the short, 12-day response time frame.

The CIC® credential has grown in volume, relevance, and significance throughout the past 35 years. This is evidenced by the value of certification study results as well as previous published literature highlighting key facts and sentiment within the infection prevention and control community. In addition, external activities by legislatures have increased their focus on certification requirements, as it continues to validate one's competency within the profession. The outcome of this study provides a pulse of current CIC® credential standing within the infection prevention and control community and allows for additional research to be conducted in order to further highlight the value of certification.

REFERENCES

1. Murphy, D. M., Hanchett, M., Olmsted, R. N., Farber, M. R., Lee, T. B., Haas, J. P., & Streed, S. A. (2012). Competency in infection prevention: A conceptual approach to guide current and future practice. *American Journal of Infection Control, 40*(4), 296-303. doi: 10.1016/j.ajic.2012.03.002
2. Zingg, W., Mutters, N. T., Harbarth, S., & Friedrich, A. W. (2015). Education in infection control: A need for European certification. *Clinical Microbiology and Infection, 21*(12), 1052-1056. doi: 10.1016/j.cmi.2015.09.001
3. Henman, L. J., Corrigan, R., Carrico, R., Suh, K. N., Anderson, K., Boukidjian, R., Callery, S., Conner, J., Fugate, M., Garcia-Houchins, S., Gibbons, J., Kaiser, M. T., Rebmann, T., Round, L., Rohrbach, P., Rhodenizer-Rose, S., Andrews, J., Flinchum, A., Fulton, M., Hsu, V., & Smyer, J. (2015). Identifying changes in the role of the infection preventionist through the 2014 practice analysis study conducted by the Certification Board of Infection Control and Epidemiology, Inc. *American Journal of Infection Control, 43*(7), 664-668. doi: 10.1016/j.ajic.2015.02.026
4. Davis, J., Billings, C., & Malik, C. (2018). Revisiting the Association for Professionals in Infection Control and Epidemiology Competency Model for the Infection Preventionist: An evolving conceptual framework. *American Journal of Infection Control, 46*(8), 921-927. doi: https://doi.org/10.1016/j.ajic.2018.04.210
5. Goldrick, B. A. (2007). The Certification Board of Infection Control and Epidemiology white paper: The value of certification for infection control professionals. *American Journal of Infection Control, 35*(3), 150-156. doi: 10.1016/j.ajic.2006.06.003
6. Bernard, H., Hackbarth, D., Olmsted, R. N., & Murphy, D. (2018). Creation of a competency-based professional development program for infection preventionists guided by the APIC Competency Model: Steps in the process. *American Journal of Infection Control, 46*(11), 1202-1210. doi: 10.1016/j.ajic.2018.04.225
7. Landers, T., Davis, J., Crist, K., & Malik, C. (2017). APIC Mega-Survey: Methodology and overview. *American Journal of Infection Control, 45*(6), 584-588. doi: 10.1016/j.ajic.2016.12.012
8. Carrico, R. M., Wiemken, T., Westhusing, K., Christensen, D., & McKinney, W. P. (2013). Health care personnel immunization programs: An assessment of knowledge and practice among infection preventionists in US health care facilities. *American Journal of Infection Control, 41*(7), 581-584. doi: 10.1016/j.ajic.2012.08.013
9. Krein, S. L., Hofer, T. P., Kowalski, C. P., Olmsted, R. N., Kauffman, C. A., Forman, J. H., Banaszak-Holl, J., & Saint, S. (2007). Use of central venous catheter-related bloodstream infection prevention practices by U.S. hospitals. *Mayo Clinic Proceedings, 82*(6), 672-678. doi: 10.4065/82.6.672
10. Pogorzelska, M., Stone, P. W., & Larson, E. L. (2012). Certification in infection control matters: Impact of infection control department characteristics and policies on rates of multidrug-resistant infections. *American Journal of Infection Control, 40*(2), 96-101. doi: 10.1016/j.ajic.2011.10.002
11. Saint, S., Greene, M. T., Olmsted, R. N., Chopra, V., Meddings, J., Safdar, N., & Krein, S. L. (2013). Perceived strength of evidence supporting practices to prevent health care-associated infection: Results from a national survey of infection prevention personnel. *American Journal of Infection Control, 41*(2), 100-106. doi: 10.1016/j.ajic.2012.10.007

CONCISE REPORT

Phenotypic and genotypic characteristics of community-acquired and hospital-acquired carbapenem-resistant *Enterobacteriaceae* in patients with liver cirrhosis at the National Liver Institute of Egypt

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ABSTRACT

Background: Carbapenem-resistant *Enterobacteriaceae* (CRE) is considered one of the most urgent public health problems worldwide with associated high morbidity and mortality rates. CRE has both community-acquired (CA) and hospital-acquired (HA) danger because of the transmissible nature of plasmids.

Objectives: We aimed to compare the phenotypic and genotypic characteristics of carbapenemase genes in CRE isolates causing CA and HA infections in cirrhotic patients and the distribution of carbapenemase genes in both settings.

Method: CRE isolates were taken from 38 recruited cirrhotic patients at the National Liver Institute at Menoufia University in Egypt between January 2017 and January 2018 with *Enterobacteriaceae* isolates resistant to at least one carbapenem. Isolates were identified and described by conventional techniques and confirmed by the VITEK 2 system, which was also used for antimicrobial susceptibility and the detection of extended-spectrum β-lactamase production. We then phenotypically and genotypically characterized all isolates for the presence of the most prevalent carbapenemase enzymes (*Klebsiella pneumoniae* carbapenemase [KPC], Verona integron metallo-beta-lactamases [VIM], New Delhi metallo-beta lactamase [NDM], and oxacillinase-48 [OXA-48]) and genes using multiplex polymerase chain reaction confirmed results.

Results: All CRE isolates included in this study were resistant to all carbapenems tested and susceptible to colistin, while 20 of the 38 isolates were sensitive to tigecycline. Among the 24 HA CRE isolates, nine isolates (37.5%) contained OXA-48, three (12.5%) contained both OXA-48 and NDM-1, two contained KPC (8.3%), one carried NDM-1 (4.2%), and one included VIM (4.2%). The OXA-48 gene was the most frequent gene in both groups, and no statistically significant difference was found between the two groups in regards to prevalence.

Conclusion: OXA-48 CRE is the most prevalent carbapenemase gene in Egyptian cirrhotic patients with similar phenotypic and genotypic characteristics to CA cases. This indicates the equal prevalence of CRE in community and hospital settings.

KEYWORDS

Carbapenem-resistant *Enterobacteriaceae*; cirrhotic patients

INTRODUCTION

Rapidly emerging antimicrobial-resistant *Enterobacteriaceae* have been noted frequently with decompensated liver cirrhosis patients due to recurrent hospitalizations and repeated exposure to antibiotics either for treatment or prophylactic purposes. In addition, although carbapenem-resistant *Enterobacteriaceae* (CRE) are considered hospital-acquired (HA) pathogens, community-acquired (CA) CRE are also a threat and the knowledge about community-acquired CRE is limited [1, 2].

CRE are capable of inactivating carbapenem via different mechanisms, such as the overproduction of ampC enzymes, extended-spectrum beta-lactamase (ESBLs), carbapenemase enzymes that inactivate the β-lactam antibiotics, including carbapenems, efflux pumps, and deletion of porins [3]. Although CRE are initially considered HA pathogens, CA CRE are also noted [4].The most clinically important carbapenmases are *Klebsiella pneumoniae* carbapenemase (KPC) in the Ambler class A category, Verona integron metallo-beta-lactamases types (VIM), imipenemase, New Delhi metallo-betalactamase-1 (NDM-1) in the class B category, and oxacillinase-48 (OXA-48) in the class D category [5]. The dissemination of KPC, VIM,

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NDM, and OXA-48 among *K. pneumoniae* and *Escherichia coli* has been emerging in different countries [6].

NDM and OXA-48 producers are both HA and CA pathogens, whereas KPC producers are mainly HA isolates [7]. The activity of carbapenemase enzymes is identified by phenotypic assays, while carbapenemase encoding genes are identified by molecular assays [8, 9].

In the current study, we investigated the phenotypic and genotypic characteristics of CA and HA CRE isolates from cirrhotic patients admitted to the National Liver Institute (NLI) at Menoufia University in Egypt.

METHODS

Design

The study was performed from January 2017 to January 2018 at the NLI (Menoufia University, Egypt). NLI is a university hospital with a capacity of 320 beds that provides medical services for 107,450 hepatic patients annually.

The study was approved by the NLI Research Ethics Committee and the Research Ethics Committee of Menoufia University's Faculty of Medicine. Informed consent was obtained from all participants before their enrollment in the study.

Patients

A total of 38 *Enterobacteriaceae* isolates resistant to at least one carbapenem were isolated from different clinical specimens (e.g., blood, urine, sputum, wound, stool, and swabs from central lines and urinary catheters). Patient consent was ensured.

Diagnostic criteria

Inclusion criteria

HA CRE were isolated from patients who were hospitalized for > 48 hours. CRE is considered CA if the infection was present on admission or developed less than 48 hours after hospitalization. The definition of infection or colonization was followed by the guidelines published by the Centers for Disease Control and Prevention.

Exclusion criteria

Enterobacteriaceae isolates that were sensitive to carbapenems or associated with asymptomatic colonization were excluded. Duplicate isolates from the same patient were also excluded, unless they were isolated from different specimens with a distinguishable susceptibility pattern.

Bacterial cultures and antimicrobial susceptibility

Isolates were plated on blood agar and MacConkey agar (Oxoid, UK), depending on the type of clinical specimens. Cultures were then examined macroscopically for colonial morphology and a Gram stain was performed on suspected colonies. All *Enterobacteriaceae* isolates were selected then subcultured at 37° C overnight on MacConkey agar media for purity and further identification tests. Further, confirmation of the isolates was performed using the automated VITEK 2 Compact system (BioMérieux, France) and Gram-negative (GN) cards following the manufacturer's instructions.

Antimicrobial susceptibility and production of ESBL were determined using the VITEK 2 Compact system and AST-GN73 cards following the manufacturer's instructions. Confirmed isolates were stored in nutrient broth supplemented with 16% glycerol at -80° C until used for phenotypic and genotypic characterization [10]. All CRE isolates were then tested for the presence of the most prevalent carbapenemase enzymes (KPC, VIM, NDM, and OXA-48) and genes by phenotypic (Modified Hodge Test) [11] and genotypic methods (multiplex polymerase chain reaction [PCR]) [12].

Statistical method

Data was collected and entered to the computer using the SPSS program for statistical analysis (v. 18, Chicago, IL). Data were entered as numerical or categorical. Numerical data were shown as mean and standard deviation (SD). Student's t-test was done to compare means and SD of two sets of numerical data. Categorical data were expressed as frequency and percent (%) and a chi-squared test (x^2) was used to study association. Whenever any of the expected cells were less than five, Fischer's exact test was used. *P*-value was considered statistically significant when it was less than 0.05.

RESULTS

All CRE isolates included in this study were resistant to all carbapenems tested and susceptible to colistin, while 20 out of 38 isolates were sensitive to tigecycline

Of the 38 CRE isolates, 24 patients had HA infection (63.2%) and 14 patients (36.8%) had CA infection. The mean age of patients with HA infection and CA infection was 49.60± 8.28 years and 45.56± 10.25 years, respectively. There was no significant difference between the two median ages ($P = 0.06$).

Infection, bacterial species, and carbapenemase gene distribution for HA and CA isolates are shown in Table 1. There was no statistically significant difference between the two groups.

The OXA-48 gene was the most frequent gene in CA and HA CRE. Among the 24 HA CRE isolates, nine isolates (37.5%) contained OXA-48, three (12.5%) contained both OXA-48 and NDM-1, two contained KPC (8.3%), one contained NDM-1 (4.2%), and one contained VIM (4.2%). The prevalence of carbapenemase genes in CA isolates was as follows: 28.7% contained OXA-48, 14.3% contained NDM-1, and 7.1% contained both OXA-48 and NDM-1. Our study revealed that the OXA-48 gene was the most frequent gene in both groups and no statistically significant difference was found.

DISCUSSION

Phenotypic and genotypic characteristics in CA and HA CRE isolates causing infections in patients with liver cirrhosis were compared, and the role of carbapenemase genes and their distributions in both CA and HA infections were investigated. Exposure to antibiotics (such as carbapenem and quinolones), healthcare-associated interactions, the presence of indwelling devices, the use of mechanical ventilators, and comorbidities are

TABLE 1: Distribution of carbapenemase-resistant *Enterobacteriaceae* isolates according to site of infection, bacterial species, and carbapenemase genes.

	Hospital-acquired infections (*n* = 24)	Community-acquired infections (*n* = 14)	*P*-value
Site of infection			
Pneumonia	3 (12.5%)	4 (28.6%)	0.21
Urinary tract infection	5 (20.8%)	3 (21.4%)	0.96
Bacteremia	4 (16.7%)	3 (21.4%)	0.71
Wound infection	4 (16.7%	4 (28.6%)	0.38
Bacterial species			
Klebsiella pneumoniae	19 (79.2%)	9 (64.3%)	0.31
Escherichia coli	3 (12.5%)	5 (35.7%)	0.09
Morganella morgannii	2 (8.3%)	0 (0.0%)	0.95
Carbapenemase gene			
Negative for all	8 (33.3%)	6 (42.8%)	
OXA-48	9 (37.5%)	4 (28.7%)	0.77
NDM-1	1 (4.2%)	2 (14.3%)	
KPC	2 (8.4%)	0 (0.0%)	
VIM	1 (4.2%)	0 (0.0%)	
OXA-48 and NDM-1	3 (12.5%)	1 (7.1%)	
KPC and NDM-1	0 (0.0%)	1 (7.1%)	

all risk factors responsible for the higher incidence of CRE in these patients. Moreover, the acquisition and transfer of drug-resistant genes through plasmids and transposons and its spread to the community via the fecal-oral route may be responsible for the appearance of CA infections by CRE among such patients [13].

Previous studies reported nearly similar findings: Tang et al. (2016) found that 29.5% of 78 CRE cases were CA, but the study included colonization [4]. Sheng et al. (2016) reported that 21.3% of CRE cases were CA [14]. In contrast to our study, Miller & Johnson (2015) and Thaden et al. (2014) reported lower incidence of CA CRE in comparison to HA (9.8% and 5.6%, respectively) [15, 16].

HA CRE was most frequently associated with urinary tract infections (UTI) (20.8%), while in CA, pneumonia was the most frequent infection (28.6%).This was consistent with other studies showing that UTIs were the most common HA infection, accounting for almost 40% of all nosocomial infections [17], while for CA, pneumonia is the most frequent infectious disease worldwide [18]. Also, Salerno et al. (2016) reported that UTIs, spontaneous bacterial peritonitis, and bacteremia were the most frequent HA infections in cirrhotic patients, while pneumonia was the most frequent CA infection (33%) [19]. On the other hand, Tang et al. (2016) reported that pneumonia was the most common HA CRE infection in cirrhotic patients, followed by UTIs [4].

In regard to the type of bacteria, *K. pneumoniae* was the most common organism (73.7%), followed by *E. coli* (21.1%). Similar results were reported in many studies testing the presence of CRE among hospital and community samples [3, 16, 20]. However, others found that *E. coli* was the most common organism overall, followed by *K. pneumoniae* or *Enterobacter cloacae* (21-23).

The spread of CRE isolates into the community from healthcare settings or vice versa via the fecal-oral route and the highly transmissible nature of plasmid-borne carbapenemases may have contributed to the wide spread of CRE with comparable phenotypic characteristics in both settings.

Although no significant difference was found between the two CRE groups in regard to the genotypic characteristics and the prevalence of carbapenemase genes, OXA-48 was the most predominant gene among the 24 HA CRE isolates (37.5%) and the CA CRE isolates (28.7%). Our observation was consistent with other studies that identified the OXA-48 gene as the most predominant gene [24].

The KPC and VIM genes were only detected in HA CRE, which could be due to the limited number of CA CRE cases.

OXA-48 was also reported to be commonly distributed in the Mediterranean region of Africa and Europe [25] and Saudi Arabia [26], which supports our findings. In addition to OXA-48-like and NDM-1 genes, VIM was detected in one CRE isolate. The low detection rate of this gene may be attributed to the higher prevalence of this gene in Europe than Africa [25]. Moreover, the only *Morganella morganii* isolate detected in our study expressed the OXA-48 gene.

Interestingly, five out of the 38 CRE were found to co-express two carbapenemase genes. NDM-1 genes co-existed with OXA-48 genes in four isolates (three HA and one CA isolate) and co-existed with the KPC gene in one isolate, which confirms the high coexistence rate of different carbapenemases among *Enterobacteriaceae* isolates.

In conclusion, CRE have a wide distribution in the community with comparable phenotypic and genotypic characteristics to those in hospital settings, highlighting the overuse of antibiotics, adequate antibiotic empirical control, and the need for implementation of strict infection control guidelines in healthcare facilities. Further research involving more patients is needed in order to confirm our findings and highlight the need for antimicrobial stewardship. Coordination between infection control teams and healthcare workers is also crucial to prevent the spread of CRE.

REFERENCES

1. Perovic, O., Britz, E., Chetty, V., & Singh-Moodley, A. (2016). Molecular detection of carbapenemase-producing genes in referral Enterobacteriaceae in South Africa: A short report. *South African Medical Journal, 106*(10), 975-977. doi: 10.7196/SAMJ.2016.v106i10.11300
2. Fernández, J., Bert, F., & Nicolas-Chanoine, M. H. (2016). The challenges of multi-drug-resistance in hepatology. *Journal of Hepatology, 65*(5), 1043-1054. doi: 10.1016/j.jhep.2016.08.006
3. Nordmann, P., Poirel, L., & Dortet, L. (2012). Rapid detection of carbapenemase-producing *Enterobacteriaceae*. *Emerging Infectious Diseases, 18*(9), 1503-1507. doi: 10.3201/eid1809.120355
4. Tang, H.-J., Hsieh, C.-F., Chang, P.-C., Chen, J.-J., Lin, Y.-H., Lai, C.-C., Chao, C.-M., & Chuang, Y.-C. (2016). Clinical significance of community- and healthcare-acquired carbapenem-resistant *Enterobacteriaceae* isolates. *PLoS ONE, 11*(3), e0151897. doi: 10.1371/journal.pone.0151897

5. Jacob, J. T., Klein, E., Laxminarayan, R., Beldavs, Z., Lynfield, R., Kallen, A. J., Ricks, P., Edwards, J., Srinivasan, A., Fridkin, S., Rasheed, K. J., Lonsway, D., Bulens, S., Herrera, R., McDonald, C. L., Patel, J., Limbago, B., Bell, M., & Cardo, D. (2013). Vital signs: Carbapenem-resistant *Enterobacteriaceae*. *Morbidity and Mortality Weekly Report, 62*(9), 165-170. Retrieved from https://jhu.pure.elsevier.com/en/publications/vital-signs-carbapenem-resistant-enterobacteriaceae-4
6. Lee, C. R., Lee, J. H., Park, K. S., Kim, Y. B., Jeong, B. C., & Lee, S. H. (2016). Global dissemination of carbapenemase-producing *Klebsiella pneumoniae*: Epidemiology, genetic context, treatment options, and detection methods. *Frontiers in Microbiology, 7*, 895. doi: 10.3389/fmicb.2016.00895
7. Nordmann, P., & Poirel, L. (2014). The difficult-to-control spread of carbapenemase producers among *Enterobacteriaceae* worldwide. *Clinical Microbiology and Infection, 20*(9), 821-830. doi: 10.1111/1469-0691.12719
8. Moemen, D., & Masallat, D. T. (2017). Prevalence and characterization of carbapenem-resistant *Klebsiella pneumonia* isolated from intensive care units of Mansoura University hospitals. *Egyptian Journal of Basic and Applied Sciences, 4*, 37-41. doi: 10.1016/j.ejbas.2017.01.001
9. El-Sweify, M. A., Gomaa, N. I., El-Maraghy, N. N., & Mohamed, H. A. (2015). Phenotypic detection of carbapenem resistance among *Klebsiella pneumoniae* in Suez Canal University Hospitals, Ismailiya, Egypt. *International Journal of Current Microbiology and Applied Sciences, 4*(2),10-18. Retrieved from https://www.ijcmas.com/vol-4-2/Mohammad%20A.%20El-Sweify,%20et%20al.pdf
10. Murray, P. R., Baron, E. J., Jorgensen, J. H., Pfaller, M. A., & Yolken, R. H. (2003). *Manual of clinical microbiology* (8th ed.). Washington, D.C.: American Society of Microbiology Press.
11. Anderson, K. F., Lonsway, D. R., Rasheed, J. K., Biddle, J., Jensen, B., McDougal, L. K., Carey, R. B., Thompson, A., Stocker, S., Limbago, B., & Patel, J. B. (2007). Evaluation of methods to identify the *Klebsiella pneumoniae* carbapenemase in *Enterobacteriaceae*. *Journal of Clinical Microbiology, 45*(8), 2723-2725. doi: 10.1128/JCM.00015-07
12. Poirel, L., Walsh, T. R., Cuvillier, V., & Nordmann, P. (2011). Multiplex PCR for detection of acquired carbapenemase genes. *Diagnostic Microbiology and Infectious Disease, 70*(1), 119-123. doi: 10.1016/j.diagmicrobio.2010.12.002
13. Kelly, A. M., Mathema, B., & Larson, E. L. (2017). Carbapenem-resistant *Enterobacteriaceae* in the community: A scoping review. *International Journal of Antimicrobial Agents, 50*(2), 127-134. doi: 10.1016/j.ijantimicag.2017.03.012
14. Sheng, W. H., Badal, R. E., & Hseuh, P.-R. (2013). Distribution of extended-spectrum β-lactamases, AmpC β-lactamases, and carbapenemases among *Enterobacteriaceae* isolates causing intra-abdominal infections in Asia-Pacific region: Results of the Study for Monitoring Antimicrobial Resistance Trends (SMART). *Antimicrobial Agents and Chemotherapy, 57*(7), 2981-2988. doi: 10.1128/AAC.00971-12
15. Miller, B. M., & Johnson, S. W. (2016). Demographic and infection characteristics of patients with carbapenem-resistant *Enterobacteriaceae* in a community hospital: Development of a bedside clinical score for risk assessment. *American Journal of Infection Control, 44*(2), 134-137. doi: 10.1016/j.ajic.2015.09.006
16. Thaden, J. T., Lewis, S. S., Hazen, K. C., Huslage, K., Fowler, Jr., V. G., Moehring, R. W., Chen, L. F., Jones, C. D., Moore, Z. S., Sexton, D. J., & Anderson, D. J. (2014). Rising rates of carbapenem-resistant *Enterobacteriaceae* in community hospitals: A mixed-methods review of epidemiology and microbiology practices in a network of community hospitals in the southeastern United States. *Infection Control & Hospital Epidemiology, 35*(8), 978-983. doi: 10.1086/677157
17. Iacovelli, V., Gaziev, G., Topazio, L., Bove, P., Vespasiani, G., & Finazzi Agrò, E. (2014). Nosocomial urinary tract infections: A review. *Urologia, 81*(4), 222-227. doi: 10.5301/uro.5000092
18. Di Pasquale, M., Henchi, S., Vanoni, N., & Blasi, F. (2017). Cardiovascular complications in patients with community-acquired pneumonia. *Community Acquired Infection, 4*(2), 23-31. Retrieved from http://www.caijournal.com/article.asp?issn=2225-6482;year=2017;volume=4;issue=2;spage=23;epage=31;aulast=Di
19. Salerno, F., Borzio, M., Pedicino, C., Simonetti, R., Rossini, A., Boccia, S., Cacciola, I., Burroughs, A. K., Manini, M. A., La Mura, V., Angeli, P., Bernardi, M., Dalla Gasperina, D., Dionigi, E., Dibenedetto, C., & Arghittu, M. (2016). The impact of infection by multidrug-resistant agents in patients with cirrhosis. A multicenter prospective study. *Liver International, 37*(1). doi: 10.1111/liv.13195
20. Guh, A. Y., Bulens, S. N., Mu, Y., Jacob, J. T., Reno, J., Scott, J., Wilson, L. E., Vaeth, E., Lynfield, R., Shaw, K. M., Vagnone, P. M., Bamberg, W. M., Janelle, S. J., Dumyati, G., Concannon, C., Beldavs, Z., Cunningham, M., Cassidy, P. M., Phipps, E. C., Kenslow, N., Travis, T., Lonsway, D., Rasheed, J. K., Limbago, B. M., & Kallen, A. J. (2015). Epidemiology of carbapenem-resistant *Enterobacteriaceae* in 7 US communities, 2012-2013. *JAMA, 314*(14), 1479-1487. doi: 10.1001/jama.2015.12480
21. Coccolini, F., Sartelli, M., Catena, F., Montori, G., Di Saverio, S., Sugrue, M., Ceresoli, M., Manfredi, R., & Ansaloni, L. (2015). Antibiotic resistance pattern and clinical outcomes in acute cholecystitis: 567 consecutive worldwide patients in a prospective cohort study. *International Journal of Surgery, 21*, 32-37. doi: 10.1016/j.ijsu.2015.07.013
22. Garrido, A., Seral, C., Gude, M. J., Casado, C., González-Domínguez, M., Sáenz, Y., & Castillo, F. J. (2014). Characterization of plasmid-mediated β-lactamases in fecal colonizing patients in the hospital and community setting in Spain. *Microbial Drug Resistance, 20*(4), 301-304. doi: 10.1089/mdr.2013.0109
23. Alexopoulou, A., Papadopoulos, N., Eliopoulos, D. G., Alexaki, A., Tsiriga, A., Toutouza, M., & Pectasides, D. (2013). Increasing frequency of gram-positive cocci and gram-negative multidrug-resistant bacteria in spontaneous bacterial peritonitis. *Liver International, 33*(7), 975-981. doi: 10.1111/liv.12152
24. Morsi, S. S. (2016). Comparative evaluation of phenotypic and genotypic methods for detection of carbapenemases in clinically significant *Klebsiella pneumonia* isolates. *Egyptian Journal of Medical Microbiology, 25*, 109-116.
25. Sekyere, J. O., Govinden, U., & Essack, S. (2015). The molecular epidemiology and genetic environment of carbapenemases detected in Africa. *Microbial Drug Resistance, 22*(1), 59-68. doi: 10.1089/mdr.2015.0053
26. Memish, Z. A., Assiri, A., Almasri, M., Roshdy, H., Hathout, H., Kaase, M., Gatermann, S. G., & Yezli, S. (2015). Molecular characterization of carbapenemase production among Gram-negative bacteria in Saudi Arabia. *Microbial Drug Resistance, 21*(3), 307-314. doi: 10.1089/mdr.2014.0121

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[1] Sixt N, Dalle F, Lafon I, Aho S, Couillault G, Valot S, et al. Reduced fungal contamination of the indoor environment with the PLASMAIR™ system (Airinspace). J Hosp infect 2007; 65:156-162.
[2] Fernandez-Gerlinger MP, Jannot AS, Rigaudeau S, Lambert J, Eloy O, Mignon F, Farhat H, Castaigne S, Merrer J Rousselot P.

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IPAC Canada is a multidisciplinary professional association of those engaged in the prevention and control of infections in all healthcare settings.

IPAC Canada represents its members in the pursuit of patient and staff safety and in the promotion of best infection prevention and control practices.
We work regularly with other professional associations and regulatory bodies to develop guidelines.

Our members come from across the continuum of care. Visit our website **www.ipac-canada.org** to see the many benefits and resources that are available to members.

INFECTION PREVENTION AND CONTROL CANADA (IPAC CANADA)

STAFF-FRIENDLY ANTIMICROBIAL CURTAINS

Privacy curtains – two words that make ICPs shudder. Curtains are a challenge - they define the patient's environment providing shelter, privacy and comfort... and they are touched continuously, potentially undermining hand hygiene and your cleaning and disinfection protocols.

Our easy to install, antimicrobial curtains have been tested in Canadian and European hospitals.

- ☑ *Reduce staff injury by 80%*
- ☑ *Preferred by staff*
- ☑ *3 log reduction of pathogens such as MRSA*

*Contact us and let us show you how we can help you **reduce costs**, **protect staff** and **patients.***

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PREVENA™
INCISION MANAGEMENT SYSTEM

PROTECT YOUR INCISIONS

The PREVENA™ Incision Management System:

is intended to manage the environment of surgical incisions and surrounding intact skin in patients at risk for developing post-operative complication, such as infection, by maintaining a closed environment via the application of negative pressure wound therapy system to the incision. The PREVENA™ Dressing skin interface layer with silver reduces microbial colonization in the fabric.

PREVENA™ Therapy can help:

- Hold incision edges together
- Remove fluids and infectious materials
- Act as a barrier to external contamination
- Deliver continuous negative pressure at -125mmHg up to 7 days

For more information, please visit prevenatherapy.com or call 1-800-668-5403 to schedule a meeting with your local KCI Representative

NOTE: Specific indications, contraindications, warnings, precautions and safety information exist for PREVENA™ Therapy. Please consult the applicable PREVENA™ System Clinician Guide instructions for use prior to application. This material is intended for healthcare professionals.

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