VOLUME 35
NUMBER 4

WINTER 2020-2021

CJIC

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

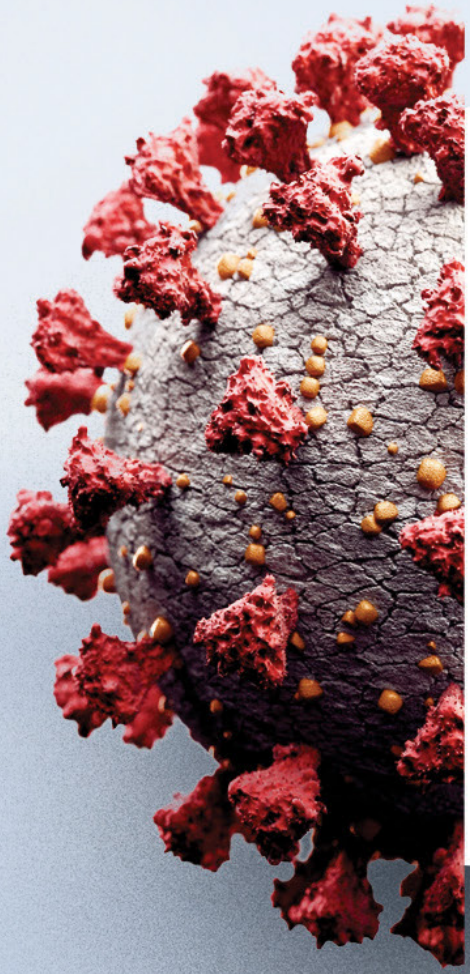
Official Publication of ipac Infection Prevention and Control Canada pci Prévention et contrôle des infections Canada

ISSN - 1183 - 5702

INSIDE

PM# 40065075 Return undeliverable Canadian addresses to lauren@kelman.ca

FROM NOVEL TO NEW NORMAL.



VIROX®
TECHNOLOGIES INC.

Engineering revolutionary disinfectants for the war against pathogens

INNOVATION • FORMULATION • EDUCATION • VALIDATION

virox.com

Creators of AHP®
ACCELERATED® HYDROGEN PEROXIDE
Patented

Stop the Spread of Infection

Protect your patients and staff from the spread of infection with Vernacare's Human Waste Disposal System

- Single-use products help prevent the spread of infection and reduce cross-contamination
- Hands-free macerators provide a safer method of human waste disposal
- Single-use patient wipes that are maceratable for safe and easy disposal

For more information:
1-800-268-2422 • www.vernacare.com

Vernacare

Cold and Flu season and the COVID-19 Pandemic

Cold and flu season is approaching and COVID-19 virus is still a significant concern, with the number of active cases across the country rising every day[1]. The 2020 cold and flu season will bring new challenges as SARS-CoV-2, the virus that causes COVID-19 may have similar symptoms and transmission similarities.

Transmission and Management

The flu shot is the most effective way to help prevent the flu.[4] However, because cold and flu viruses can spread by touching contaminated surfaces as well as by being in close contact with someone who is ill, safeguarding your environment plays an important role in protecting public health. Influenza viruses can survive on hard non-porous surfaces such as stainless steel and plastic for up to 48 hours.[5]

Furthermore, certain high-touch hard surfaces are especially likely to transmit these viruses. Telephones (48%), keyboards and computer mice (38%) are considered germ hotspots in the office during cold and flu season.[6]

All of this points to hard surface disinfection, a key part of any cold and flu prevention and management strategy.

DID YOU KNOW?

The flu is one of the 10 leading causes of death in Canada[4]

- **Approximately 12,000 Canadians are hospitalized for the flu each year**
- **Approximately 3,500 Canadians die from the flu each year**

The impact of COVID-19 on how we deal with the 2020 flu season

The COVID-19 pandemic creates several challenges for dealing with the upcoming cold and flu season and delivering the seasonal influenza immunization program. There is a need to create measures to avoid transmitting the COVID-19 virus to staff, volunteers and clients, the need for PPE, the risk of COVID-19 resurgence during the period where flu vaccines are being given, risk of exposure to the COVID-19 virus when accessing immunization and increased demand for the flu vaccine.[7]

Infection prevention and control (IPC), including proper cleaning and disinfection procedures are important to reduce the risk of transmitting the COVID-19 virus.[7]

Prevention is key

Following the measures recommended by the Public Health Agency of Canada, and choosing products that clean and disinfect hard non-porous surfaces can help prevent the spread of the viruses that cause COVID-19, cold and the flu.[11]

Cleaning and disinfecting surfaces to kill the viruses that cause colds, the flu and COVID-19 is essential as we prepare for the 2020 cold and flu season.

Coinfection and the lessons we can learn from Asia and Australia

Early reports from China indicated that coinfection with other respiratory diseases was rare in COVID-19 patients. However, another report showed that 11.8% of patients with COVID-19 were coinfected with influenza A or B.[8]

Australia experienced a record low flu season this year, due in part to an increase in flu vaccinations and also the measures taken to reduce the spread of the SARS-CoV-2 virus that causes COVID-19, such as wearing masks, social distancing and proper cleaning and disinfection procedures.[9,10]

While the trends seen in the southern hemisphere may provide clues to what the northern hemisphere can expect for the approaching 2020 cold and flu season, we must also be careful not to make assumptions.[8]

Clorox Total 360® Disinfectant Cleaner is exclusively for the Clorox Total 360® System and is Health Canada-approved to kill Cold & Flu viruses and SARS-CoV-2, the virus that causes COVID-19, in 2 minutes.

References: 1. Government of Canada. Coronavirus disease (COVID-19): Outbreak update. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html#a1. Accessed September 29, 2020. **2.** Workplace Safety and Prevention Services. https://www.wsps.ca/Information-Resources/Topics/Cold-and-Flu-Season.aspx#downloads. Accessed September 29, 2020. **3.** Ting E, Ungar WJ. Systematic review of the cost-effectiveness of influenza immunization programs: A Canadian perspective. 2015. https://lab.research.sickkids.ca/task/wp-content/uploads/sites/66/2018/06/2015-04-Influenza-FULL-REPORT.pdf. **4.** Government of Canada. Flu (influenza): For health professionals. https://www.canada.ca/en/public-health/services/diseases/flu-influenza/health-professionals.html. Accessed September 29, 2020. **5.** Kramer A, *et al.* How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis* 2006;6:130. https://bmcinfectdis.biomedcentral.com/articles/10.1186/1471-2334-6-130. **6.** Clorox Professional Products Company Survey. May 2015. **7.** Government of Canada. Guidance for influenza vaccine delivery in the presence of COVID-19 https://www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci/guidance-influenza-vaccine-delivery-covid-19.html. **8.** Rubin R. What happens when COVID-19 collides with flu season? *JAMA*. 2020;324(10):923-25. **9.** Favaro A. What Canada can learn from the Southern Hemisphere's season of 'virtually no influenza' https://www.ctvnews.ca/health/what-canada-can-learn-from-the-southern-hemisphere-s-season-of-virtually-no-influenza-1.5099934. Accessed October 5, 2020. **10.** Pratt, E. Why Australia had a mild flu season and what that means for the United States. https://www.healthline.com/health-news/australia-mild-flu-season-what-means-for-the-united-states#What-it-means-for-North-America. Accessed October 5, 2020. **11.** Public Health Agency of Canada Coronavirus disease (COVID-19) Cleaning and disinfecting public spaces. https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/diseases-conditions/coronavirus/cleaning-disinfecting-public-spaces/cleaning-disinfecting-public-spaces-eng.pdf. Accessed September 8, 2020.

Learn more, or request a product demo at **CloroxPro.ca | healthcare@clorox.com**

CLOROXPRO™

Protect her. She has aqua aerobics classes to get to.

CloroxPro™ offers 3 formulations for triple protection from hospital-acquired infections.

Your patients trust you to create a safe healing environment, so trust CloroxPro™ to stand behind you to help protect them. With multiple Health Canada-registered disinfectants, based on 3 chemistries in a variety of ready-to-use formats, you have more choices to meet your unique cleaning and disinfection needs. Because we believe that supporting you every step of the way means protecting them.

CLOROXPRO™

CloroxPro.ca | healthcare@clorox.com

MÉDIC ACCÈS
Since 2007

INTRODUCES

Clip Unclip+®

PPE DISTRIBUTION SYSTEM

The launch of our brand new Mobile and Wall-Mounted CLIP-UNCLIP-PLUS PPE Distribution Systems.

Configure the systems for daily care and instantly customize your configuration for IPAC conditions on a daily basis.

Dynamic, Ergonomic, Ecological and Instantly Scalable to Infinity!

Where Infection Prevention and Control is COMBINED with Hygiene and Sanitation!

To find out more, visit our website at

www.medicacces.ca

Made in Canada

Fast + Effective

A Fast and Effective Equipment Washer...

Medco Equipment, Inc.'s multipurpose portable equipment washer provides dramatic bacteria reduction. Independent lab tests have documented an impressive 99.9% reduction in bacteria ***after one wash***! This machine washes and sanitizes two wheelchairs in five minutes. It also cleans commode chairs, shower chairs, walkers, carts, window screens etc. **2,000 customers worldwide are now sanitizing more than 3.4 million wheelchairs yearly!** Free 30 day trial and delivery. Rent, lease-purchase or purchase. It's a portable dishwasher for wheelchairs and equipment! All stainless steel. CE.UL and CUL listed, 5 year wall to wall warranty. Seven day delivery.

Medco® EQUIPMENT

For more information call (800) 717-3626 or visit
www.medcoequipment.com

STEVENS
Inspired by the care you deliver

distributors of

MEIKO The clean solution · Diversey · GOJO · Metrex · Medicom · PARKER

www.stevens.ca

Eastern Canada	Québec	Ontario	Manitoba	Midwestern Canada	British Columbia
1-800-565-0765	1-855-660-7750	1-800-268-0184	1-800-665-0368	1-800-665-0368	1-800-565-8444
ACCS@stevens.ca	QCSAC@stevens.ca	ONCS@stevens.ca	MWCS@stevens.ca	MWCS@stevens.ca	BCCS@stevens.ca

Together, we do amazing things every day

We're leaders in our work. We support patients, their families, staff, physicians and volunteers across the continuum of care.

Our Infection Prevention and Control program is one of a kind. With province-wide surveillance, hand hygiene initiatives, medical device reprocessing quality reviews, and various education and best practice resources, we work collaboratively to integrate IPC principles into all aspects of patient care.

Learn more at ahs.ca/ipc.

Alberta Health Services

Infection Prevention & Control

Healthy Albertans.
Healthy Communities.
Together.

Canada's Top 100 Employers 2018

Alberta's TOP 70 EMPLOYERS 2017

Canada's Top Employers for Young People 2018

For more information or to order,
please visit
www.GloGerm.com or
Call 435-259-5931

How effective are your hand hygiene protocols?

Let Glo Germ show you.

Our Commitment

For 30 years, you've trusted us. To use quality ingredients and our best science. To help keep you, your staff, and your patients healthy. Today, people are turning to the PURELL® brand more than ever. We've doubled production already, delivering one billion uses of hand sanitizer each week to those on the front line. And we won't stop until you have the product you need. So you can continue to care for those who depend on you.

Stay Well. Be Well.

Purell®

Learn More at PURELL.ca

ENHANCE YOUR FACILITY WITH **STERAMIST®** DISINFECTION

ADVANCED DISINFECTION **AGAINST THE CORONAVIRUS PANDEMIC**

In the effort to protect your facility against the ongoing SARS-CoV-2 pandemic, **SteraMist® disinfection technology can help you protect staff, patients, and visitors.** With the power of SteraMist® technology, you receive:

- A portable, easy-to-use technology to integrate into existing protocols.
- Superior material compatibility for any surface, including sensitive electronics.
- Quick application and no toxic byproducts to help increase room turnover.

HEALTH CANADA **APPROVED**

DIN No. 02469448

DISCOVER THE POWER OF **STERAMIST®** TECHNOLOGY TODAY

TOMI ENVIRONMENTAL SOLUTIONS | STERAMIST POWERED BY BINARY IONIZATION TECHNOLOGY®

TOMIMIST.COM | 800.525.1698

EDITOR
Victoria Williams, BSc, BASc, MPH, CIC
Infection Prevention and Control Coordinator
Sunnybrook Health Sciences Centre
2075 Bayview Ave., Toronto, ON M4N 3M5
Tel: 416-480-6100 x 7970 Fax: 416-480-6845
editor-in-chief@ipac-canada.org

ASSOCIATE EDITOR
Devon Metcalf, MSc, PhD, CIC
Infection Prevention and Control Specialist
Public Health Ontario
350 Conestoga Blvd., Unit B4B, Cambridge, ON N1R 7L7
Tel: 226-314-2127 Fax: 519-624-6212
associate-editor@ipac-canada.org

POSTING EMPLOYMENT OPPORTUNITIES/OTHER INFORMATION
IPAC Canada Membership Services Office
info@ipac-canada.org

PUBLISHER
Craig Kelman & Associates

3rd Floor, 2020 Portage Avenue, Winnipeg, MB R3J 0K4
Tel: (204) 985-9780 Fax: (204) 985-9795
www.kelman.ca E-mail: info@kelman.ca

EDITOR - Reba R. Lewis
DESIGN/PRODUCTION - Kristy Unrau
MARKETING MANAGER - Al Whalen
ADVERTISING COORDINATOR - Stefanie Hagidiakow

Send change of address to:
IPAC Canada
P.O. Box 46125, RPO Westdale,
Winnipeg, MB R3R 3S3
info@ipac-canada.org

Publications Mail Agreement #**40065075**
Return undeliverable Canadian addresses to: lauren@kelman.ca

SUBSCRIPTIONS
Subscriptions are available from the publisher at the following rates: All Canadian prices include GST.
Prices are listed as personal/institutional.
Canada: $30/$38 (GST # 100761253); USA (in US funds): $28/$36;
Other countries: $45/$60.

Subscriptions do not include online access to the journal. Members have online access to the current issue.

VISION
No preventable infections for Canadians. Ever.

MISSION
We inspire, nurture and advance a culture committed to infection prevention and control.

IPAC CANADA is now on YOUTUBE, FACEBOOK, TWITTER and LINKED IN

WINTER 2020-2021

VOLUME 35
NUMBER 4

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

FEATURES

The *Canadian Journal of Infection Control* is the official publication of Infection Prevention and Control Canada (IPAC Canada). The Journal is published four times a year by Craig Kelman & Associates, Ltd. and is printed in Canada on recycled paper. Circulation: 3,000.

Advertising or products and services in the *Canadian Journal of Infection Control* do not imply endorsement by IPAC Canada.

ISSN 1183-5702

Indexed/abstracted by the Cumulative Index to Nursing and Allied Health Literature (CINAHL)/EBSCO, SilverPlatter Information, Inc. and CrossRef.

The *Canadian Journal of Infection Control* is a Canadian periodical as defined by section 19 of the Canadian Income Tax Act. The deduction of advertising costs for advertising in this periodical is therefore not restricted.

www.ipac-canada.org

IPAC CANADA
2020 - 2021 Board of Directors

Executive Officers

President
Barbara Catt, RN, BScN, MEd, CIC
IPAC Manager, Congregate Settings
Scarborough Health Network,
Scarborough, Ontario
president@ipac-canada.org

President-elect
Zahir Hirji, BScN, MHS, CIC,
Manager, Risk Management/Patient Safety
Scarborough and Rouge Hospital
2867 Ellesmere Road
Scarborough, ON M1E 4B9

Secretary
Jennifer Happe, BSc, MSc
Infection Control Professional
Alberta Health Services
3942 50 A Avenue, Red Deer, AB T4N 6R2

Treasurer
Michael Rotstein, RN, BScN, MHSc, CIC, CHE
Client Services Director
Closing the Gap Healthcare
2810 Matheson Blvd E, Ste 100
Mississauga ON L4W 4X7

Directors

Kim Allain, BScN, RN, MHS, CIC
Quality Improvement and IPAC Safety Lead
Nova Scotia Health Authority
902 Bethune Bldg, 1276 South Park Street
Halifax, NS B3H 2Y9

Madeleine Ashcroft, RN, BScN, MHS, CIC
Infection Control Specialist
Public Health Ontario
300-480 University Avenue
Toronto, ON M5G 1V2

Stefania Cloutier, BES, BASc, CIPHI(C), CIC
Infection Control Professional
Halton Healthcare - Georgetown Hospital
1 Princess Anne Drive
Georgetown ON L7G 2B8

Joseph Kim, MD, FRCPC
Infectious Disease Consultant
Alberta Health Services
7007 14 Street SW
Calgary, AB T2V 1P9

Baljinder Sidhu, RN, BScN, CIC, MPH
Manager, Population and Public Health
Fraser Health Authority
205 17700-56 Avenue
Surrey BC V3S 1C7

Public Representative
Stephen Palmer
79 Amberview Drive
Keswick, ON L4P 3Y3

Other Positions

Editor-in-Chief – Canadian Journal of Infection Control
Victoria Williams, BSc, BASc, MPH, CIC
editor-in-chief@ipac-canada.org

Associate Editor
Devon Metcalf, MSc, PhD, CIC
associate-editor@ipac-canada.org

Web Communications Manager
Tanya Denich, MSc, CIC
webcommunications@ipac-canada.org

Webmaster
Pamela Chalmers
webmaster@ipac-canada.org

Online Novice IP&C Course Coordinators
Heather Candon, BSc, MSc, CIC
basicde@ipac-canada.org

Jane Van Toen, MLT, BSc, CIC
basicde@ipac-canada.org

Social Media Manager
Kelsey Houston, BScH, MPH
socialmedia@ipac-canada.org

Professional Agents

Legal Counsel
Terrance Carter/Theresa Man
Carters Professional Corporation
211 Broadway, Orangeville, ON L9W 1K4

Auditor
Philip Romaniuk, CPA, CA
Grant Thornton LLP
94 Commerce Drive
Winnipeg, MB R3P 0Z3

Membership Services Office

Executive Director
Gerry Hansen, BA
PO Box 46125 RPO Westdale,
Winnipeg, MB R3R 3S3
Phone: 204-897-5990/866-999-7111
Fax: 204-895-9595
executivedirector@ipac-canada.org

Deliveries only:
67 Bergman Crescent, Winnipeg, MB R3R 1Y9

Administrative Assistant
Kelli Wagner
Phone: 204-488-5027 Fax: 204-488-5028
Toll-Free: 1-855-488-5027
admin@ipac-canada.org

General Information
info@ipac-canada.org

Return to TABLE OF CONTENTS

Welcome

New Editor-in-Chief

The Board of Directors of IPAC Canada welcomes **James Ayukekbong, PhD, CIC** as Editor-in-Chief, *Canadian Journal of Infection Control*.

ipac Infection Prevention and Control Canada

pci Prévention et contrôle des infections Canada

Dr. Ayukekbong holds a PhD in Medical Science/Epidemiology and Certification in Infection Prevention and Control (CIC®). He is an active member of IPAC Canada and IPAC Northeastern Ontario. To date, he has published 20 peer-reviewed articles, including commissioned reviews and editorials.

Dr. Ayukekbong serves as the Vice President of Infection Prevention and Control at Southbridge Care Homes in Ontario. We welcome Dr. Ayukekbong to his new role with IPAC Canada.

The Board of Directors gives its most profuse thanks to outgoing Editor-in-Chief, Victoria Williams. Her service to IPAC Canada and CJIC has been tireless.

We also wish to thank Devon Metcalf for her continued contributions in her role as Associate Editor.

Return to TABLE OF CONTENTS

Diversey™

Difficult Times Demand These Ideal Disinfection Solutions

Oxivir® Tb Wipes

Daily Disinfection Is Key To Infection Prevention

Bactericidal • Virucidal 1 min

powered by ACCELERATED HYDROGEN PEROXIDE

One-step, one-wipe, one-minute cleaning and disinfection of hard surfaces. The active ingredient breaks down into oxygen and water after use. Gentle on people and assets.

MoonBeam™3

Kills SARS-Cov-2 In Seconds*

Bactericidal • Virucidal 3 min

Disinfection assurance is more important than ever. MoonBeam optimizes UV-C disinfection with three individually adjustable light arms that angle the UV light dose directly to high-touch surfaces.

* Based on third-party testing

Take infection prevention to a new level. Learn more at **sdfhc.com**

The COVID-19 Saga: Lessons for the Future

James A. Ayukekbong

Corresponding author:

Dr. James A. Ayukekbong, Editor-in-Chief, Canadian Journal of Infection Control (CJIC)

EDITORIAL

The severity and impact of the current coronavirus disease (COVID-19) pandemic highlights the need for public health mechanisms to prevent further escalation or future outbreaks. SARS-CoV-2, causative agent of COVID-19, is the third epidemic coronavirus to emerge in the human population in the past two decades. Severe acute respiratory syndrome coronavirus (SARS-CoV-1) occurred in 2002, which reportedly infected 8,098 people and caused 774 deaths worldwide. Ten years later, the Middle East respiratory syndrome coronavirus (MERS-CoV) emerged, causing a total of 2,564 infections, and 881 fatalities as of December 2020 [1]. The current SARS-CoV-2 has resulted in over 95 million cases and 2 million deaths worldwide as of January 17, 2021. Initially, the importation of cases through international travel of infected individuals to uninfected countries was the main cause of the expansion of the pandemic, which has caused unprecedented economic and social impact, ranging from travel restrictions, business closures, and a complete shutdown of social activities. After about one year into the pandemic, it is essential to reflect on the gaps and challenges in response and measures to prevent future outbreaks.

First, there was an apparent delay in recognizing the epidemic as a public health emergency of international concern. It took one month from the time the Chinese government notified the World Health Organization (WHO) about the epidemic on January 3, 2020 to when the WHO declared it a public health emergency of international concern on January 30, and later on March 11, 2020 it was declared a pandemic [2]. Time is obviously of the essence, and if this could be considered in future epidemics of similar magnitude, most countries would institute mechanisms in a timely manner to mitigate the risk of importation or transmission. For example, travel bans or flight restriction from impacted regions.

Second, there was also a delay by some countries in taking swift measures. In the most initially impacted countries of the world such as the United States, Italy, Spain, and France, there was an apparent delay in instituting mandatory lockdowns and maintaining social distancing [3]. For example, the decision to lockdown Northern Italy was leaked before being approved and the population started to escape from the North to the South. In some parts of Italy, soccer matches with a huge number of spectators were ongoing during the COVID-19 outbreak and this may have impacted the spread of the disease within the country. Other countries, especially those in Africa, were caught up in the misconception that Africans may be genetically resistant to coronaviruses, or that the virus does not survive in warmer, more humid climates. All these factors delayed public health response efforts. In addition, there were also gaps in contact tracing and enforcing self-isolation for those who had been involved in recent international travels.

Third, the risk of healthcare transmission was not seriously considered. Although COVID-19 transmission occurs within the community, healthcare-associated transmission was the main driver of spread in the first wave in highly impacted countries like Italy. There was a prompt need for healthcare workers to be tested, and for those who tested positive to be restricted from work and asked to self-isolate while asymptomatic personnel would wear appropriate PPE (e.g., universal mask and face shield) at work. Furthermore, each healthcare establishment should have an Infection Prevention and Control (IPAC) program with a dedicated and trained team, with at least one trained IPAC focal person. The basic component of such a program must include hand hygiene, appropriate PPE donning/doffing, staff education and retraining, surveillance, outbreak investigation and management, transmission-based precautions, environmental cleaning and disinfection, audits and continuous quality improvement activities related to infection rates and IPAC activities.

In order to prevent further escalation of the current pandemic and prevent future outbreaks, the following considerations are essential: Research for vaccines and therapeutics against coronaviruses must be expanded with focus on protein structures in the virus that are comparatively stable in order to protect from novel and emerging viral strains of pandemic potential [4].

Strengthening of national laboratory systems for early detection of emerging pathogens along with zoonotic disease surveillance. Land use activities such as deforestation and farming bring humans and wild animals in close contact and disrupt habitats, thereby providing opportunities for diseases to spill over. Therefore, there is need for a comprehensive

Conflict of interest: None

investigation of animal reservoirs, mapping of the value chains and networks, and assessing human behaviours that predispose to zoonotic diseases. Also, there is need to improve local capacity and strengthening of the local workforce through a one health approach – that recognizes that the health of people is closely connected to the health of animals and our shared environment.

The COVID-19 pandemic has exposed the weaknesses of the health system in many countries of the world. Therefore, the need for proactive measures to improve health systems and surge capacity (e.g., ventilators, Personal Protective Equipment, etc.) cannot be overemphasized. Scaling up of preparedness plans prior to the onset of a public health emergency should be a priority for every country. For example, the absence or shortage of mechanical ventilators to support COVID-19 patients with breathing difficulties could severely impact the prognosis of the disease.

Despite the proactive preparedness measures, outbreaks may still be inevitable, therefore, measures to effectively respond must be in place. The first consideration in the control of all future epidemics will be timely identifying and mapping out the epicentre of the outbreak and multi-sectoral interventions to prevent or control the spread from the source. For example, travel restrictions to prevent exportation of cases out of the epicentre, or importation to outbreak-free regions.

As soon as an epidemic of pandemic potential is declared, a national state of emergency has to be instituted, and an intersectoral collaboration to enforce social distancing, contact tracing, mass screening, self-isolation and quarantine should be a priority [2].

Considering the long incubation period of coronaviruses (1-14 days) and high rate of asymptomatic infections, wearing of masks by the population is a key source control measure in preventing asymptomatic people from spreading droplets. On the other hand, healthcare providers must wear medical masks during routine patient care and N95 when performing aerosol-generating medical procedures to mitigate the risk of healthcare transmission. Elective procedures should be avoided, and the population should be advised to stay at home and only come to the hospital for critical care needs. This will reduce the depletion of PPE, minimize the overwhelming of the health system, thereby reducing hospital transmission. It has also been shown that SARS-CoV-2 can persist in the air for hours, or on different environmental surfaces for days [5]. Therefore, regular cleaning and disinfection is essential to prevent transmission and the immediate transfer of non-COVID-19 patients into rooms previously occupied by COVID-19 patients should be avoided. The use of UV-C disinfection, air purification technologies and HVAC system enhancement may be relevant in creating a safer environment of care.

Finally, it is important to mention that the most devasted pandemic in history was the Spanish flu of 1918 that lasted for two years, in three waves with 500 million people infected and 50 million deaths. Most of the fatalities occurred in the second wave because the population was tired of self-isolation, quarantine and social distancing measures that when they were first lifted, people jumped out in the streets giving way to the second wave that resulted in tens of millions of deaths. A similar trend is being observed in the current COVID-19 pandemic. Fortunately, one year into the pandemic, vaccine candidates are being used to vaccinate vulnerable and high-risk populations with the ultimate goal of slowing further spread of the virus and reducing fatalities.

Together, the trend of novel coronavirus emergence suggests that coronaviruses will continue to emerge periodically, inducing serious infectious diseases of huge global health impact. The recognition of animals (e.g., bats, camels, snakes, rodents, etc.) as the natural reservoirs for coronaviruses should necessitate intersectoral (one health) targeted surveillance in these animals and in high-risk populations. The world needs a global response system for outbreaks, as an outbreak anywhere is a risk everywhere.

REFERENCES

1. Ayukekbong J, Ntemgwa M, Ayukekbong S, et al. COVID-19 compared to other epidemic coronavirus diseases and the flu. World J Clin Infect Dis 2020:10;1-13
2. Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Biomed*. 2020. 19;91(1):157-160. doi: 10.23750/abm.v91i1.9397. PMID: 32191675; PMCID: PMC7569573.
3. Giugliano, F. (2020, March 23). The lessons from Italy's COVID-19 mistakes. *Bloomberg Opinion*. Available via https://www.bloomberg.com/opinion/articles/2020-03-23/italy-s-covid-19-trial-and-error-and-lessons-for-france-and-u-k (Accessed 17 May 2020).
4. Haynes Barton F. A New Vaccine to Battle COVID-19. *N Engl J Med* 2020. DOI: 10.1056/NEJMe2035557.
5. Van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *New Engl J Med* 2020; https://doi. org/10.1056/NEJMc2004973.

Conflict of interest: None

POSITION STATEMENT: Reprocessing of Critical and Semi-Critical Devices in Community Healthcare Settings

This position statement was developed by the Reprocessing Interest Group and has been reviewed by the Community Healthcare Interest Group
Chair: Vi Burton/Karrie Yausie
Principal Authors: Clare Barry, Cara Wilkie, Anne Augustin, Brenda Dewar, Donna Perron, Fiona Mattrasingh, Nicki Gill, Merlee Steele Rodway, Andrea Neil

Publication Date
Original: 2019 November

BACKGROUND

Reprocessing of critical and semi-critical medical equipment/devices [1] in community healthcare settings, when not performed according to current standards [2], has been linked with healthcare-associated infections and outbreaks [3-15]. The purpose of this document is to provide infection prevention and control (IPAC) recommendations for the management and reprocessing of critical and semi-critical medical equipment/devices used in community healthcare settings so that consistent reprocessing standards are applied in all healthcare settings. This includes cleaning, disinfection, sterilization, and storage. This position statement does not address the cleaning and disinfection of endoscopes.

POSITION STATEMENT

1. **Clients expect and require safe care regardless of where the procedure is performed and standards of reprocessing shall be met in any setting where it is carried out.**

2. **All employers and healthcare providers are responsible for:**
- Adhering to best practices and standards for reprocessing when using any semi-critical and critical equipment/devices during provision of care [2,16].
- Complying with standards for transportation and storage of reprocessed medical equipment/devices and *Transportation of Dangerous Goods Act* requirements on transportation of soiled equipment/devices [2, 17-19, 20].
- Having written procedures based on current standards [2,19].
- Ensuring individuals who clean, disinfect or sterilize reusable medical equipment/devices are educated, trained, and have competency assessments to meet the national and provincial guidelines. This training shall be documented and reviewed yearly and when there are updates [2,16,18].
- As a minimum, have sufficient medical equipment/devices/kits available to accommodate daily client needs.
- Having a documented process for recall of medical equipment/devices in the event of reprocessing failure [2].
- Follow IPAC and Occupational Health and Safety guidelines, such as Routine Practices and Additional Precautions, personal protective equipment, safe sharps management, hand hygiene, disposal of high-level disinfectants (HLD), and procedures for staff exposures that occur during reprocessing [2].

3. Reprocessing critical and semi-critical medical equipment/devices (including loaned, leased or borrowed medical equipment/ devices) shall be in accordance with Spaulding's classification [1], meet manufacturers' instructions for use (MIFU) and current national guidelines (i.e., Canadian Standards Association (CSA) [2], the Public Health Agency of Canada [PHAC/Health Canada]), and provincial standards [17,21], including specialized staffing, auditing [22], and dedicated space). If there is a disagreement between the MIFU and published guidelines, the more stringent level shall be used [2].

Conflict of interest: None

4. Prior to purchasing medical equipment/devices:
- The employer and healthcare provider shall determine that the recommended reprocessing methods, as validated by the manufacturer, meet current recommended standards and the reprocessing methods can be met by those responsible for reprocessing.
- The employer and healthcare provider shall determine if it can be cleaned/reprocessed according to MIFU. Items that cannot be cleaned/reprocessed according to the MIFU shall not be purchased. If already purchased, the item shall be replaced or be designated single-use.

5. Medical equipment/devices that are labelled as single-use by the manufacturer have not been validated to be reprocessed, therefore, these devices shall be disposed of after use. All needles and all syringes are single-use only and shall be discarded after one use [2,16,17].

6. Critical and semi-critical medical equipment/devices labelled as single use must not be reprocessed and reused unless the reprocessing is done by a licensed reprocessor. There are reprocessors in the USA licensed by the United States Food and Drug Administration [2], but none are currently based in Canada. Third party reprocessors must also be licensed in Canada [23].

7. "Non-critical and semi-critical medical equipment/devices that are owned by the client; re-used by that client and used only by that client in their home; and not used for another purpose, do not require disinfection between uses, provided that they are adequately cleaned and stored dry between uses [16]." Examples include respiratory equipment and lancet holding devices.

8. All semi-critical equipment/devices that can be sterilized, will be sterilized according to the MIFU. If a semi-critical device cannot be sterilized, then it shall, at a minimum, be high-level disinfected according to the MIFU between patient uses [2] (e.g., trans-vaginal probe).

   Note: In some jurisdictions (e.g., Ontario), high-level disinfection is not permitted in dentistry. Semi-critical reusable dental instruments that contact the mucous membranes or non-intact skin (e.g., mouth mirrors, amalgam condensers, reusable impression trays, handpieces,) shall be cleaned followed by sterilization [24].

9. The use of liquid chemicals for sterilization of instruments is not recommended for critical medical equipment/devices that are used for sterile procedures due to the limitations in maintaining sterility to point of use. "Devices cannot be wrapped or adequately contained during processing in a liquid chemical sterilant to maintain sterility following processing and during storage [19]."

10. Immediate-Use Steam Sterilization (IUSS, formerly referred to as flash sterilization) is not recommended, except where there is an urgent, unplanned need, with no other options available.

11. Glass bead sterilizer, microwave oven, boiling, chemiclave, and ultraviolet irradiation are unacceptable as means of sterilization [16].

Option 1: Use single-use disposable equipment/devices and discard after use [2,19].

Option 2: Reusable critical and semi-critical medical equipment/devices reprocessed using the contracted services of a Medical Device Reprocessing Department (MDRD) such as a hospital or private service-provider. The employer and healthcare provider are responsible to verify the MDRD meets current CSA standards (e.g., sterilization verification documents provided upon request, and documentation to demonstrate reprocessor technician training) [2]. Accreditation Canada states:

"Preferably, medical device reprocessing (MDR) is done through a centralized system that provides reprocessing services to multiple areas within the organization. From a safety and cost-effectiveness perspective, centralizing reprocessing services is preferred to replicating them in several areas of the organization. If reprocessing services are decentralized, they are held to the same standards as the MDR department [18]."

Option 3: The healthcare provider and/or organization chooses to reprocess reusable equipment/devices themselves. The current pertinent CSA standards shall be followed for reprocessing practices. If there is sufficient capacity to reprocess the critical and semi-critical medical equipment/devices to meet current CSA standards, then the reprocessing may occur on the site.

In addition to #1-11 above, the employer and healthcare provider must follow quality assurance recommendations:
- Monitor and document physical, chemical and biological indicators, for all sterilizers following MIFU [2].
- Monitor and document high-level disinfectants (e.g., minimum effective concentration, date of dilution/replacement, contact time) following the MIFU.
- Incorporate a preventative maintenance schedule according to medical equipment/device MIFUs.

STAKEHOLDERS

All employers and healthcare providers (HCPs) in community settings include, but are not limited to, client homes in which healthcare is provided, ambulatory clinics, physicians, and other healthcare practitioners' offices, outreach settings, and other community settings where reusable medical equipment is used. Also, healthcare organizations and policymakers whose patients receive care in the same community and which could play a role in facilitating their community partners to meet the applicable standards

GLOSSARY/DEFINITIONS

Capacity: Employer and healthcare provider has sufficient resources (e.g. financial, equipment, space, personnel) to verify they meet all the current national reprocessing guidelines: CSA, the Public Health Agency of Canada (PHAC/Health Canada).

Client: Includes patient, resident, or any other person who receives treatment.

Community healthcare setting: (Adapted from CSA [2]): Any location outside of an acute care hospital where healthcare is provided, which includes (but is not limited to):

- client homes in which healthcare is provided
- medical clinics or the clinics/offices of other healthcare providers (with or without treatment spaces/overnight stays);
- laser eye clinics;
- outpatient and other office surgical facilities;
- dental general and surgical facilities;
- standalone laboratory facilities and diagnostic imaging centres;
- nursing homes, long-term care facilities, assisted living facilities;
- mental health facilities;
- group homes;
- hospice care facilities;
- stand-alone dialysis clinics; and
- public health clinics.

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 microorganisms, including bacterial spores. Reprocessing critical equipment/devices involves meticulous cleaning followed by sterilization [1].

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

High-Level Disinfection (HLD): The level of disinfection required when processing semi-critical medical equipment/devices. A process capable of killing vegetative bacteria, mycobacteria (including *Mycobacterium tuberculosis*, fungi, and lipid and non-lipid viruses), as well as some, but not necessarily high numbers of, bacterial spores [2].

Immediate-use steam sterilization (IUSS) (formerly referred to as flash): The shortest possible time between a sterilized item's removal from the sterilizer and its aseptic transfer to the sterile field. Immediacy implies that a sterilized item is used during the procedure for which it was sterilized and in a manner that minimizes its exposure to air and other environmental contaminants. A sterilized item intended for immediate use is not stored for future use, nor held from one case to another. Immediacy, rather than being defined according to a specific time frame, is established through the critical analysis and expert collaboration of the healthcare team [2].

Loaned Equipment: Medical equipment/devices used in more than one facility, including borrowed, shared or consigned equipment/devices, which are used on patients/clients/residents. Reprocessing is carried out at both loaning and receiving sites. Loaned equipment may also be manufacturer-owned and loaned to multiple healthcare facilities [2].

Limited Capacity: Employer and healthcare providers have insufficient resources (including space, personnel, financial, equipment) to meet all the current national reprocessing guidelines CSA, the PHAC/Health Canada. If these minimum standards cannot be met, single-use disposable items, or a centralized Medical Device Reprocessing Center should be used.

Manufacturer's Instructions for use (MIFU): The written instructions for use provided by the manufacturer or distributor of a product, which contain the necessary information for the safe and effective use of the product [7].

Medical Device Reprocessing Department (MDRD): Any reprocessing area/department whose sole industry is reprocessing of medical devices [2].

Minimum effective concentration (MEC): The lowest concentration of the active ingredient(s) in a disinfectant solution at which the product is still effective.

Semi-Critical Medical Equipment/Device: Medical equipment/device that comes in contact with non-intact skin or mucous membranes, but ordinarily does not penetrate them (e.g., respiratory therapy equipment, transrectal probes, and specula).

Single-use/Disposable: Medical equipment/devices designated by the manufacturer for single-use only. Single-use equipment/devices shall not be reprocessed.

Single patient use: Medical equipment/devices that may be used on a single client and may be reused on the same client, but may not be used on other clients.

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

As per the Canadian Standard Association (CSA) [2]:
"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.

CROSS REFERENCES

- Cleaning and Disinfection of Non-critical Multi-use Equipment and Devices in Community Settings. IPAC Canada. 2018. Available from https://ipac-canada.org/photos/custom/Members/pdf/17Jan_Cleaning%20NonCrit%20Equip%20Comm%20Position%20Statement_revised_Jan2018_final.pdf
- Reprocessing of Critical Foot Care Devices. IPAC Canada. 2019. Available from https://ipac-canada.org/photos/custom/Members/pdf/Position%20Statement%20%20_ReprocessingCriticalFootCare_RevisedJuly2019.pdf

REFERENCES

1. Spaulding EH. The role of chemical disinfection in the prevention of nosocomial infections. In: PS Brachman and TC Eickof (Ed). Proceedings of International Conference on Nosocomial Infections, 1970. Chicago, IL: American Hospital Associations; 1971:254-74.
2. Canadian Standards Association. CAN/CSA-Z314-18 Canadian medical device reprocessing. Rexdale, ON: Canadian Standards Association; February 2018.
3. Center for Disease Control and Prevention. Healthcare-Associated Hepatitis B and C Outbreaks (≥ 2 cases) Reported to the Centers for Disease Control and Prevention (CDC) 2008-2017. Retrieved from https://www.cdc.gov/hepatitis/outbreaks/healthcarehepoutbreaktable.htm
4. Simcoe Muskoka District Health Unit. 2018. Retrieved from http://www.simcoemuskokahealth.org/HealthUnit/About/Newsroom/NewsRelease/Details/2018/06/19/Update-on-IPAC-investigation-related-to-Orillia-dental-clinic-Continued-recommendation-for-possible-testing
5. Wellington Dufferin Guelph Public Health, 2018. Retrieved from https://www.wdgpublichealth.ca/sites/default/files/file-attachments/ticket/may_23_2018_initial_report_ipac_lapse_posting_drs_ayanbadejo_and_donovan.pdf
6. Thunder Bay District Health Unit, 2018. Retrieved from https://www.tbdhu.com/sites/default/files/files/resource/2018-03/IPAC%20Initial%20Lapse%20Report%20-%20Natural%20Health%20Chiropractic%20-%20March%2022%2C%202018%20-%20Initial%20Report.pdf
7. Ottawa Public Health, 2018. Retrieved from http://www.ottawapublichealth.ca/en/reports-research-and-statistics/resources/Documents/ipacreport_robillardhearing_20170323_en.pdf
8. Region of Peel, 2018.Retrieved from http://www.peelregion.ca/health/infectioncontrol/pdf/IPAC-lapse-transparency-report.pdf.
9. Alberta Health Services, 2016. Retrieved from https://www.albertahealthservices.ca/news/Page13309.aspx.
10. B. Kung, J. Medical device reprocessing (MDR) in Alberta medical clinics: Patient safety risk warrants regulatory oversight. (2016). *Journal of Infectious Diseases & Therapeutics*, 4,8 (Suppl).
11. Horizon Health Network, 2013. Retrieved from http://en.horizonnb.ca/home/media-centre/horizon-news/horizon-discloses-low-risk-patient-safety-issue.aspx
12. Centre intégré de santé et de services sociaux (CISSS) de la Côte-Nord, 2018. Retrieved from http://www.cisss-cotenord.gouv.qc.ca/fileadmin/documents/Documentation/Communiques_de_presse/2018/2018-04-25_-_Communique_de_presse_-_Rappel_en_ORL-angl.pdf
13. Wise ME, Bancroft E, Clement EJ, et al. (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.
14. FDA. Reprocessing of medical devices; 2018 Mar. Related: Infections associated with reprocessed duodenoscopes; 2018. Retrieved from https://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ReprocessingofReusableMedicalDevices/ucm454630.htm
15. CDC. HAN advisory: Immediate Need for Healthcare Facilities to Review Procedures for Cleaning, Disinfecting, and Sterilizing Reusable Medical Devices; 2015 Sep. Retrieved from https://emergency.cdc.gov/han/han00382.asp
16. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Provincial Infectious Diseases Advisory Committee. Best practices for cleaning, disinfection and sterilization of medical equipment/devices. 3rd ed. Toronto, ON: Queen's Printer for Ontario; May 2013, Retrieved from http://www.publichealthontario.ca/en/eRepository/PIDAC_Cleaning_Disinfection_and_Sterilization_2013.pdf
17. Ontario Agency for Health Protection and Promotion (Public Health Ontario), Provincial Infectious Diseases Advisory Committee. Infection Prevention and Control for Clinical Office Practice. 1st Revision. Toronto, ON: Queen's Printer for Ontario; April 2015. Retrieved from http://www.publichealthontario.ca/en/eRepository/IPAC_Clinical_Office_Practice_2013.pdf
18. Accreditation Canada: Standards: Reprocessing of Reusable Medical Devices. January, 2017 Accreditation Canada, page 2. Retrieved from https://accreditation.ca/standards/
19. Centers for Disease Control (CDC). Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. Retrieved from https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html
20. Transportation of Dangerous Goods Act, 1992, S.C. 1992, c. 34
21. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Recommendations for education, training and certification for reprocessing in clinical office settings; 2016. Retrieved from https://www.publichealthontario.ca/en/eRepository/Recommendations_Certification_Clinical_Office_Settings.pdf
22. IPAC-Canada Audit Toolkit. Central reprocessing departments. 2016. Retrieved from https://ipac-canada.org/audit-toolkit-new-users.php.
23. Health Canada. Update: Notice to Stakeholders - Health Canada's Regulatory Approach to Commercial Reprocessing of Medical Devices Originally Labelled for Single Use (File number: 16-105050-455). 2016 May 4. Retrieved from https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/activities/announcements/update-notice-stakeholders-regulatory-approach-commercial-reprocessing-medical-devices-originally-labelled-single-use.html
24. Royal College of Dental Surgeons of Ontario, Standard of Practice: Infection Prevention and Control in the Dental Office. November 2018. Retrieved from https://az184419.vo.msecnd.net/rcdso/pdf/standards-of-practice/RCDSO_Standard_of_Practice_IPAC.pdf

ORIGINAL ARTICLE

The Cost of Contact Precautions: A Systematic Analysis

Anuj Sharma MA[1], Jenine Leal PhD[2,3,4], Joseph Kim MD[2], Craig Pearce MSc[2], Dylan R. Pillai MD, PhD[5], Aidan Hollis PhD[1]

[1]*Department of Economics, University of Calgary, Calgary, Alberta, Canada.*
[2]*Infection Prevention and Control, Alberta Health Services, Calgary, Alberta, Canada*
[3]*Departments of Community Health Sciences and Microbiology, Immunology and Infectious Diseases, University of Calgary, Calgary, Alberta, Canada*
[4]*O'Brien Institute for Public Health, University of Calgary, Calgary, Alberta, Canada*
[5]*Departments of Pathology & Laboratory Medicine, Medicine, and Microbiology & Infectious Diseases, University of Calgary, Calgary, Alberta, Canada*

Corresponding Author:

Aidan Hollis, Department of Economics, University of Calgary, Calgary, Alberta, Canada
Tel: 1-403-220-5861 | Email: ahollis@ucalgary.ca

ABSTRACT

Background: There is a need for robust estimates of per hour cost of contact precautions in hospitals. Our study aims to formulate and apply a methodology for estimating this cost.

Methods: A formula was established with components including patient room entries by Healthcare Worker (HCW), proportion of entries by HCW categories, time taken to don and doff Personal Protective Equipment (PPE), price of PPE, and HCW employment cost. A literature review for the period 2000-2020 was conducted to estimate room entries per hour; we applied proportion of room entries reported in literature; a local study was used for estimating time taken to don and doff gown and gloves; the price of PPE was provided by Alberta Health Services; and employment cost was captured from public sources.

Results: Results of the literature review suggest an average 4.35 entries per hour by HCW and most entries were made by nurses. The local study data suggested that on average it took 85 seconds in total for HCW to don and doff PPE. Using all the components of the formula, the total cost per hour per patient associated with additional PPE was estimated to be C$8.95 (US$6.82).

Conclusion: A simple framework for estimating hourly costs of contact precautions was presented. Although the hourly cost was modest, the implications are significant when considering annual number of patient-hours of contact precautions.

KEYWORDS

Contact precautions, PPE, cost

INTRODUCTION

With the recent development of many rapid diagnostic tests for infection, hospitals are facing challenging questions about which ones to implement [1,2]. One potential benefit of rapid tests is allowing the early discontinuation of contact precautions where appropriate. Contact precautions are used in hospitals with an aim to reduce the transmission of pathogens, including antibiotic-resistant organisms [3]. While shown to be effective in limiting pathogen transmission in hospital settings, implementing contact precautions can also add cost burden related to additional use of personal protective equipment (PPE) and designated isolation rooms [4-6]. Most studies on costs associated with PPE for any contact precautions have used a random average or proxy for number of room entries to determine the number of PPE used per isolation day/hour [6-10]. Contact precautions require little PPE, with patients on droplet or airborne precautions needing additional (and more costly) PPE.

The objective of this study was to formulate and apply a methodology for estimating the cost per hour of contact precautions. An accurate estimation of additional costs associated with contact precautions may enable better assessment of the financial benefit from appropriate early discontinuation. The methodology may be extended to address costs of other isolation regimens, such as those required for airborne precautions.

METHODS

In this study, we estimated the time and material cost associated with the use of gowns and gloves for contact precautions. We do not consider other potentially associated costs, such as private accommodation or additional cleaning.

To estimate all costs of keeping a patient on contact precautions, there are multiple components requiring assessment. These can be summarized as $C=E\times(T\times\sum_i F_i W_i+P)$, where E represents the number of room entries per hour, T the time it takes to don and doff gown and gloves, F_i the fraction of each

type of Healthcare Worker (HCW) among all room entries, W_i the hourly employment cost of each type of HCW, and P the price of gown and gloves. We therefore estimate each of these components separately and then calculate the total estimated cost per hour of contact precautions C. All dollar values are shown in 2020 Canadian dollars.

Patient Room Entries (E)

Search strategy and study selection

Literature search strategies (detailed in the Appendix) were each formulated for EMBASE and PubMed abstract databases, and all articles published on or before March 28, 2020 were included. There was no restriction imposed on the language of the articles.

In this literature review, inclusion criterion was defined as all articles that studied HCW or personal visitor entries to isolated patient rooms as compared to non-isolated patient rooms in a hospital. The exclusion criterion was defined as the absence of reported mean room entries for isolated patient rooms.

The study selection procedure was independently performed by two authors (AS and AH) in two phases. Firstly, screening of titles and abstracts were done based on the inclusion criterion. In the second phase, an independent manual review of the full text of these articles was conducted based on the exclusion criterion.

Data extraction and synthesis

The selected studies were utilized to obtain data points independently by two authors (AS and AH). These data points included study designs, reasons for isolation precautions, population characteristics, data collection period, data collection time of the day, type of room entries included, room type, number of patients in isolated and/or non-isolated groups, and mean patient room entries and p-values.

Statistical analysis and estimations

All analysis was performed using Microsoft Excel. Mean number of room entries per hour per patient along with p-values of test of the difference between isolated and non-isolated groups from studies selected in literature review were tabulated.

Time to Don and Doff Gown and Gloves (T)

Local study for time to don and doff PPE at Foothills Medical Centre, Calgary, Canada

The data was originally collected as part of a Quality Improvement (QI) project. The objective of this study was to remove additional precautions for a set of patients (those colonized with Vancomycin-Resistant Enterococci and no other risk factors). Volunteer data collectors were trained by one author (CP) to time and record donning and doffing. They sat at the end of a hallway and, for 1 hour, recorded each time an HCW entered the room. Volunteers collected information on time taken by HCWs to don and doff gown and gloves, not including time for hand hygiene. HCWs were distinguished by their clothing types.

Statistical analysis and estimations

All analysis was performed using Microsoft Excel. Mean time to don and doff gown and gloves from the local study data were calculated and tabulated. Estimated time to don and doff gown and gloves from the local study were compared with a tutorial video posted by Public Health Ontario.

Proportion of Room Entries by HCW from the Literature (F)

For data on the proportion of room entries by HCW, we used articles that reported such proportions from our literature review of patient room entries. We used the average of the proportions from the shortlisted articles.

Mean employment cost of HCW from Open-Source Website (W)

Mean hourly wage rate of HCW categories, including doctors, nurses and housekeeping staff in Canada was abstracted from *https://www.salaryexpert.com*. To calculate employment costs, we grossed up wages to account for non-salary benefits, using the same proportions of salary to non-salary benefits as those shown in Schedule 2 of the 2020 Alberta Health Services Annual report for each category of HCW. This allowed us to calculate the hourly employment costs.

Cost of Gown and Gloves (P)

Cost of gown and gloves used for contact precautions in hospitals was collected from Alberta Health Services. The cost of laundering a gown was $0.42 and cost of purchasing a pair of nitrile gloves was $0.10.

RESULTS

Room Entries: Literature Review

The flow of the literature search selection process was depicted in **Figure 1**. There were 191 literature abstracts found on EMBASE and PubMed. There were seven duplicates found and removed. Out of the remaining 184 articles, 156 were excluded in the first screening of titles and abstracts because they did not meet the inclusion criteria. This left 28 articles for the full-text screening based on the exclusion criterion. Only six out of these publications had relevant results for analysis.

A summary of the studies which had relevant results for analysis was presented in Table 1. The studies included observational, quasi-experimental, case control and randomized controlled trial designs, which included both children and adult populations. All but one study examined the impact of contact precautions for antibiotic-resistant organisms. Data collection period in terms of total hours of room entry observations was greater than 490 hours in all but one study with a range of 91 to 10,080 hours [12]. There were two studies that collected entry data using electronic monitors, which allowed observation for a full 24 hours of the day [13,14]. Other studies collected only day and evening time data [12,15-17]. All studies recorded HCW visits and three studies included personal visitors. Most studies included both Intensive Care Unit (ICU) and Non-ICU wards, and one study included an Intermediate Care Unit (IMCU).

Return to TABLE OF CONTENTS

TABLE 1: Summary of studies used in the analysis

Study	Study Design	Population Characteristics	Type of Entries	Room Type	Isolation (N)	Non-Isolation (N)	Data Collection Period	Data Collection Time of the Day	Reasons for Isolation
Evans H.L., *et al.* (2003)	Observational	**Mean age:** Isolated patients = 47.8 years, Non-Isolated patients = 58.3 years. **Male sex n (%):** Isolated patients = 41(85), Non-Isolated patients = 36 (75)	HCW[1]	ICU[2] and Non-ICU[2]	48	48	91 hours	Monday through Friday between 8:00 A.M. and 1:00 P.M.	MRSA[3] (69%), VRE[4] (40%), *Clostridium difficile* (19%), multidrug-resistant Acinetobacter spp (4%), and multidrug-resistant *S.maltophilia* (4%).
Morgan D.J. (2013)	Observational	—	HCW[1]	ICU[2] and Non-ICU[2]	—	—	19-month study period, 7,743 HCW[1] visits were observed over 1,989 hours of observation	1 hour at random times	MRSA[3], VRE[4], gram-negative bacteria susceptible to two or fewer classes of antibiotics not including tigecycline or polymyxin, or *Clostridium difficile*
Rizzo A., *et al.* (2010)	prospective case-controlled	—	HCW[1] and Personal Visitors	Non-ICU[2]	31	50	From July 2008 to July 2009	Full 24 hours using photoelectric sensor	17 (54.8%) patients isolated for MRSA[3], three (9.7%) patients isolated for VRE[4], five (16.7%) patients isolated for *Clostridium difficile*, two (6.5%) patients isolated for TB[5] and four (12.9%) patients isolated for immuno-suppression.
Swoboda S.M., *et al.* (2004)	Quasi-experimental	Median age = 62	HCW[1] and Personal Visitors	IMCU[7]	—	—	283,488 electronically monitored entries into a patient room with 251,526 exits for 420 days (10,080 hrs and 3,549 patient days)	Full 24 hours	Surgical patients
Cohen B., *et al.* (2012)	Observational	Adults and Children	HCW[1] and Personal Visitors	ICU[2] and Non-ICU[2]	46%	54%	3,250 room entries were recorded during 491.4 patient hours of observation	Between 5:00 A.M. and 8:00 P.M.	—
Harris A.D., *et al.* (2013)	Cluster-randomized trial	Mean age: Isolated patients=59.6, Non-Isolated patients =57.9. Male sex (%): Isolated patients=52.4, Non-Isolated patients =56.7	HCW[1]	ICU[2]	—	—	Isolated patients and Non-Isolated patients: Number of hours of observation for HCW[1] visits (756.5 Vs. 716.5). number of HCW[1] visits (3,213 Vs.3,775).	Two hours per week of observations occurred at varied times of day over the entire study period.	—

Note: [1]Healthcare Workers; [2]Intensive Care Unit; [3]Methicillin-resistant *Staphylococcus aureus*; [4]Vancomycin-Resistant Enterococci; [5]Tuberculosis

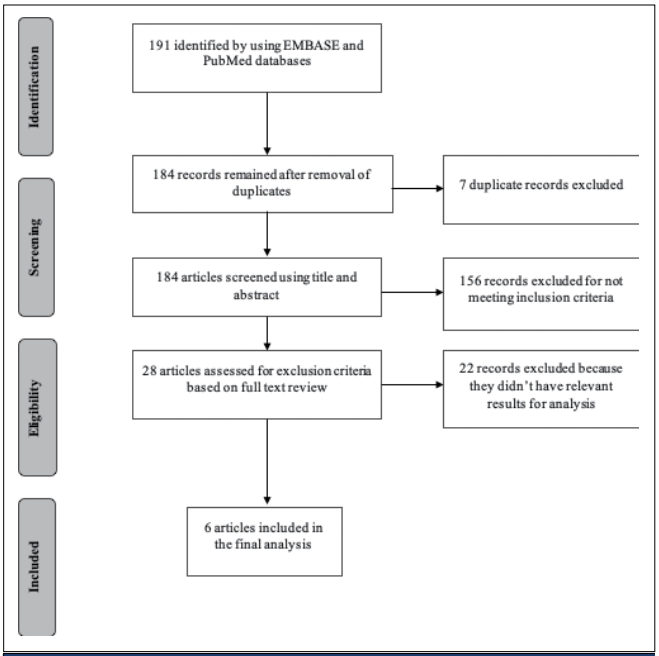


FIGURE 1: Flow chart of literature search selection.

Mean Room Entries from Literature Review

The mean room entries reported in the selected studies are presented in Table 2, and ranged from 2.78 to 5.3 per hour per patient for isolated patients and from 4.37 to 10.90 per hour per patient for non-isolated patients. In general, HCW entered more in non-isolated patient rooms than the isolated rooms and this difference was statistically significant.

For the purpose of cost estimation, we used the average of the mean number of entries into isolated patient rooms from five studies and mean number of entries into all patient rooms from one study. (Since the latter was almost equal to the mean number for isolated patients, removing it would not have any effect on our estimates [13].) This average was 4.35 entries per hour per patient. We did not differentiate between ICU and non-ICU patients, since there was no clear pattern of differences in the number of entries.

Time to Don and Doff PPE from Local Study

The analysis from the QI study presented in **Table 3** showed that on an average, it took 56.07 seconds for HCW to don gown and gloves and 28.92 seconds to doff gown and gloves. We examined the tutorial videos for how to don and doff gown and gloves posted by Public Health Ontario (*https://www.youtube.com/watch?v=6YybqhkIL9M and https://www.youtube.com/watch?v=sk4A96IW8bQ*). The examples in these videos take 68 (41) seconds to don (doff) gown and gloves, slightly longer than the means from the QI study. There are a few cases in the QI study in which HCWs took much longer than the mean to don or doff gowns and gloves, in which case, it is possible that the HCWs were involved in some other activity – such as a conversation – at the same time. We have not attempted to adjust for this formally.

TABLE 2: Mean room entries per hour per patient

Study	Mean Room Entries for all Patients (Per Hour Per Patient)	Mean Room Entries for Isolated Patients (Per Hour Per Patient)	Mean Room Entries for Non-Isolated Patients (Per Hour Per Patient)	Isolated vs. Non-Isolated (P-value)
Evans H.L., *et al.* (2003) [12]	—	5.30	10.90	<0.0001
Morgan D.J. (2013) [15]	—	2.78	4.37	<0.001
Rizzo A., *et al.* (2010) [14]	—	4.76	6.44	<0.003
Swoboda S.M., *et al.* (2004) [13]	4 (Min-Max; 0-8)	—	—	—
Cohen B., *et al.* (2012) [16]	5.5 (Min-Max; 0-28)	5 (Min-Max; 0-28)	6 (Min-Max; 0-26.4)	—
Harris A.D., *et al.* (2013) [17]	—	4.28 (95% CI, 3.95-4.64)	5.24 (95% CI, 4.46-6.16)	0.02

TABLE 3: Mean time to don and doff gown and gloves (in seconds)

PPE[1] Activity	N	Mean	SD[2]	Median
Don (Gown & Gloves)	30	56.07	23.34	50.00
Doff (Gown & Gloves)	12	28.92	26.88	18.50
PPE[1] Activity	**Q1[3]**	**Q3[4]**	**Min**	**Max**
Don (Gown & Gloves)	37.63	70.00	27.00	103.00
Doff (Gown & Gloves)	5.00	52.00	5.00	75.00

Note: PPE: [1]Personal Protective Equipment; SD: [2]Standard Deviation; Q1: [3]First quartile; Q3: [4]Third quartile.

Proportion of Room Entries by HCW Categories

Three studies reported a breakdown of room entries by HCW categories [12,15,16]. Of these, two studies that reported proportions by isolated and non-isolated patient groups were used [12,15]. These studies categorized HCW into three broad types i.e., nurses, doctors and others. Others included hospital housekeeping staff.

The proportion of entries by HCW categories in the literature presented in **Table 4** showed that the majority of patient room entries was made by nurses, followed by others and doctors. The average proportion of patient room entries in the isolated patient rooms by HCW categories from these two studies was calculated as 16% for doctors, 53% for nurses and 31% for others.

Return to TABLE OF CONTENTS

TABLE 4: Proportion of room entries by HCW categories			
	Isolated Patients		
Studies	Doctor	Nurse	Others
Evans H.L., *et al.* (2003) [12]	50 (10%)	247 (51%)	184 (38%)
Morgan D.J. (2013) [15]	367 (22%)	890 (53.5%)	406 (24.5%)
	Non-Isolated Patients		
Studies	Doctor	Nurse	Others
Evans H.L., *et al.* (2003) [12]	97 (10%)	501 (50%)	394 (40%)
Morgan D.J. (2013) [15]	1328 (22%)	3261 (53.5%)	1491 (24.5%)

Mean wage rate of HCW Categories

Table 5 shows the mean hourly wage and employment cost in Canada for hospitalists, nurses and others (hospital housekeepers). The non-salary benefits were 49.5% for physicians, 33% for nurses, and 24% for other staff.

TABLE 5: Mean hourly wage of HCW in Canada		
HCW[1]	Mean Hourly Wage ($)	Mean Employment Cost ($)
Doctor (Hospitalist)	124	184.76
Nurse	41	54.53
Others (Housekeeper Hospital)	17	21.08

Note: [1]Healthcare Workers

Source: *https://www.salaryexpert.com; https://www.salaryexpert.com/salary/job/hospitalist/canada; https://www.salaryexpert.com/salary/job/nurse/canada; https://www.salaryexpert.com/salary/job/housekeeper-hospital/canada*

Summary of PPE Costs Attributed to Contact Precautions

The total-per-hour cost associated with additional PPE was $8.76 (Table 6). The chief component in total cost was the labour cost of HCW related to time required for donning and doffing PPE, which was estimated to be $6.49. The estimated daily cost of contact precautions was $210 (or US$150). Table 6 presents point estimates, allowing each element of the cost to be adjusted based on specific circumstances, such as the cost per gown, the number of room entries, or the employment cost per hour.

DISCUSSION

This study combines data on room entries from existing studies with data on time to don and doff gown and gloves from a QI study, along with specific data on employment costs and PPE costs, within a transparent framework to estimate the hourly cost of contact precautions. Results from the literature review on patient room entries suggests that HCWs, on average, entered isolated patient rooms 4.35 times in an hour and most of these entries were made by nurses (53%) followed by others (31%) and doctors (16%). Estimates from the local QI study imply that it takes HCWs 85 seconds to don and doff gown and gloves on average. This time is shorter than in the Ontario demonstration videos we examined, which may be intentionally slow to clarify the steps required. Using these numbers along with average hourly wage rate of HCWs in Canada, our study estimated that the per-hour cost of gown and gloves attributed to contact precautions was approximately $8.95.

TABLE 6: Estimation of per hour cost of PPE	
Gown and Gloves Cost Category	Cost Per Hour ($)
Unit Cost of Gown ($0.42 per unit * 4.35 entries)	1.83
Unit Cost of Gloves ($0.10 per unit * 4.35 entries)	0.44
Labour Cost of Doctor (4.35 entries * 16% * $184.76 employment cost * 85 seconds to don and doff PPE[1])	3.04
Labour Cost of Nurse (4.35 entries * 53% * $54.53 employment cost * 85 seconds to don and doff PPE[1])	2.97
Labour Cost of Others (4.35 entries * 31% * $21.08 employment cost * 85 seconds to don and doff PPE[1])	0.67
Total Cost	**8.95**

Note: [1]Personal Protective Equipment

The approach that we have used, with accurately reported room entries from published literature and new data on time to don and doff gown and gloves, gives our estimates a high degree of credibility. In addition, our study allows hospitals or researchers to apply components of our costing (e.g., number of room entries per hour) mixed with other location-specific components (e.g., salaries) to obtain estimates of additional cost of contact precautions. Similarly, the formula may be applied in other settings, such as long-term care facilities, where contact precautions are applied, with appropriate adjustments. The formula used in our study can also be easily extended to other types of isolation precautions. There may be other costs related to additional precautions, which were not included in our calculation. For example, a previous study estimated per-day costs of anxiety and depression in terms of quality adjusted life-year (QALYs) at approximately US$9.83 [18]. These costs can be used to evaluate cost-benefit analysis of implementing rapid diagnostic tests for infectious diseases.

Existing studies on the cost of contact precautions in terms of use of gown and gloves have a large range of estimates from as low as US$14.40 (accounting for materials only) to as high as GBP300 per day [5-10]. The estimated cost of contact precautions examined in this study falls in the middle at approximately $210 (US$153) per day.

Unnecessary additional precautions may be costly. In order to evaluate the added value of rapid diagnostic tools that may aid in timely discontinuation of isolation precautions, accurate estimation of costs associated with

isolation precautions is imperative. While the estimated cost per hour was modest, given the number of hours of contact precautions, the implications are not insubstantial. For example, an analysis of VA hospitals in the US reported that within 8,318,675 patient-days during the years 2007-2010, about 13.6% were for patients with MRSA on contact precautions, which approximates 27 million hours [19]. At Foothills Medical Centre in Calgary, Alberta, internal data show that the proportion of patients on contact precautions has varied from 5% to 10% over the years 2014-2019. However, it is also important to acknowledge that not applying contact precautions, or terminating them too early, may also be costly and harmful to patients, depending on the specific circumstances [4].

While we have focused on the dollar cost of contact precautions, another perspective on contact precautions is that compliance requires significant time. If unnecessary contact precautions are lifted, HCWs will have additional time to devote to patient care. As we show above, HCWs spend about 6 minutes in donning and doffing gowns and gloves for every hour that patients are on contact precautions.

Our study has many limitations. There was variability in population characteristics of the studies used in the literature review on patient room entries. Additionally, only two of the reviewed studies counted room entries over the entire 24-hour period. All other studies focused on daytime hours only and therefore would capture only the busiest time for room entry. The sample size of the local study on time to don and doff gown and gloves was small with considerable variation, and compliance with PPE varies by location. We did not account for the difference between ICU and other wards. Also, we did not include any post-hospital discharge enhanced terminal cleaning specific to contact precautions as our focus was on the effect of shortening or extending contact precautions.

In conclusion, our study provides a simple framework to estimate the hourly costs of contact precautions, which may be used and adapted by other healthcare settings using local information on practices and costs. Future studies should consider mechanisms to improve the measurement of entries into isolation and non-isolation rooms, by different healthcare workers, over a 24-hour period.

FUNDING ACKNOWLEDGEMENT

The authors gratefully acknowledge support from Canadian Institutes of Health Research, grant 389455.

APPENDIX

Literature search strategy: EMBASE and PubMed

EMBASE = ('infection':ab,ti OR 'infections':ab,ti OR 'infectious':ab,ti OR 'contagion':ab,ti OR 'contagious':ab,ti) AND ('hospital':ab,ti OR 'hospitals':ab,ti OR 'inhospital':ab,ti OR 'in-hospital':ab,ti OR 'hospitalization':ab,ti OR 'hospitalisation':ab,ti OR 'hospitalized':ab,ti OR 'hospitalised':ab,ti OR 'inpatient':ab,ti OR 'in-patient':ab,ti) AND ('isolation':ab,ti OR 'quarantine':ab,ti OR 'contact precaution':ab,ti OR 'contact precautions':ab,ti) AND ('room entry':ab,ti OR 'room entries':ab,ti OR 'ward entry':ab,ti OR 'ward entries':ab,ti OR 'visit':ab,ti OR 'visits':ab,ti) AND ('human'/de)

PubMed = (((((isolation[Title/Abstract] OR quarantine[Title/Abstract]) OR contact precautions[Title/Abstract]) OR contact precaution[Title/Abstract] OR patient contact[Title/Abstract]) AND (hospital[Title/Abstract] OR hospitals[Title/Abstract] OR inhospital[Title/Abstract]) OR in-hospital[Title/Abstract]) OR hospitalization[Title/Abstract] OR hospitalisation[Title/Abstract] OR hospitalised[Title/Abstract] OR hospitalized[Title/Abstract] OR inpatient[Title/Abstract] OR in-patient[Title/Abstract]) AND (infection[Title/Abstract] OR infections[Title/Abstract] OR infectious[Title/Abstract]) OR contagion[Title/Abstract] OR contagious[Title/Abstract] AND ((ward[Title/Abstract] OR room[Title/Abstract]) AND (entry[Title/Abstract] OR entries[Title/Abstract])OR (hcw [Title/Abstract] and visit[Title/Abstract]) OR (hcw [Title/Abstract] and visits[Title/Abstract]) OR (healthcare worker[Title/Abstract] and visit[Title/Abstract]) OR (healthcare worker[Title/Abstract] and visits[Title/Abstract])) AND "humans"[MeSH Terms]

REFERENCES

1. Sexton ME, Jacob JT. (2017). Optimal use of rapid diagnostics in infection control and prevention. *Clinical Microbiology Newsletter*, 39, 83–89. https://doi.org/10.1016/j.clinmicnews.2017.05.001.
2. Sullivan K V., Bard JD. (2019). New and novel rapid diagnostics that are impacting infection prevention and antimicrobial stewardship. *Current Opinion in Infectious Diseases*, 32, 356–364. https://doi.org/10.1097/QCO.0000000000000565.
3. Siegel JD, Rhinehart E, Jackson M, Linda; Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings (2007) 2019:1–204.
4. Sprague E, Reynolds S, Brindley P. (2016). Patient isolation precautions: Are they worth it? *Canadian Respirology Journal*, 2016, 1–5. https://doi.org/10.1155/2016/5352625.
5. Jan A. Roth, MD; Claudia Hornung-Winter PIR. (2018). Direct costs of a contact isolation day: A prospective cost analysis at a Swiss university hospital. *Infection Control and Hospital Epidemiology*, 39, 9–11.
6. Verlee K, Berriel-Cass D, Buck K, Nguyen C. (2014). Cost of isolation: Daily cost of isolation determined and cost avoidance demonstrated from the overuse of personal protective equipment in an acute care facility. *American Journal of Infection Control*, 42, 448–449. https://doi.org/10.1016/j.ajic.2013.10.014.
7. Spence MR, Dammel T, Courser S. (2012). Contact precautions for methicillin-resistant *Staphylococcus aureus* colonization: Costly and unnecessary? *American Journal of Infection Control*, 40, 535–538. https://doi.org/10.1016/j.ajic.2011.07.016.
8. Hübner C, Hübner N-O, Muhr M, Claus F, Leesch H, Kramer A, *et al*. (2015). Cost analysis of hospitalized *Clostridium difficile*-associated diarrhea (CDAD). *GMS Hygiene and Infection Control*, 10,Doc13. https://doi.org/10.3205/dgkh000256.

9. Kunori T, Cookson B, Roberts JA, Stone S, Kibbler C. (2002). Cost-effectiveness of different MRSA screening methods. *Journal of Hospital Infection*, 51, 189–200. https://doi.org/10.1053/jhin.2002.1247.
10. Otter JA, Burgess P, Davies F, Mookerjee S, Singleton J, Gilchrist M, *et al*. (2017). Counting the cost of an outbreak of carbapenemase-producing Enterobacteriaceae: an economic evaluation from a hospital perspective. *Clinical Microbiology and Infection*, 23, 188–196. https://doi.org/10.1016/j.cmi.2016.10.005.
11. Alberta Health Services, Consolidated Financial Statements, March 31, 2020. Retrieved from https://www.albertahealthservices.ca/assets/about/publications/ahs-pub-2019-20-financials.pdf, accessed 23 October 2020.
12. Evans HL, Shaffer MM, Hughes MG, Smith RL, Chong TW, Raymond DP, *et al*. (2003). Contact isolation in surgical patients: A barrier to care? *Surgery*, 134, 180–188. https://doi.org/10.1067/msy.2003.222.
13. Swoboda SM, Earsing K, Strauss K, Lane S, Lipsett PA. (2004). Electronic monitoring and voice prompts improve hand hygiene and decrease nosocomial infections in an intermediate care unit. *Critical Care Medicine*, 32, 358–363. https://doi.org/10.1097/01.CCM.0000108866.48795.0F.
14. Rizzo A, V. Trivedi, T. Aldaghlas, R. Richmond, R. Sun LR. Care for the Isolation Patient: Not enough? Assoc Acad Surg Soc Univ Surg 2010.
15. Morgan DJ, Pineles L, Shardell M, Graham MM, Mohammadi S, Forrest GN, *et al*. (2013). The effect of contact precautions on healthcare worker activity in acute care hospitals. *Infection Control and Hospital Epidemiology*, 34,69–73. https://doi.org/10.1086/668775.
16. Cohen B, Hyman S, Rosenberg L, Larson E. (2012). Frequency of patient contact with health care personnel and visitors: Implications for infection prevention. *Joint Commission Journal on Quality and Patient Safety*, 38, 560–565. https://doi.org/10.1016/S1553-7250(12)38073-2.
17. Harris AD, Pineles L, Belton B, Johnson JK, Shardell M, Loeb M, *et al*. (2014). Universal glove and gown use and acquisition of antibiotic-resistant bacteria in the ICU. *Survey of Anesthesiology*, 58, 158–159. https://doi.org/10.1097/sa.0000000000000059.
18. Sharma A, Pillai DR, Lu M, Doolan C, Leal J, Kim J, *et al*. (2020). Impact of isolation precautions on quality of life: a meta-analysis. *Journal of Hospital Infection*, 105, 35-42. https://doi.org/10.1016/j.jhin.2020.02.004.
19. Jain R, Kralovic SM, Evans ME, Ambrose M, Simbartl LA, Obrosky DS, *et al*. (2011). Veterans Affairs initiative to prevent nethicillin-resistant *Staphylococcus aureus* infections. *New England Journal of Medicine*. 364, 1419–1430. https://doi.org/10.1056/NEJMoa1007474.

REPRINT

Surface and Air: What Impact Does UV-C at the Room Level Have on Airborne and Surface Bacteria?

Linda D. Lee, DrPH, MS, MBA, *Executive Vice President and Chief Science Officer, VidaShield*

Corresponding Author:

Dr. Linda Lee, American Green Technology, 52129 State Route 933, South Bend, IN 46637

ABSTRACT

Background: Short-wave ultraviolet light (UV-C) is known to have the ability to render bacteria inert. We theorized that using UV-C in a continuous fashion at the room level would not only lower the amount of bacteria circulating in the air, but also lessen the amount of bacteria found on surfaces in the same space.

Methods: We set up field trials at three hospitals (Texas, Nevada, and Massachusetts) where we tested air and surface for bacteria, installed continuous UV-C products at the room level, and then tested air and surface again.

Results: In all cases, airborne bacteria was reduced between 79 and 91% over pre-installation values. Most surfaces also showed reductions in bacteria from 48 to 69%, although we report one incident of an increase of 288%.

Conclusion: The data indicate that using active air UV-C technology at the room level reduces the bioburden in the air and on surfaces, including in occupied spaces. Hospitals should consider implementing active UV-C technology to improve air quality.

KEYWORDS

Air disinfection, UV-C, airborne bacteria

INTRODUCTION

An early publication on the effectiveness of ultraviolet light on bacteria is from 1877, when two British scientists noticed that Pasteur's solution, when placed in lead-covered test tubes, grew innumerable bacteria, while the same solution in unshielded test tubes placed in sunlight, did not (1). Since then, many studies have demonstrated that UV rays are a powerful way to render bacteria inert, beginning with Coblentz in 1922 (2) and Sharp in 1939 (3).

It has been known for decades that many diseases, such as tuberculosis and influenza, are spread via airborne and/or droplet transmission. More recently, studies have shown that pathogens thought to be spread through direct contact can also become aerosolized. Roberts et al. demonstrated that *Clostridium difficile* (*C. diff.*) spores could be disseminated through the air (4) as did Best et al. (5). Li et al. reviewed 40 studies to show a strong association between building ventilation and the transmission of airborne disease (6). Eames et al. wrote similarly, but with a tighter focus on hospital acquired infection (HAI), including methicillin-resistant *Staphylococcus aureus* (MRSA) (7). Nazaroff's discussion of indoor bioaerosol dynamics lays out how the airflow in a space moves particulate matter, including microbes (8).

Knowing that disease could be spread through the air, and that short-wave ultraviolet (UV-C) can render pathogens inert, it is logical that the medical community would turn to UV-C to reduce the amount of bacteria circulating in the air. Bolton and Cotton discussed how UV disinfection works in general (9) and Boyce discussed specific technologies for using UV-C in hospitals (10). Rutala et al. studied how UV-C worked at the room level to eliminate bacteria (11).

Over the decades, several approaches to UV-C were developed. These methods included using UV-C as part of the water filtration system, using it in the HVAC system, and using it as a stand-alone, mobile product. Each method has some things to recommend it, in terms of effectiveness, ease of use, and cost, but also each one has drawbacks, including these same factors and, in the case of the mobile unit, the necessity for training as well as the requirement that the space to be treated be unoccupied. Reed provided an excellent historical perspective (12) and Memarzadeh et al. concluded that ultraviolet germicidal irradiation (UVGI) is a useful addition to the disinfection toolbox (13).

The potential for surfaces to hold onto microbial contaminants despite standard cleaning methods is clear. Hospodsky et al. noted that an important source of airborne materials is a result of human activity, such as entering a room, which resuspended particles from surfaces (14). Our study was designed to examine the effect of using UV-C at the room level on the amount of bacteria in the air, and whether cleaning the air would have a positive effect on surface bacteria.

Conflict of interest: Dr. Lee is employed by VidaShield, which provided the UV-C products used in this study.

METHODS

Environmental studies were conducted at an acute-care hospital in Massachusetts (Hospital A), an acute-care children's hospital in Texas (Hospital B), and an acute-care hospital in Nevada (Hospital C). In each case, the study materials and methodology were the same. Baseline air and surface samples were taken, UV-C units were installed, and several weeks after that, air and surface sampling were repeated, and before-and-after results compared.

Baseline microbiologic sampling for the studies was accomplished by collecting air samples onto trypticase soy agar with blood (TSA) plates (Hardy Diagnostics, Santa Maria, CA). The sampler works by pulling air in through a perforated cover. The air impacts the agar plates, which are coated with blood. The cells that land on the plates start to reproduce and form colonies. These colonies are counted (raw CFU). This number is adjusted using a standard method for the probability that more than one viable particle was pulled though a single sampling hole and merged with other particles on the plate to produce a single colony. This adjustment is the correction hole factor.

Multiple samples were taken from each location. Representative areas sampled included next to the bed, at the window, near the linen cart, at the nightstand and near the window.

Air samples were collected with SAS 180 samplers (BioScience International, Rockville, MD). All air samples were run at 1000L (approximately five and a half minutes), and air was collected onto 90 mm sampling plates. As plates were collected, they were packed in coolers with gel packs, then packaged with gel packs and shipped overnight to an independent laboratory (Antimicrobial Test Laboratories (now Microchem Laboratories), Round Rock, TX).

Surface samples of 25 cm^2 were collected directly onto the Rodac sampling plates, using a straight downward motion to insure the sampling plate contacted the surface with sufficient pressure to collect the sample. Plates were then refrigerated and prepared for overnight shipping to the lab. For surface bacterial sampling, TSA with Lecithin and Tween plates were used.

Multiple samples were taken from each location. Representative areas sampled included the bed rails, the over-bed table, keyboards and chair arms. All plates were refrigerated and prepared for overnight shipping to the same independent lab. At the lab, all plates were incubated at 30 ± 2° C for 5-7 days, after which they were evaluated. Total colony forming units (CFUs) were recorded for each specimen.

In each study location, after pre-installation sampling was complete, UV-C units (VidaShield™; American Green Technology, South Bend, IN) were installed. Each unit contained a fully shielded UV-C bulb housed atop a standard 2 x 4 ceiling light fixture. A 59 watt shielded UV lamp produced 15 watts of high output ultraviolet-C energy at a wavelength of 253.7 nanometers. Because the radiation chamber where the UV lamp is housed is enclosed and the air passes through the chamber, there is little to no distance from the lamp to the air that passes directly over the lamp. At its furthest point, the span is 6 inches. Each unit holds four small fans (similar to those in a desktop

FIGURE 1. UV-C unit diagram

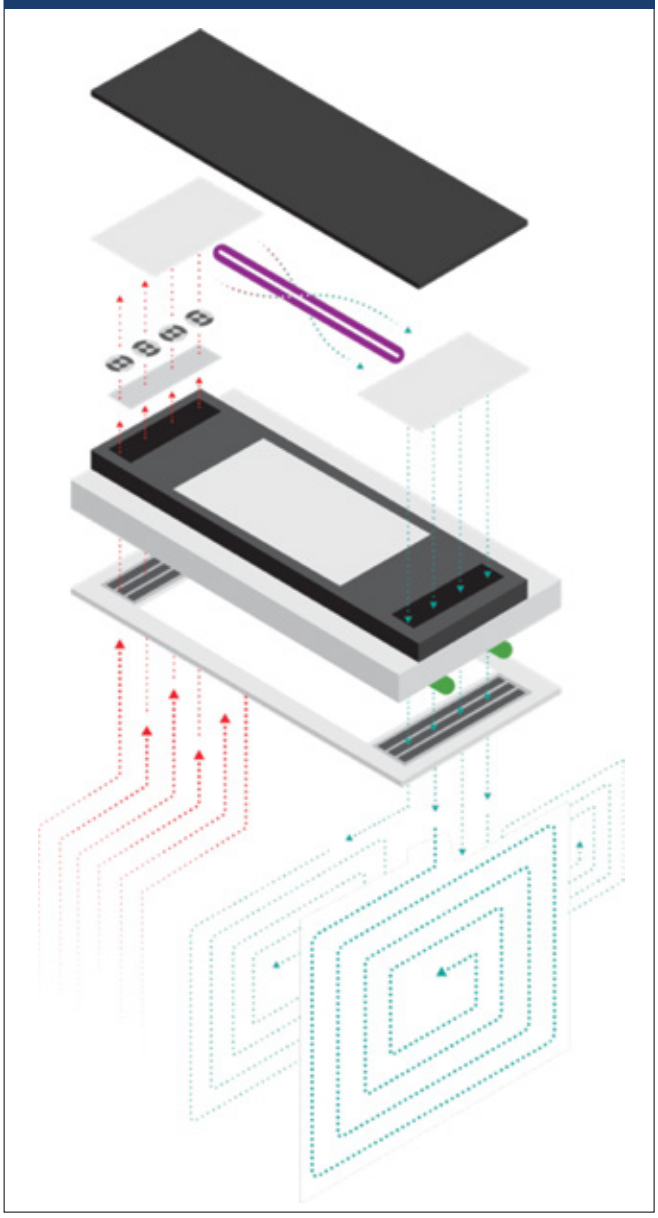


FIGURE 2. UV-C unit installed

computer) that create differential pressure to continuously draw air into the system at 50 cubic feet per minute. On the way to the irradiation chamber, the air passes through a MERV 6 filter to remove dust and large particulates and then, once treated, the cleaned air is pushed back into the room. The intake and exhaust baffles are set at a 30-degree angle, which moves the air in a pattern that avoids repeatedly recirculating the same air. The fans draw air into the unit at a rate of 50 CFM. When operating continuously, the unit theoretically will treat a volume of air equivalent to an 8' x 10' x 10' (800 cubic feet) room four times per hour. The UV-C portion of the units run continuously, 24/7 whether the overhead room light is on or off. The units available for test were with no downlight, fluorescent/LED downlights and LED array downlights. Units were installed following each facility's infection control risk assessment (ICRA). Once the units were operational all areas were reopened for normal use. The product used in this study is requires only minimal maintenance (an annual bulb and filter change), easily performed by existing facilities services staff.

For a variety of hospital operational reasons, after intervals of 228, 35, and 70 days (for Hospitals A, B, and C), the sampling was repeated. The same materials were used and the same methodology was followed. The same lab performed all testing. The intervals were counted from the day of the first unit installation. Room availability dictated the speed of installation and post-installation testing.

RESULTS

It is well established that UV-C is effective at treating the air. Therefore, results showing that airborne bacteria counts would be lower at the room level post-installation were expected. Because the air would be cleaner after UV-C treatment, we also anticipated a reduction in bacteria on surfaces, which we found in most cases.

By trialing continuous UV-C air purification technology in geographically distinct areas we hoped to discover its efficacy when implemented at the room level. In every case, the amount of airborne bacteria was greatly reduced, and in most cases, surface bacteria was also reduced.

Hospitals reported that healthcare-associated odors were diminished considerably. This was especially evident at Hospital C, where foul odors had been a constant in the closed unit psychiatric holding area, but also mentioned at Hospital A. We believe that cleaning the air with active UV-C technology not only reduced the number of CFUs present, but also resolved odors. This may be due, at least in part, to the UV-C acting on the biological nature of the odors.

DISCUSSION

Hospodsky et al. documented human occupancy as the major source of indoor airborne bacteria but observed that the skin, nasal and hair that is shed becomes not only airborne but also settles on surfaces (14). Huang et al. explored the likelihood that a hospital patient could acquire antibiotic-resistant bacteria from someone who had been in the room before (15). Mitchell *et al.* expanded by performing a meta-analysis on the same topic. They noted the use of UV-C lighting fixtures as a way to reduce the likelihood of a future patient acquiring infection from a prior room occupant (16). King et al. studied surface contamination as a result of airborne disposition of bacteria. They found that small particle bioaerosols are spread with no correlation between surface area of contaminants and distance from the source (17).

Schabrun and Chipchase identified healthcare equipment as a significant source of nosocomial infections (18). Otter et al. agreed that contaminated surfaces are implicated in transmission of pathogens, and further called out UV-C as a disinfection technique with improved efficacy over conventional methods (19). Dumford identified portable hospital equipment

TABLE 1: Mean airborne bacteria correction hole factor CFUs pre- and post-installation

Study location	Mean CFUs pre-installation	Mean CFUs post-installation	Change	Student's t-test, one-tailed p value
Hospital A ICU	167	37	-79%	0.0305
Hosp. A OR Breakroom	472	92	-81%	0.0264
Hospital B patient room	599	55	-91%	0.0002
Hospital C 6 bed psych unit	439	88	-80%	0.0234

All facilities had significant reductions in airborne bacteria with 24/7 operation of the shielded UV-C ceiling unit.

TABLE 2: Mean surface bacteria correction hole factor CFUs pre- and post-installation

Study location	Mean CFUs pre-installation	Mean CFUs post-installation	Change	Student's t-test, one-tailed p value
Hospital A ICU	45	19	-57%	0.0049
Hosp. A OR Breakroom	120	62	-48%	0.2922*
Hospital B patient room	25	97	+288%	0.0104
Hospital C 6 bed psych unit	115	36	-69%	0.0288

*This p value due to small sample size

Most facilities had significant reductions in surface bacteria after implementing UV-C at the room level.

Return to TABLE OF CONTENTS

as holding reservoirs of *C. diff.* (20) and Stiefel et al. investigated surfaces as a source of MRSA contamination (21). Shiomori et al. demonstrated that making the bed of a patient with MRSA dispersed MRSA into the air in significant amounts for at least fifteen minutes (22).

Kramer, Schwebke and Kampf looked at how long pathogens can survive on surfaces (23). Acinetobacter spp. survived up to five months, *C. diff.* up to five months, *Escherichia coli* up to 16 months, and *Staphylococcus aureus*, including MRSA, up to seven months. Jawad et al. pointed out that the relative humidity in a space impacts the survival of Acinetobacter spp. and concluded that the bacteria can be transferred from surfaces not only by moist vectors but also by dry ones (24).

It is clear from the literature that bacteria in the air and on surfaces poses a risk to patients, visitors, and staff. Our study showed that using UV-C at the room level reduced the bio burden of the air, and, in most cases, of that on surfaces.

In our study, Hospital B had a very large percentage increase (+288%) in surface bacteria post-installation although the actual numbers weren't extreme (25, 97). We attribute this to the fact that the study room had been terminally cleaned before pre-installation samples were taken. The pre-installation samples were taken in a cleaned, unoccupied and closed room. The post-installation samples were taken in the room after a patient on isolation had occupied the room and had not been terminally cleaned at the time post-installation samples were taken. This result demonstrates the importance and efficacy of surface cleaning as part of the entire infection control process.

Limitations: A limitation of this study is the location of study sites in fully functioning operational facilities. We had no control over people opening and closing doors thereby affecting airflow into and out of the room, how and how often surfaces were cleaned, as well as the consistent cleaning procedures and the number and types of patients who occupied the spaces. Room furnishings were not identical, nor were layouts. Most patient rooms tested were occupied by patients or work areas were functioning as intended and in use by staff. These variables may have affected the results. A second limitation is the decision to study total bacteria CFUs, and not specific pathogens, fungi, or viruses. Because the study was in live environments, and not in a lab, we had no control over the number and types of pathogens that might be present. Because the hospital environment is dynamic and we did not seed the environment with any given pathogen we used total bacteria load as a surrogate for all pathogens. This approach might be seen as similar to using a biological indicator in a steam sterilizer to ensure hospital equipment and supplies are properly sterilized for use on patients. When the equipment is cleaned and wrapped and sterilized it would be hard to test every potential pathogen, but an indicator helps provide a level of assurance that the equipment is ready for use.

CONCLUSIONS

The data clearly demonstrate that using active air UV-C technology at the room level reduces the bioburden in the air and improves indoor air quality. In addition, the majority of the facilities had reduced surface bacteria in areas where continuous UV-C air purification at the room level was operational. Hospitals should consider adding active air UV-C technology at the room level to decrease airborne and surface microorganisms and improve indoor air quality.

REFERENCES

1. Downes, A. & Blunt, T. P. (1877). Researches on the effect of light upon bacteria and other organisms. Retrieved from https://archive.org/details/philtrans06219880. doi:10.1098/rspl.1877.0068.
2. Coblentz, W. W. & Fulton, H. R. (1924). A radiometric investigation of the germicidal action of ultra-violet radiation. Retrieved from https://archive.org/details/scientificpapers49519geor.
3. Sharp, G. (1939). The lethal action of short ultraviolet rays on several common pathogenic bacteria. *Journal of Bacteriology 37*, 447-459.
4. Roberts, K., Smith, C. F., Snelling, A. M., Kerr, K. G., Banfield K. R., Sleigh, P. A., & Beggs, C. B. (2008). Aerial Dissemination of *Clostridium difficile* spores. *BMC Infectious Diseases 8* (7) doi:10.1186/1471-2334-8-7.
5. Best, E. L., Fawley, W. N., Parnell, P, & Wilcox, M. H. (2010). The potential for airborne dispersal of *Clostridium difficile* from symptomatic patients. *Clinical Infectious Diseases 50* (11), 1450-1457. doi:10.1086/652648.
6. Li, Y., Leung, G. M., Tang, J. W., Yang, X., Chao, C. Y., Lin, J. Z., & Yuen, P. L. (2007). Role of ventilation in airborne transmission of infectious agents in the built environment – a multidisciplinary systematic review. *Indoor Air 17* (1) 2-18.
7. Eames, I., Tang, J. W., Li, Y. & Wilson, P. (2009) Airborne transmission of disease in hospitals. *Journal of the Royal Society Interface 6* Suppl 6. S698-702. doi:10.1098/rsif.2009.0407.focus.
8. Nazaroff, W. (2014). Indoor bioaerosol dynamics. *Indoor Air 26*: 61-78. doi:10.1111/ina.12174.
9. Bolton, J. & Cotton, C. (2008). *The ultraviolet disinfection handbook*. American Waterworks Association.
10. Boyce, J. M. (2016). Modern technologies for improving cleaning and disinfection of environmental surfaces in hospitals. *Antimicrobial Resistance and Infection Control* 5:10 doi:10.1186/s13756-016-0111-x.
11. Rutala, W. A., Gergen, M. F., & Weber, D. J. (2010). Room decontamination with UV radiation. *Infection Control & Hospital Epidemiology 31* (10), 1025-1029. doi:10.1086/656244.
12. Reed, N. (2010). The history of ultraviolet germicidal irradiation for air disinfection. *Public Health Reports 125* (1) 15-27.

13. Memarzadeh, F., Olmsted, R. N., & Bartley, J. M. (2010). Applications of ultraviolet germicidal irradiation disinfection in health care facilities: effective adjunct, but not stand-alone technology. *38* (Suppl.) 13-24. doi:10.1016/j.ajic.2010.04.208.
14. Hospodsky, D., Qian, J., Nazaroff, W. W., Yamamoto, N., Bibby, K., Rismani-Yazdi, H. & Peccia, J. (2012). Human occupancy as a source of indoor airborne bacteria. *PLoS One (7)* 4 doi:10.1371/journal.popne.0034867.
15. 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:10.1001/archinte.166.18.1945.
16. Mitchell, B. G., Dancer, S. J., Anderson, M. & Dehn, E. (2015). Risk of organism acquisition from prior room occupants: a systematic review and meta-analysis. *Journal of Hospital Infection 91* (3) 211-217. doi:10.1016/j.jhin.2015.08.005.
17. King, M.-F., Noakes, C. J., Sleigh, P. A., & Carmago-Valero, M. A. (2013). Bioaerosol deposition in single and two-bed hospital rooms: a numerical and experimental study. *Building and Environment 59* 436-447. doi.org/10.1016/j.buildenv.2012.09.011.
18. Schabrun, S. & Chipchase, L. (2006). Healthcare equipment as a source of nosocomial infection: a systematic review. *Journal of Hospital Infection, 63* (3), 239-245. doi:10.1016/j.jhin.2005.10.013.
19. 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* (5 Suppl.), S6-S11. doi:10.1016/j.ajic.2012.12.004.
20. Dumford III, D. M., Nerandzic, M. M., Exkstein, B. C., & Donskey, C. J. (2009). What is on that keyboard? Detecting hidden reservoirs of *Clostridium difficile* during an outbreak associated with North American pulsed-field gel electrophoresis type 1 strains. American *Journal of Infection Control, 37* (1), 15-19. doi:10.1016.j.ajic.2008.07.009.
21. Stiefel, U., Cadnum, J. L., Eckstein, B. C., Guerrero, D. M., Tima, M. A., & Donskey, C. J. (2011). Contamination of hands with methicillin-resistant *Staphylococcus aureus* after contact with environmental surfaces and after contact with the skin of colonized patients. *Infection Control Hospital Epidemiology 32* (2) 185-187. doi:10.1086/657944.
22. Shimori, T., Miyamoto, H., Makishima, K., Yoshida, M., Fujiyoshi, T., Ukada, T., & Hiraki, N. (2002). Evaluation of bedmaking-related airborne and surface methicillin-resistant Staphylococcus aureus contamination. *Journal of Hospital Infection, 50* (1), 30-35. doi:10.1053/jhin.2001.1136.
23. Kramer, A., Schwebke, I., & Kampf, G. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infectious Diseases 6* (130). doi:10.1186/1471-2334-6-130.
24. Jawad, A., Heritage, J., Snelling, A. M., Gascoyne-Binzi, D. M., & Hawkey, P. M. (1996). Influence of relative humidity and suspending menstrua on survival of Acinetobacter spp. on dry surfaces. *Journal of Clinical Microbiology, 34* (12), 2281-2287.

What Can IPAC Canada Do for You? Supporting Surveillance Activities in Canadian Acute and Long-Term Care Settings

Jennifer Happe BSc MSc
Chair, IPAC Canada, Surveillance & Applied Epidemiology Interest Group

Katherine Paphitis BSc BASc MSc CPHI (C)
Co-Chair, IPAC Canada, Surveillance & Applied Epidemiology Interest Group
SAEIG email: *saeig@ipac-canada.org*

Communicable diseases are a public health concern in Canada and early detection of communicable diseases can assist in implementation of measures aimed at minimizing and preventing further transmission, hence their surveillance is critical [1,2]. Surveillance is generally defined as the systematic collection, analysis, and interpretation of data for diseases of public health significance, including healthcare associated infections and antimicrobial resistant organisms [3]. It is closely integrated with the timely dissemination of these data to those responsible for preventing and controlling diseases [3]. Surveillance activities may be continuous in nature, or data may be gathered via point prevalence studies. Activities may be conducted at unit, facility, province, territory, national and international levels. Understanding and practice of communicable disease surveillance are core competencies of those practicing in infection prevention and control [4]. Surveillance is integral to infection prevention and control because it measures the burden of disease and so the need for interventions and the efficacy of interventions aimed at controlling the spread of communicable diseases. Surveillance data are used to establish benchmark reference points for internal and external comparison of the incidence and prevalence of disease, including detection of sentinel events, outbreaks and pandemics. Potential risk factors for acquisition and carriage of a disease can be derived from surveillance datasets. Surveillance also functions to provide timely, useful evidence to leaders and decision makers to establish priorities, and guide policies and programs.

Despite the value of communicable disease surveillance, many practicing in infection prevention and control face barriers in conducting surveillance. Common surveillance challenges include inadequate information technology resources, lack of access to health records and other key information sources because of geographic restrictions and unavailability of electronic records, a shortage of skilled staff, and competing responsibilities and budget priorities. IPAC Canada offers a number of tools to support members and non-members in their surveillance practice. All resources are available on the Surveillance and Applied Epidemiology Interest Group webpage.

1. IPAC Canada created standardized infection case definitions for use in Canadian long-term care (LTC) facilities [5]. These surveillance definitions were used to inform the LTC Surveillance Toolkit described below. These are recommended for use in Canadian LTC settings to provide a standard set of definitions that allow for benchmarking and comparison between jurisdictions across Canada.
2. IPAC Canada developed a position statement supporting surveillance in LTC settings [6]. This position statement includes a recommendation that all LTC settings in Canada routinely conduct surveillance for healthcare-associated infections at a minimum. The position statement is especially useful for those geographic jurisdictions where surveillance in LTC is not a legal mandate.
3. The IPAC Canada LTC Surveillance Toolkit, adapted from Public Health Ontario, supports the entire surveillance process. It contains tools to assess readiness to conduct surveillance, staff training and tools to support data collection and validation, using the IPAC Canada LTC case definitions, though the Toolkit can be customized for any set of definitions. The Toolkit contains a Microsoft Excel database to store data and is set up to automatically calculate rates of all infections and of those deemed to be healthcare-associated only, and to prepare tables and figures of infection rates and epidemiologic curves for reporting. The database can be used alone, or as part of the broader Toolkit. The complete IPAC Canada LTC Surveillance Toolkit, including a recorded tutorial on how to use the Toolkit, is available to IPAC Canada members and non-members alike.

Conflict of interest: None

4. The IPAC Canada Acute Care Surveillance Tracking Tool, adapted from the IPAC Canada LTC Surveillance Toolkit database tool, is a Microsoft Excel database. It is set up to automatically calculate rates of all infections and of those deemed to be healthcare-associated, as well as to prepare tables and figures of infection rates and epidemiologic curves for reporting. This Tool can be customized for use with any set of case definitions. The IPAC Canada Acute Care Surveillance Tracking Tool, and a recorded tutorial on how to use the Tool, are available to IPAC Canada members.
5. Surveillance Workshop sessions serve to provide a framework on what surveillance is, why it is important, and an overview of the six components to robust and effective surveillance system (planning and training, data collection, data cleaning and analysis, data interpretation and benchmarking, reporting and evaluation). Interactive exercises couched in acute care and LTC scenarios provide opportunities to apply some of the surveillance concepts presented, and to use some of the surveillance tools described above. Surveillance Workshop recordings and independent study materials are available to IPAC Canada members.

All IPAC Canada members are encouraged to explore each of these resources and take advantage of all that IPAC Canada has to offer to support surveillance practices.

REFERENCES

1. Canadian Nosocomial Infection Surveillance Program. (2018). 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://www.canada.ca/en/public-health/services/publications/science-research-data/summary-report-healthcare-associated-infection-antimicrobial-resistance-antimicrobial-use-surveillance-data-2013-2017.html
2. Public Health Agency of Canada. (2020). Canadian Antimicrobial Resistance Surveillance System – report 2020. Retrieved from https://www.canada.ca/content/dam/hc-sc/documents/services/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2020-report/CARSS-2020-report-2020-eng.pdf
3. Teutsch, S. M., & Churchill, R. E. (Eds.). (2000). Principles and practice of public health surveillance. Oxford University Press, USA.
4. Infection Prevention and Control Canada (IPAC Canada). (2016). IPAC Canada Core Competencies for Infection Control Professionals. Retrieved from https://ipac-canada.org/photos/custom/pdf/2016_IPAC_Canada_CoreCompetenciesforICPs.pdf
5. Infection Prevention and Control Canada (IPAC Canada). (Fall 2017). Surveillance Definitions of Infections in Canadian Long Term Care Facilities. *Canadian Journal of Infection Control*. Suppl: 32:3, 10-17.
6. Infection Prevention and Control Canada (IPAC Canada). (Fall 2019). Position Statement: Surveillance in Long Term Care Settings. *Canadian Journal of Infection Control*. 34:3, 127-128.

HealthConnex™

Infection Control and Outbreak Management Software

Improve Outcomes

- ➜ Identify potential outbreaks before they occur
- ➜ Reduce outbreak duration and severity

Save Time and Money

- ➜ Reduce time needed to collect and report on infections
- ➜ Easily integrates with leading EHRs

Mobile Friendly

- ➜ Access data from any device
- ➜ Point of Care apps assist with collecting data

Easy to Use

- ➜ Easy to use clinical workflow
- ➜ Manage & report on both **staff and residents** in real-time

STAY AHEAD OF IT

Transform the *quality of care* with accurate *visual & actionable data*

Visually identify potential outbreaks on your floor plans before they occur.

Detect potential infections and outbreaks in real time

HealthConnex is an intuitive, cloud-based infection surveillance platform tailored specifically for long term care and senior living facilities. HealthConnex easily integrates with leading EHRs.

HealthConnex is based on IPAC Canada and McGeer's criteria. Improve resident safety by being alerted when signs and symptoms meet infection site definitions.

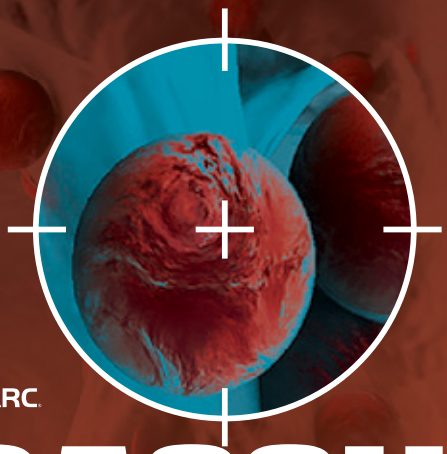
With over 200 long-term care facilities using HealthConnex, we are leading the charge in managing Infection Control.

Connect with us!

sales@healthconnex.ai

www.healthconnex.ai

FIRST AND ONLY ***HEALTH CANADA-REGISTERED*** *PRODUCT*
AGAINST BIOFILMS



SANI MARC

BIOASSURE™ MC

DIN 02456435

KILLS BACTERIA IN **BIOFILMS** IN **DRAINS** IN 5 MINUTES
KILLS AND REDUCES THE SPREAD OF **SUPERBUGS**

ASK A QUESTION
1 800 361-7691

GET MORE INFO
sanimarc.com/bioassure

ACCESS OUR WHITE PAPER ON BIOASSURE EFFICACY

ASK FOR A DEMO
sales@sanimarc.com

BIOASSURE products are distributed by Wood Wyant, a subsidiary of Sani Marc Group.

WOOD WYANT
Subsidiary of Sani Marc Group

THE DIFFERENCE IS A HIGHER STANDARD OF CARE

WITH A DUAL FORMULATION STERILE SOLUTION AND STERILE APPLICATOR. The new BD ChloraPrep™ Patient Preoperative Skin Preparation has elevated sterility assurance to a higher level, achieving a sterility assurance level (SAL) of 10^{-6}, the same required for injectable products.[1] Other 2% chlorhexidine gluconate (CHG)/alcohol applicators used in hospitals today do not contain sterile solutions, which may put patients at risk of infection.[2] Rest assured that you're putting your patients' safety first when using this dual formulation of sterile 2% CHG + 70% isopropyl alcohol (IPA) solution packaged in a one-step, single-use sterile applicator. Developed by our unique proprietary sterilization process,[1] we have achieved what may have been thought of as impossible. Discover the difference of overcoming antiseptic contamination. **Discover the new BD.**

References
1 Degala, et al. United States Patent 9,078,934. July 14, 2015.
2 Chang C, Furlong LA. Microbial stowaways in topical antiseptic products. *N Eng J Med.* 2012;367(23):2170-2173.

Discover our fully sterile skin prep products at **bd.com/SterileSolution**

BD

CORNERSTONE MEDICAL
Innovative solutions | Client-focused service

Introducing Clear*Panels*™

A mobile screen solution for easy and safe monitoring of patients

Clear*Panels*™ is part of Silentia's extensive screen system for various healthcare settings.

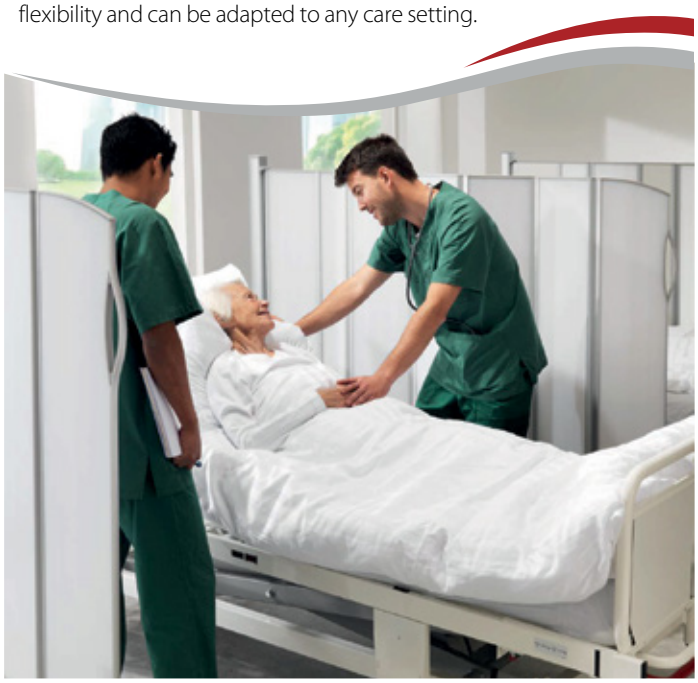
Emergency and examination room
Monitoring with a protective barrier

Easy to clean
Meets strict hygiene requirements

Clear*Panels* is a completely transparent, mobile screen that makes it easy to monitor and communicate with patients. It meets the healthcare sector's strict hygiene requirements with smooth and easily accessible surfaces that withstand disinfectants used in Canadian healthcare facilities.

Keep it *Clean*™

The demand for a hygienic area around the patient becomes more and more important everyday. Keep it *Clean*™ is Silentia's key motto for improved hygiene standards. Silentia's screen system has exceptional flexibility and can be adapted to any care setting.



The lightweight construction is user-friendly and optimizes stability and safety. Manufactured with recyclable materials, panels are made of polycarbonate that withstand disinfectants used in any healthcare setting.

Silentia Privacy Screens have been the altenative to privacy curtains since 1990.

To lean more, call 1-800-652-3895
or visit **www.cornerstone-medical.com**

Diversey™

Difficult Times Demand These Ideal Disinfection Solutions

powered by ACCELERATED HYDROGEN PEROXIDE Patented

Accel®

Accel®
Effective Disinfection With A Choice Of Dwell Times

Accel® INTERvention™
1 min. dwell time

Accel® PREvention™
3-5 min. dwell time

One-step cleaning and disinfection with a choice of dwell times. Effective against key pathogens – including MRSA, VRE, Norovirus, Rhinovirus and Influenza. Compatible with most hard, non-porous surfaces.

MoonBeam™3
Kills SARS-Cov-2 In Seconds*

Disinfection assurance is more important than ever. MoonBeam optimizes UV-C disinfection with three individually adjustable light arms that angle the UV light dose directly to high-touch surfaces.

* Based on third-party testing

Take infection prevention to a new level. Learn more at **sdfhc.com**

PROCESS CLEANING SOLUTIONS
Bringing Science to the Art of Cleaning

DISCOVER THE BENEFITS OF PCS NEUTRAL PH SODIUM HYPOCHLORITE'S

PCS Neutral PH Oxidizing Disinfectant Cleaning.

PCS Oxidizing Cleaning destroys organic soils that harbour and shield bacteria and viruses from chemical disinfectants. Organic soils often remain on surfaces after wiping with detergent based disinfectants.

PCS Neutral pH NPH 250 or 1000 Oxidizing Disinfectant/Disinfectant Cleaners. Using PCS Apply and Dry Cleaning Process Removes and Oxidizes large amounts of organic soils which include pathogenic bacteria and viruses.

Use PCS Apply and Dry Cleaning Process to prevent pathogen transfer to adjacent surfaces.

Quote from Health Canada

"Disinfectants, household cleaners, and bleach are meant to be used to clean surfaces."

Coming soon

Neutral pH PCS 1000 Plus Oxidizing Disinfectant Cleaner
- Oxidizing cleaner
- Oxidizing hospital grade Disinfectant
- Oxidizing broad spectrum virucide
- Active Ingredient 0.14% w/w Sodium Hypochlorite when packed

Neutral pH PCS 1000 Plus Oxidizing Disinfectant Cleaner for use on hard non-porous environmental surfaces in domestic, health care facilities, institutions, schools and hospitality industries, where organic soils may be present.

To clean and oxidize frequently touched surfaces Apply undiluted to surface wipe dry with microfiber or other clean dry absorbent cloth or rinse or allow to air dry.

To disinfect frequently touched surfaces such as non-critical medical equipment, bed rails, washroom fixtures and surfaces that are potential fomites in health care facilities, long term care, schools, institutions and in domestic settings.

Apply to pre cleaned surfaces allow surface to remain wet for time indicated below. Wipe surface dry, rinse or allow to air dry.

Bacteria/Virus	Contact time
Staphylococcus aureus (ATCC 6538)	5 minutes
Pseudomonas aeruginosa (ATCC 15442)	5 minutes
Human Coronavirus	2 minutes
Adenovirus Type 5	3 minutes

This product is a broad-spectrum virucidal hard surface disinfectant that is expected to inactivate the SARS-CoV-2 (the virus that causes COVID-19)

CALL FOR PAPERS

The *Canadian Journal of Infection Control* is a leading international peer-reviewed journal providing a platform for knowledge transfer and academic discourse in the field of infection prevention and control and hospital epidemiology. The journal invites submission of manuscripts outlining original research that examines, informs, and advances this professional field.

Authors should follow the content and format recommendations as outlined in the journal's Guidelines for Authors (**https://ipac-canada.org/canadian-journal-of-infection-control-3.php**). Manuscripts are accepted in English and French and should be submitted electronically by emailing all materials to the attention of:

Jim Ayukekbong, Editor-in-Chief
Canadian Journal of Infection Control
editor-in-chief@ipac-canada.org

A signed copy of IPAC Canada's Publisher-Author agreement must be received before a manuscript will be published. The agreement is available at **https://ipac-canada.org/canadian-journal-of-infection-control-3.php**. Please note that there is an approximate three- to four-month timeline between receipt of manuscript, peer review, editing, and publication. The *Canadian Journal of Infection Control* is a quarterly publication indexed by the Cumulative Index to Nursing and Allied Health Literature (CINAHL)/EBSCO, SilverPlatter Information, Inc. and CrossRef.

ipac pci
Infection Prevention and Control Canada
Prévention et contrôle des infections Canada

IPAC CANADA NATIONAL CONFERENCE

~~2020~~ 2021 VISION now What's on the Horizon?

VIRTUAL MAY 3-5 2021

SAVE THE DATE! WE ARE GOING *VIRTUAL!*

2021 NATIONAL
EDUCATION CONFERENCE
MAY 3-5, 2021

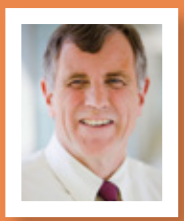
EDUCATION HIGHLIGHTS

COVID 19 – Lessons Learned and Moving Forward
COVID and TB in Vulnerable Populations
Clinical Practice in Long Term Care
Disaster Management
Communication Conundrums
Diagnostic Stewardship
Statistics Driving Policy
Disinfection Symposium
HOT TOPICS!

JOIN US AND HELP US CELEBRATE IPAC CANADA'S 45TH

ORAL PRESENTATIONS! POSTER PRESENTATIONS!

GUEST SPEAKERS



Dave Williams

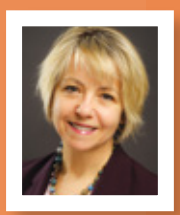
Defying Limits: Lessons from the Edge of the Universe

Keynote Address: Dr. Dave Williams
Record-breaking Astronaut, Aquanaut and Leadership Expert

Linda Duxbury

Burnout/Mental Health in Healthcare Workers

Speaker: Dr. Linda Duxbury
Canada's most accomplished researcher, writer and speaker on work-life balance, has influenced policy and attitudes to help create supportive work environments in both the private and public sectors.



Bonnie Henry

The COVID-19 Experience

Speaker: Dr. Bonnie Henry
Provincial Health Officer
Province of British Columbia

VIRTUAL INDUSTRY SHOWCASE! SPECIAL EVENTS! FUN EVENTS!

WHO SHOULD ATTEND?

Infection Prevention and Control Professionals and healthcare providers interested in the prevention and control of infections in all healthcare settings.

REGISTRATION

Will commence December 2020. See www.ipac-canada.org for program information.

SUBMIT ABSTRACTS

Deadline: January 8, 2021
Watch for guidelines to be posted and announced, November 2020.

FOR MORE INFORMATION:

IPAC Canada
info@ipac-canada.org
www.ipac-canaad.org

This journal would not be possible without the advertising support of the following companies and organizations. Please think of them when you require a product or service. You can also access the electronic version at *www.ipac-canada.org*.

Company	Page	Phone	Web Site
Alberta Health Services	149		www.ahs.ca/ipc
AMG Medical Inc.	IBC	800-665-4831	www.arjo.com
BD	179	866-979-9408	www.bd.com
Clorox Healthcare	144, 145	866-789-4973	www.cloroxhealthcare.ca
Cornerstone Medical Inc.	180	800-652-3895	www.cornerstone-medical.com
Diversey	156, 181	800-668-7171	www.sdfhc.com
Glo Germ Company	150	435-259-5931	www.glogerm.com
GOJO Canada, Inc.	151	800-321-9647	www.GOJOCanada.ca
HealthConnex Incorporated	177	800-279-8926	www.healthconnex.ai
Medco Equipment	147	800-717-3626	www.medcoequipment.com
Médic Accès	146	877-782--3017	www.medicacces.ca
Process Cleaning Solutions	182	877-745-7277	www.processcleaningsolutions.com
Sani Marc Group	178	800-361-7691	www.sanimarc.com
SC Johnson Professional CA Inc.	OBC	519-443-8697	www.debmed.ca
Tagg Design Inc.	176	416-249-2220	www.taggcleanhands.com
The Stevens Company Limited	148	800-268-0184	www.stevens.ca
TOMI Environmental Solutions, Inc.	152	800-525-1698	www.tomimist.com
Vernacare Canada Inc.	143	800-268-2422	www.vernacare.com
Virox Technologies Inc.	IFC	800-387-7578	www.virox.com

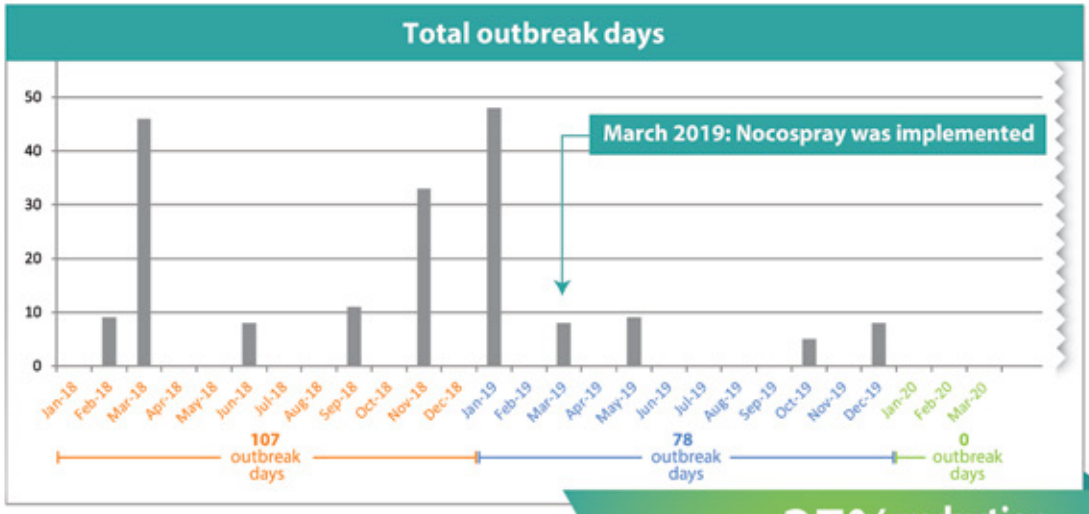
REDUCE THE RISK
OF ACUTE RESPIRATORY INFECTIONS (ARI)
LIKE THE FLU

WITH THE TOUCH OF A BUTTON

- Demonstrated efficacy against pathogens like VRE, *C.diff.*, and those that cause respiratory and gastrointestinal illness.*
- Works effectively in a small bathroom or a large common room.
- Includes data recording capability to make your improvements measurable and repeatable[T].
- Biodegradable. The **Nocospray System** disinfects without adding to landfills.
- Will not contribute to antimicrobial resistance.

* Customer reported result
T - 6 Principles of the Continuous Improvement Model

IMPACT OF NOCOSPRAY SYSTEM IMPLEMENTATION IN AN ONTARIO LONG TERM CARE HOME



2018 vs 2019 **27% reduction** in total outbreak days

Find out how the Nocospray system can help you!
Call 1-800-363-2381 or visit usat www.nocospray.ca

MedPro DEFENSE®

Rev1 09/20

SC Johnson
PROFESSIONAL
A Family Company™

BUILT ON A LEGACY OF

TRUST

For over a century, you've placed your trust in our innovative, high-quality brands, including skin care, air care, and surface care products, to clean and protect what matters—that's a responsibility we take seriously. Explore the ways our products work within healthcare environments. **Visit scjp.com**

SC Johnson Professional™ Healthcare
Protecting the patient, caregiver, and the healthcare environment

deb · pledge · Windex · Ziploc · MEYER'S CLEAN DAY