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INSIDE

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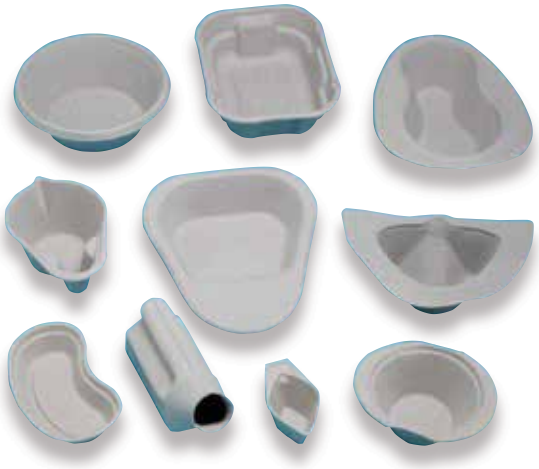

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New COVID-19 variants – is your disinfectant still effective?

Viruses, including SARS-CoV-2, the virus that causes COVID-19, evolve over time.[1,2] When a virus is circulating through a population, like during the COVID-19 pandemic, it is more likely to develop mutations (changes to the genetic material).[2] Once there are several significant mutations to the virus, this is called a new strain, or variant, of the virus.[1,2]

How do variants of the coronavirus develop?

The coronavirus SARS-CoV-2 is an enveloped virus. This means that the virus has a lipid layer around it. Coronaviruses are so named because of the protein "spikes" on the surface of the virus, which give it a crown-like appearance. It is these "spikes" that allow the virus to interact with human cells.[3]

In the variants of the COVID-19 virus, the protein spikes are different from those of the original virus.[3] This can raise concerns that the viruses are different in terms of time for transmission, or severity of disease.[1-3]

COVID-19 virus variants in Canada.

In Canada, there are several variants of concern that have been identified and are being tracked by provinces and the Public Health Agency of Canada, including B.1.1.7, B1.351 and P1.[2,3] Variant B1.1.7 was first detected in the U.K.; B.1.351 in South Africa; and P.1 in Brazil.[2] Recently, Ontario, Alberta and Quebec have detected cases of the B1.617 variant that was first identified in India.[4]

It has been noted that the UK and South African variants appear to spread more rapidly than the original virus, though they do not appear to cause more severe cases of COVID-19.[2,3]

As the numbers of cases of these new variants increases, you may be wondering about whether disinfectants will still be effective.

Effective cleaning and disinfection can help lower the chance of spreading the COVID-19 virus.[5]

Disinfectant efficacy.

The good news is that as an enveloped virus, even the variants of SARS-CoV-2 are still susceptible to disinfectants.[6]

Health Canada maintains a list of disinfectants which have been demonstrated direct and indirect effectiveness against SARS-CoV-2.[6] They also state that the disinfectants on this list are expected to be effective against all strains (variants) of SARS-CoV-2, as genetic changes in a virus are unlikely to affect the efficacy of a disinfectant.[6]

We know that effective disinfection is essential in helping to reduce the spread of the COVID-19 virus.[5,7,8] Since the COVID-19 virus is most likely to be on surfaces you frequently touch with your hands, Health Canada recommends that you clean and disinfect high-touch surfaces regularly to help reduce the chance of spreading the virus.[6]

Check the Health Canada website to see if your disinfectant is on the list.

CloroxPro® can provide disinfection solutions.

CloroxPro® has a range of disinfectant products that have demonstrated direct efficacy against the COVID-19 virus. When used as directed, all these products are approved by Health Canada as effective at killing the SARS-CoV-2 virus, some of them in as little as 15 seconds on hard, non-porous surfaces.

Learn more about the CloroxPro® products that can be used against SARS-CoV-2 at Cloroxpro.ca

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References: 1. World Health Organization. The effects of virus variants on COVID-19 vaccines. https://www.who.int/news-room/feature-stories/detail/the-effects-of-virus-variants-on-covid-19-vaccines#:~:text=When%20a%20virus%20replicates%20or,of%20the%20original%20virus. Accessed April 19, 2021. **2.** Government of Canada. Coronavirus disease (COVID-19): Outbreak update. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html. Accessed April 19, 2021. **3.** Tracking variants of the novel coronavirus in Canada. https://www.ctvnews.ca/health/coronavirus/tracking-variants-of-the-novel-coronavirus-in-canada-1.5296141 Accessed May 13, 2021. **4.** https://www.cbc.ca/news/canada/toronto/covid-19-ontario-april-23-2021-1.5999347 Accessed April 29, 2021 **5.** Government of Canada. Coronavirus disease (COVID-19): Prevention and risks. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks.html. Accessed April 19, 2021. **6.** Government of Canada. Hard-surface disinfectants and hand sanitizers (COVID-19): List of disinfectants with evidence for use against COVID-19. https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19/list.html. Accessed April 19, 2021. **7.** Health Europa. COVID-19 variants and implications for environmental hygiene. https://www.healtheuropa.eu/covid-19-variants-environmental-hygiene/106876/. Accessed April 19, 2021. **8.** Disinfectants with "virucidal activity against enveloped viruses" effective against SARS-CoV-2. https://www.news-medical.net/news/20201111/Disinfectants-with-virucidal-activity-against-enveloped-viruses-effective-against-SARS-CoV-2.aspx. Accessed April 19, 2021.

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- Toraysee™ cloth
- Bucket with rinse water

PROCEDURE

- Add 250 mls of PCS 5000 to the container, add Toraysee™ cloth and check the lid is secure, ensure the container has a workplace label.

To clean and disinfect with Toraysee™ cloth

- Remove lid from container
- Squeeze out liquid from Toraysee™ cloth
- Wipe over surfaces in one direction with damp Toraysee™ cloth

How to reuse

- Rinse cloth with water squeeze out liquid
- Replace cloth in PCS 5000 Oxidizing Disinfectant Cleaner
- PCS 5000 Oxidizing Disinfectant Solution disinfects Toraysee™ and saturates cloth for next use

To clean delicate or chemically sensitive surfaces

- Remove Toraysee™ from PCS 5000 Disinfectant solution
- Squeeze out liquid
- Rinse cloth in water and squeeze out liquid from cloth
- Wipe delicate surfaces or equipment with damp Toraysee™

These processes can be used for prolonged periods of time but common practice is to rinse Toraysee™ cloth at the end of use for the day and empty and rinse container. Water rinse Toraysee™ after use for the day, squeeze excess liquid from cloth and allow to air dry.

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- Toraysee™ after soaking in 1% sodium hypochlorite for 5 weeks removed 99.6% of soil as compared to 99.5% before treatment. Demonstrating Toraysee™ maintained excellent removal of organic soils even with prolonged presence of strong concentrations of sodium hypochlorite.

Cost of use - Based on 50 use applications per day. Toraysee™ cloth cost based on sixty days of use. Cost per day = .20		
Cost per day	=	.20
Number of cloths used for sixty days	=	1
PCS 5000 use per day 500 mls	=	1.50
Toraysee™ / PCS 5000 cost per day	**=**	**1.70**
Cost per day 5990 • 50 12”x12” wipes per day	**=**	**22.00**
NUMBER OF WIPES USED IN SIXTY DAYS	=	3000
Cost per day 5987-6 • 7”x12” wipes per day	**=**	**12.27**
NUMBER OF WIPES USED IN SIXTY DAYS	=	3000
Bucket saturation of microfiber cloths 3 L	=	8.88
Cost of microfibre cloths 50 required launder cost + Cost of cloths	=	8.34
Number of cloths used sixty days	=	50
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(3) Demonstrate that repeated use of the process that a single Toraysee™ cloth could be repeatedly used for extended periods of time.
(4) Provide repeated test demonstrating PCS 5000 Oxidizing Disinfectant Cleaner with Health Canada approved label claim to kill C. difficile spore form can remove organic and inorganic soils from Toraysee™ without the need for any additional decontamination processes.

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References: **1.** Higgins C, Palmer A, Cahill J, Nixon R. Occupational skin disease among Australian healthcare workers: a retrospective analysis from an occupational dermatology clinic, 1993-2014. Contact Dermatitis. 2016;75(4):213-22 **2.** Heese A, Hintzenstern JV, Peters K, Koch HU, Hornstein OP. 1991. Allergic and irritant reactions to rubber gloves in medical health services. Journal of the American Academy of Dermatology. 25:831-839.

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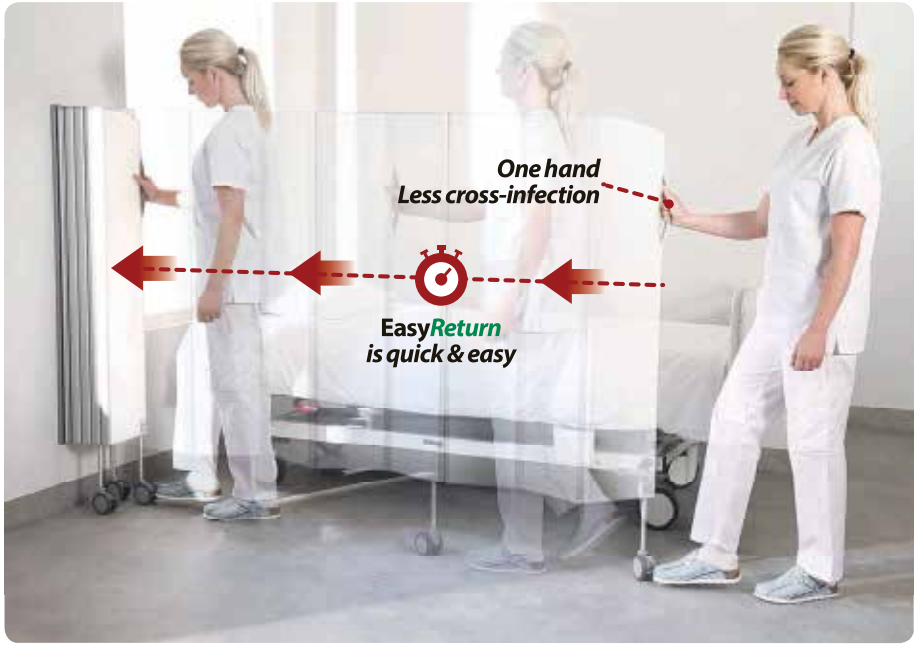

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EDITOR
Dr. Jim Ayukekbong, BMLS, Msc, PhD, CIC
Vice President
Infection Prevention and Control
Southbridge Care Homes
766 Hespeler Road, Cambridge, ON N3H 5L8
editor-in-chief@ipac-canada.org

ASSOCIATE EDITOR
Devon Metcalf, MSc, PhD, CIC
Infection Prevention and Control Specialist
Public Health Ontario
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POSTING EMPLOYMENT OPPORTUNITIES/OTHER INFORMATION
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PUBLISHER
Craig Kelman & Associates

3rd Floor, 2020 Portage Avenue, Winnipeg, MB R3J 0K4
Tel: (204) 985-9780 Fax: (204) 985-9795
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EDITOR - Reba R. Lewis
DESIGN/PRODUCTION - Jackie Magat
MARKETING MANAGER - Al Whalen
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IPAC Canada
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Public health and human rights during a pandemic – An unresolved dilemma concerning mandatory vaccination against COVID-19 for healthcare workers

James Ayukekbong, BMLS, MSc, PhD, CIC
Editor-in-Chief, Canadian Journal of Infection Control

EDITORIAL

Several vaccines against COVID-19 are currently being administered around the world, but uptake in some regions is suboptimal and the debate regarding mandatory vaccination has been raging with varying opinions. Italy recently made an exceptional decision to make COVID-19 vaccination mandatory for all healthcare workers (HCWs), after discovering outbreaks in hospitals that were linked to the refusal by staff to be vaccinated [1]. In other countries like Canada and the United States, authorities are struggling with the need to balance public health and human rights in order to achieve high vaccination uptake necessary to break the chain of transmission of the disease. Amidst these challenges, governments have both a duty to *respect* and to *protect,* and therefore, have to balance the respect of human rights and the protection of public health within the context of mandatory vaccination, especially for HCWs [2].

To be effective, any mandatory vaccination policy must establish a tangible connection between vaccination and a reduced risk of COVID-19 transmission. Of course, current data provides overwhelming evidence that COVID-19 vaccination reduces the risk of infection, and to effectively combat the disease, vaccine acceptance needs to reach a threshold to achieve herd immunity. This so-called herd immunity occurs when a large portion of a population becomes immune to a disease, making the spread of the disease from person to person unlikely. As a result, the population becomes protected – even those who have not been vaccinated [3]. Unfortunately, voluntary vaccination (especially with low uptake) is unlikely to be sufficient to achieve and maintain herd immunity. As a result, it becomes imperative for public health authorities to explore ways to achieve the anticipated level of population immunity required to interrupt transmission and control the disease. In this regards, a policy for mandatory vaccination could ensure high levels of vaccination coverage, but may come with legitimate human right concerns [4]. A study from Germany suggests that half of participants were in favour, and half against a policy of mandatory vaccination against COVID-19 [5]. The approval rate for mandatory vaccination was significantly higher among those who would get vaccinated voluntarily than among those who would not get vaccinated voluntarily [5]. It should be noted that there is also a large body of literature on the justification for the use of coercion in public health and infection control [6], and the sole ground for the use of such coercion (including restriction of liberty) is when there is risk of harm to others. It has also been suggested that for highly contagious and life-threatening diseases constituting a grave threat to public health, quasi-mandatory vaccination measures are likely to be justified [6]. On the other hand, international human rights prescribe that vaccination – like any other medical intervention, must be based on the recipient's free and informed consent. Bioethicists also suggest that people have a right to decide what they're willing to take into their body, and making vaccination mandatory violates that fundamental human right. Also, informed consent, whether expressed or implied, is an essential prerequisite of individual healthcare treatment, including vaccination [7]. Administering medical treatment in the absence of informed consent exposes healthcare professionals to liability. As a matter of fact, the requirement of informed consent protects an individual's right to bodily integrity and the only exception is in situations of emergency where the individual lacks the ability to provide consent.

In fact, the issue of mandatory vaccination may be peculiar because it involves the introduction of a foreign substance into the body, but mandating vaccination is not the only public health intervention that may violate human rights. Overall, the COVID-19 pandemic has provided many instances where constraints on individual rights and freedoms have been presented as justified in order to meet public health goals. For example, travel bans, social distancing, quarantine, restrictions on gatherings, mandatory masking, contact tracing and many other COVID-19-related measures adopted around the world have breached or constrained human rights. These rights include freedom of movement and association, the right

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to education, the right to work and the right to privacy. Although this may be construed as violation of rights, these steps are taken to protect the most fundamental of all human rights: the right to life. Therefore, compulsory vaccination of eligible population is not more a violation of human rights than already instituted public health measures. Indeed, mandatory vaccination interferes with human rights, but may be necessary to safeguard public health [8].

In discussing this topic further, it should be noted that vaccine hesitancy may be for several reasons; medical, religious, cultural, or even phobia of injections. For others, it may just be a conscientious objection to receiving a vaccine. Therefore, a distinction should be made between someone who refuses a vaccine for medical reasons as opposed to being afraid or not believing in vaccines. Within this context, individuals may be accommodated to the point of "undue hardship" where prohibitive grounds are justified, but such accommodation may not apply where prohibitive grounds aren't justified [9].

From an occupational health and safety perspective, current legislations require employers to protect their workers from health and safety risks in the workplace. If vaccination can be shown to effectively minimize the transmission of COVID-19, then mandatory vaccination policies may be argued to be one way to satisfy this obligation [9, 10]. In long-term care or healthcare facilities where vulnerable residents are cared for, employers may be able to introduce policies that protect their residents and workers from health and safety risks in the workplace. Unions may oppose such policies by filing a "grievance", but it is up to an arbitrator to determine whether the policy is a reasonable exercise of the employer's management rights under the collective agreement, or within the context of occupational health and safety legislation. A recent example is that of Jennifer Bridges *et al* (Plaintiffs) and the Huston Methodist Hospital *et al* in Texas (Defendants), where the Plaintiffs sued the Defendants for instituting a policy that required employees to be vaccinated against COVID-19 by June 7, 2021. In this case, the district judge ruled in favour of the Defendant and the case was dismissed [11].

In Canada, COVID-19 vaccination rates among long-term care workers are significantly lower compared to the rates among residents they care for. More than 95% of long-term care and retirement home residents in the country have received at least the first dose of the COVID-19 vaccine, while vaccine hesitancy among employees continues to be an issue of concern [12]. Particularly concerning is the fact that residents (including even those who are vaccinated) are often confined to their rooms after staff members test positive for COVID-19. HCWs have a moral and ethical responsibility to care for their patients or residents and should, therefore, not constitute risk to them. By not being vaccinated and being vulnerable to infection and subsequently constituting a potential source of infection to patients or residents, renders this care unsafe [13]. If one should argue that mandating vaccination for HCWs violates their human right, then providing unsafe care, or putting vulnerable residents in harm's way is also ethically fallacious and violates residents' right to safety in their home.

The subject of mandatory immunization is not entirely new in healthcare. The United States Centers for Disease Control and Prevention recommends that HCWs should receive vaccines against preventable diseases like Tuberculosis, Chickenpox, Measles, Mumps, Rubella, Hepatitis B, etc. [14], and most healthcare facilities have implemented this policy as part of their occupation health and safety plan. But in all fairness, considering the fact that vaccination involves the introduction of an active biological substance into a healthy body, it is not uncommon for it to be associated with fear or anxiety and leading to hesitancy, especially if medical or scientific data is limited, or does not fully address the issue of long-term adverse effects [15]. Another element that may diminish confidence is the fact that several Western countries have exempted manufacturers from liability in the rare case where a person suffers serious illness or injury as a result of the COVID-19 vaccine [16]. In fact, some countries agreed to indemnify vaccine manufacturers for civil-legal claims as part of the purchase pact. This "no-fault" agreement prevents the legal right of an individual to sue should they suffer significant injury arising from the inoculation of the vaccine. Therefore, it could be argued that if a government should make the COVID-19 vaccine mandatory, then, there should be some compensation to individuals who suffer significant injury arising from the vaccine [15].

In conclusion, mandatory vaccination for HCWs may not necessarily mean punishment for those who opt not to get a vaccine, but may simply mean a prerequisite to provide direct care to vulnerable population [11]. But with the current shortage of HCWs in long-term care in Canada for example, if unvaccinated employees are restricted, then this could lead to a reduction in the already overwhelmed workforce putting a strain on the sector and jeopardizing even further the care of seniors. Together, any mandatory vaccination policy, however justified, must provide accommodations for individuals who have legitimate reasons for not receiving the vaccine. Public health authorities must continue to explore other strategies to encourage vaccine uptake through education and building of vaccine confidence. Institutions may also implement risk mitigation strategies such as mandatory masks and face shields and frequent COVID-19 testing for unvaccinated persons.

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ORIGINAL ARTICLE

Neonatal intensive care unit hand hygiene: Exploring current practice and adherence barriers in a Canadian hospital

Sachin Pasricha, MD[1]; Chantal R. Valiquette, MD[1]; Megan Singh, MD[1]; Rohini Pasricha[1]; Darwin Jimal[1]; Faiza Khurshid, MD, FCPS, Msc[1,2]

[1] *Queen's University School of Medicine; Kingston, Ontario, Canada.*
[2] *Department of Pediatrics, Kingston Health Sciences Centre; Kingston, Ontario, Canada.*

Corresponding author:
Sachin Pasricha, MD
Kingston Health Sciences Center
Watkins 3, Room 4 3 218
76 Stuart Street
Kingston, ON K7L 2V7
spasricha@qmed.ca

ABSTRACT

Background: Given nosocomial infections remain a prominent issue in the Neonatal Intensive Care Unit (NICU), this quality improvement study aimed to observe adherence to the NICU Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE) guidelines, identify barriers to adherence, and propose solutions for improving adherence.

Methods: Investigators observed and statistically compared adherence (using an N-1 chi-squared test and two-tailed $p < 0.05$ representing significance) of Healthcare Practitioners (HCPs) in the NICU to the MHH and BBE guidelines for 24 one-hour shifts, stratifying by moment, body part, participant role, and time. HCPs and families completed questionnaires to identify adherence barriers. Questionnaire and observational data underwent qualitative thematic analysis to identify potential barrier solutions.

Results: Moment 1A (before contact with the environment outside the patient's isolette) adherence of (51%) was lowest and significantly different than adherence to Moments 1B (before entering the isollette) (66%, $p<0.05$), moment 3 (after potential body fluid exposure) (81%, $p=0.02$), and moment 4 (upon leaving the care environment) (60%, $p=0.01$). Nursing MHH adherence (61%) was significantly better than medical staff/trainee (38%) ($p=0.002$) and family member adherence (44%) ($p=0.02$). Forearm BBE adherence (53%) was lowest and statistically different from wrist (85%), hand/finger (91%), and nail (96%) adherence (all $p=0.01$). Daytime (82%) and nighttime (73%) BBE adherence were significantly different ($p=0.006$). A majority of providers identified skin irritation, forgetfulness, and busy environment as MHH barriers, and lacking a secure jewelry location and forgetfulness as BBE barriers, while almost all family members found hand hygiene equipment to be available and constantly filled.

Conclusions: MHH adherence differs by moment and participant role, and BBE adherence differs by body part and time, justifying targeted interventions. Strategies such as secure jewelry storage, better temperature regulation in the unit, more hand lotion, and improved signage may improve adherence.

KEYWORDS: Neonatology, Infection Control, Hand Hygiene, Quality Improvement

INTRODUCTION

Nosocomial infections are a prominent issue for hospitals and patients [1, 2], particularly in the Neonatal Intensive Care Unit (NICU), where infection rates can be as high as 25% [3, 4], reflecting inherent patient vulnerability from exposure to invasive procedures. Neonatal nosocomial infections are associated with adverse outcomes, including prolonged hospitalization, morbidity, and mortality [5, 6].

Hand hygiene is a globally recognized best practice in infection prevention and control [7]. The World Health Organization (WHO) and Public Health Ontario guidelines suggest implementing institutional multifaceted hand hygiene programs to ensure compliance [7, 8]. Adhering to the Moments of Hand Hygiene (MHH) and providing alcohol-based hand rub at point of care is essential, but remains challenging. Ontario's Provincial Infectious Diseases Advisory Committee (PIDAC) issued the 2015 perinatology best-practice guideline, which divides the neonatal and immediate neonatal care environments, thereby establishing an extra MHH on entry to the isolette/warmer (i.e., there were five NICU MHH) in Ontario. These five moments of hand hygiene include: **1A)** before contact with the immediate care environment (including the monitors, machines, chart, and outside the isolette), **1B)** before contact with the neonatal environment

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(inside the isolette), **2)** before an aseptic procedure, **3)** after potential body fluid exposure, and **4)** after leaving the immediate care environment. The PIDAC guidelines also stress the importance of being Bare Below the Elbow (BBE) (i.e., no bracelets, rings, or watches should be worn in the provision of direct neonatal patient care) [9]. This is because white coats, rings, and artificial nails may potentially harbor microorganisms [10-12].

Adherence to the PIDAC best practice guidelines reduces NICU nosocomial infection [13]. For example, studies suggest that a target of 80% hand hygiene adherence can translate to a nosocomial infection rate of one infection per 100 patient days in the NICU [14], justifying audit and feedback initiatives to improve guideline adherence. According to the United States Joint Commission, there are three ways to audit adherence: direct observation, measuring product use, and survey questionnaires [15]. In Ontario, the "Just Clean Your Hands" campaign provides a tool to audit adherence [8]. However, this tool is not equipped to observe the NICU microsystem and its additional MHH. The absence of the additional 1B moment on auditing tools prevents us from understanding how well the five MHH are adhered to. To our knowledge, there is no published literature that addresses how well the five MHH and BBE practices are followed in Canadian NICUs. Moreover, there is limited information regarding barriers specific to NICU hand hygiene, which is important because hand hygiene is a behavioural practice; understanding barriers can translate into the development of positive reinforcement techniques, which promote long-lasting attitude changes [16].

The present study employs direct observation and questionnaires, as suggested by the Joint Commission, to address this gap in the literature [15]. The specific objectives are to **1)** Observe adherence to the PIDAC's 2015 MHH and BBE guidelines in a Canadian NICU, **2)** Survey Healthcare Providers (HCPs) and families to reveal their perceptions of performing hand hygiene and adherence behaviors, and **3)** Propose solutions towards improving adherence.

METHODS

Study Design

This cross-sectional study took place from March 4 to August 27, 2018 in the NICU. It consisted of direct observation and questionnaires.

Setting

The Kingston Health Sciences Centre NICU is a 24-bed level II/III care facility that sees approximately 400 admissions per year. Hospital hand hygiene audits are part of routine accreditation reports mandated by the provincial Ministry of Health. The NICU-specific results are reviewed by a nursing manager quarterly. The present study's observations took place outside of the regular audits.

Institutional Review Board

The study was approved by the KHSC Research Ethics Board. The Project was completed with the assistance of hospital administration allowing direct observation.

Observation

Personnel: HCPs and patient families were directly observed. HCPs included trainees, nurses, physicians, respiratory therapists, and those not providing direct care, but accessing the environment (e.g., maintenance staff). Of note, though patient families are not universally trained in hand hygiene, they do get an abbreviated hand-hygiene training in our NICU and were therefore observed.

Data Collection: Five observers (S.P., C.V., M.S., R.P., D.J.), whom are medical students or resident physicians and were trained by the study's supervising investigator who specializes in quality improvement, performed one-hour mock observation and discussed what actions constitute violating adherence, so as to reduce interobserver variability. The observers individually observed on weekdays and weekends for 24 one-hour shifts (13 day shifts between 07:00 and 19:00 hours, and 11 night shifts between 19:00 and 07:00 hours). Two shifts, maximum, were performed per day. Observation periods intentionally overlapped with nurse handover, meals, and family visitation. Investigators used an adapted version of the "Just Clean Your Hands" campaign observational tool to record moments of adherence and non-adherence to both the MHH and BBE guidelines during these observational periods [8]. Observers recorded only adherence and non-adherence events that were directly witnessed. The adapted observation tool also had designated space for qualitative comments.

Questionnaire

Recruitment: For the HCP questionnaire, an email was distributed to 60 NICU nurses/allied health professionals and 20 neonatologists/pediatric residents through Qualtrics, an online survey platform, with the link to study details and questionnaire. Inclusion was based upon providing consent through Qualtrics, which was voluntary. The email was re-sent at two weeks and four weeks following the initial email. For a six-week period, the patient family questionnaire was printed and distributed to every patient family member if the patient's stay was more than seven days, as these family members are likely to spend a significant amount of time in the NICU. This included 40 families. Participation was voluntary and returning a completed questionnaire was considered implied consent. A record sheet was maintained to avoid duplicate entries.

Questionnaire Content: The HCP questionnaire included three demographic questions, five knowledge questions, and 23 Likert scale items to assess perceived adherence barriers. The knowledge assessment portion of the HCP questionnaire was adapted from a guide to improve hand hygiene by the Institute for Healthcare Improvement [17]. The patient family questionnaire included four demographic questions and 15 Likert scale items to assess attitudes and perceived barriers that could not be directly observed. The Likert scale questions were derived from literature review [13-16].

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Data Analysis

Observation: The MHH adherence rate was stratified by the five moments, participant role (e.g., doctor, nurse, family member), and time (e.g., day, night). The BBE adherence rate was stratified by body part (e.g., hand/finger, wrist, and forearm), participant role, and time. Based on these stratifications, adherence was statistically compared with an N-1 chi-squared test with a two-tailed alpha of 0.05 [18]. Verbatim observer comments were collated to inform qualitative analysis, but are, however, not reported as a separate component of this study.

Questionnaire: Results were reported descriptively. That is the number and percentage of respondents that answered each question with a specific item. Demographic and knowledge-based questions were treated as categorical data and Likert scale items as ordinal data.

Thematic analysis: Qualitative thematic analysis was performed using an inductive approach. Five reviewers (S.P., C.V., M.S., R.P., and D.J.) reviewed the observation and questionnaire results to independently identify barriers to adherence to the MHH and BBE guidelines and place these barriers on Ishikawa diagrams (fishbone diagrams that attempt to discern the cause of an event that are commonly used in quality improvement studies) [19]. The reviewers then independently proposed solutions to poor adherence and graphed them on two PICK (Possible, Implement, Challenge, and Kill) charts (2x2 table that categorizes solutions to a problem based on payoff and difficulty) [20]. Each chart reflected potential interventions to increase adherence to the MHH and BBE guidelines respectively. The five reviewers then collaborated using the independently created Ishikawa diagrams and PICK charts to create two cumulative Ishikawa diagrams and two cumulative PICK charts (one for MHH and one for BBE respectively), and then decide upon three most optimal MHH and BBE-related interventions.

RESULTS

Observation

Overall, MHH adherence was 59% (571/974). Moments 1A and 2 were least adhered to (51% and 50%, respectively). There was a statistically significant difference between Moment 1A adherence compared with 1B (66%, $p<0.05$), 3 (81%, $p<0.05$), and 4 adherence (60%, $p=0.01$) (Table 1). Additionally, we

TABLE 1: Observed Adherence to Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE).

Moment or Part of Body	Description	Overall Adherence (95% CI, N)	Adherence stratified by type of person (N)				Adherence stratified by time of day (N)	
			Doctor/ medical trainee	Nurse or nursing trainee	Family Member	Other	Day (0700-1900h)	Night (1900h-0700h)
1A	Sanitizes hands before contact with the immediate care environment[1]	51% [1B,3,4] (46-56%, 383)	37% (27)	53% (307)	46% (24)	48% (25)	51% (205)	52% (178)
1B	Sanitizes hands before contact with the neonatal environment[2]	66% [1A] (60-73%, 195)	50% (2)	68% (178)	57% (7)	38% (8)	65% (86)	67% (109)
2	Sanitizes hands before aseptic procedure	50% [3] (26-75%, 16)	N/A (0)	57% (14)	N/A (0)	0% (2)	50% (10)	50% (6)
3	Sanitizes hands after potential body fluid exposure	81% [1A,2,4] (69-94%, 37)	100% (1)	80% (35)	100% (1)	N/A (0)	100% (11)	73% (26)
4	Sanitizes hands after leaving the immediate care environment[1]	60% [1A,3] (55-66%, 343)	33% (15)	62% (296)	27% (11)	76% (21)	65% (161)	57% (182)
Overall	Moments of Hand Hygiene Adherence % (95% CI)	59% (55-62%, 974)	38% [N] (24-52%, 45)	61% [D,F] (57-64%, 830)	44% [N] (29-59%, 43)	55% (42-68%, 56)	59% (55-64%, 473)	58% (54-62%, 501)
Forearm	Including long sleeves, clothing, etc.	53% [w,h,n] (45-60%, 170)	40% (5)	52% (149)	64% (14)	50% (2)	58% (92)	47% (78)
Wrist	Including watches, bracelets, etc.	85% [f,n] (79-90%, 149)	80% (5)	89% (132)	42% (12)	N/A (0)	82% (79)	87% (70)
Hand/ Finger	Including wedding bands, excluding gloves	91% [f] (87-96%, 146)	80% (5)	93% (129)	80% (10)	50% (2)	94% (78)	88% (68)
Nail	Including nail polish, long/ artificial nails,	96% [f,w] (93-99%, 156)	100% (9)	97% (132)	92% (13)	50% (2)	98% (85)	94% (71)
Overall	Bare Below the Elbow Adherence % (95% CI)	80% (77-84%, 621)	79% (63-95%, 24)	82% (79-85%, 542)	69% (57-83%, 49)	50% (10-90%, 6)	82%* (78-86%, 334)	73%* (68-78%, 307)

[1A, 1B, 2, 3, 4] Significant difference with adherence to Moments 1A, 1B, 2, 3, and 4 respectively

[f, w, h, n] Significant difference with adherence to forearm, wrist, hand/finger, and nail respectively

[D, N, F, O] Significant difference with doctors & medical trainees, nurse and nursing trainees, family member, and other personnel respectively (noting that significance testing with Others for BBE could not be calculated because of a low sample size)

*Significant difference between day and night

Note: significant differences imply a two-sample chi-squared test with $p<0.05$.

TABLE 2: Healthcare provider beliefs about potential barriers to adhering to the Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE) guideline.

	N of healthcare providers who indicated that they ____ with the statements on the left.				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Lack of Awareness (BBE)	4	7	2	5	5
Lack of Knowledge (BBE)	4	7	2	6	4
Lack of a secure location to store jewelry (BBE)	4	9	4	4	2
Religious influences (BBE)	0	5	6	8	4
Cultural influences (BBE)	0	5	6	8	4
Forgetfulness (BBE)	3	12	4	2	2
Lack of random auditing (BBE)	7	3	5	7	1
The busy NICU environment (BBE)	1	5	3	10	4
Time constraints (BBE)	1	6	3	9	4
Lack of Awareness (MHH)	6	7	0	7	4
Lack of Knowledge (MHH)	5	5	1	10	3
Belief that the MHH do not contribute to patient care (MHH)	4	2	1	7	10
Poor placement of hand sanitizers (MHH)	6	4	2	8	4
Empty hand sanitizers (MHH)	6	3	3	10	2
Poor labelling of hand sanitizers (MHH)	3	3	1	7	9
Skin irritation caused by hand sanitization (MHH)	2	16	3	1	2
Forgetfulness (MHH)	3	13	0	5	3
Lack of random auditing (MHH)	2	3	5	9	5
The busy NICU environment (MHH)	2	14	1	4	3
Time constraints (MHH)	1	10	4	5	4
Lack of Awareness (BBE)	4	7	2	5	5
Lack of Knowledge (BBE)	4	7	2	6	4
Lack of a secure location to store jewelry (BBE)	4	9	4	4	2
Religious influences (BBE)	0	5	6	8	4
Cultural influences (BBE)	0	5	6	8	4
Forgetfulness (BBE)	3	12	4	2	2
Lack of random auditing (BBE)	7	3	5	7	1
The busy NICU environment (BBE)	1	5	3	10	4
Time constraints (BBE)	1	6	3	9	4

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found Moment 3 was the most adhered to (81%). There was a statistically significant adherence difference between Moment 3 compared with 1A, 2, and 4 (p=<0.05 for all three). When comparing participant role, there was a statistically significant difference between medical staff/trainee (38%) and nurse/nursing trainee adherence (61%, p=0.002), as well as family member (44%) and nurse/nursing trainee adherence (p=0.02), though the number of observations for medical staff/trainees (45) and families (43) were less than for nurse/nursing trainees (830).

Overall, BBE adherence was 80% (499/621). Forearm adherence was least common (53%), with a statistically significant difference compared with wrist (85%), hand/finger (91%), and nail (96%) adherence (all p<0.05). There was also a statistically significant difference between nighttime (73%) and daytime BBE adherence (82%) (p=0.006).

Questionnaire

Twenty-four of 60 HCPs (40% response rate) completed the entire online questionnaire, which included two of 10 medical staff/trainees (20%) and 21 of 60 nurses/nursing trainees/allied healthcare personnel (35%). Of note, not every respondent answered every question. Twenty-six of 40 patient families (65%) completed the questionnaire.

With respect to the HCP questionnaire, 18 of 24 (75%) respondents indicated skin irritation, 16 of 24 (67%) indicated forgetfulness, and 16 of 24 (67%) indicated the busy NICU environment as barriers (Table 2). A total of 15 of 23 (65%) respondents agreed or strongly agreed that forgetfulness and 13 of 23 (57%) agreed or strongly agreed that the lack of a secure location to store jewelry and other valuables are barriers to adhering to the BBE guideline. Of note, five of 23 (22%) respondents disagreed or strongly disagreed that they or other HCPs are comfortable commenting on witnessed failure to adherence to MHH/BBE guidelines.

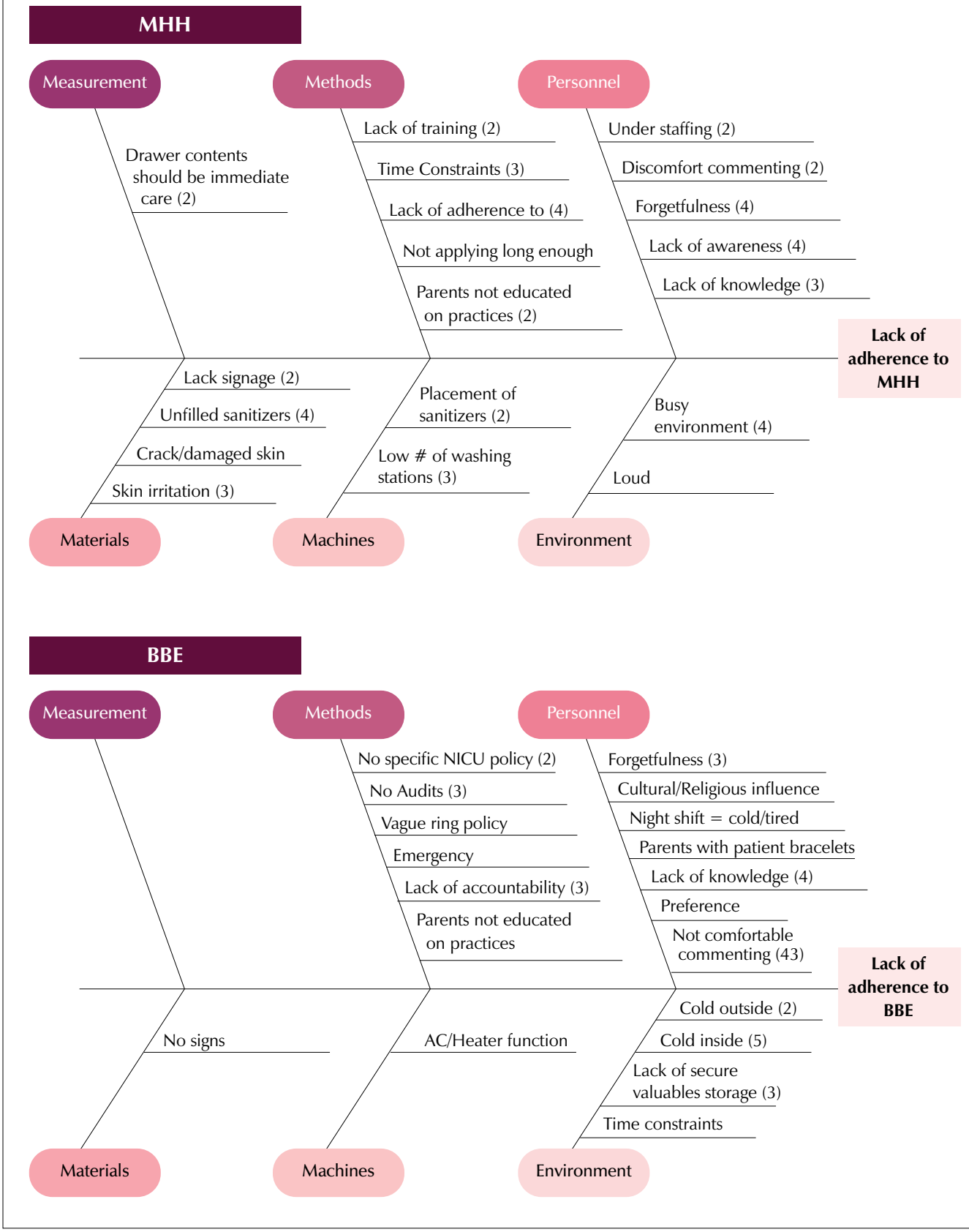
With respect to the patient family questionnaire, the majority of respondents agreed or strongly agreed that hand hygiene equipment is available in the NICU (25 respondents, 96%), at the bedside (24 respondents, 92%), is well labelled (23 respondents, 88%) and is constantly filled (23 respondents, 88%) (Table 3).

TABLE 3: Family member responses to Likert scale items on questionnaire regarding Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE).

	N of family members who indicated that they ____ with the statements on the left.				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1. HH discussed by HCP	18	5	1	1	1
2. HH discussed with visitors	16	7	1	0	2
3. I Practice HH	21	3	0	1	1
4. I Practice HH before the Immediate Care Environment	22	2	1	0	1
5. I Practice HH before establishing contact with an infant	22	1	0	1	2
6. I Practice HH before leaving the Immediate Care Environment	14	4	2	4	2
7. I Practice HH before possible body fluid exposure	23	1	0	1	1
8. Washing stations and hand sanitizers are available in the NICU	24	1	0	0	1
9. Hand sanitizers are available at the bedside	23	1	1	0	1
10. Hand hygiene equipment is well labelled	21	2	2	0	1
11. Hand hygiene equipment is constantly filled	20	3	2	0	1
12. I often forget to perform HH	2	1	1	2	19
13. HH does not take too much time	22	2	1	0	0
14. HH does not cause skin irritation	11	6	4	2	2
15. I consistently see HCPs performing HH	21	2	1	1	1

HH=Hand Hygiene; HCP=Healthcare Provider; NICU=Neonatal intensive care unit

FIGURE 1: Ishikawa diagram illustrating potential barriers to lack of adherence of Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE).



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Qualitative Thematic Analysis

The collaborative data analysis process conducted by investigators resulted in Ishikawa diagrams (Figure 1) that identified barriers to MHH and BBE adherence. The most commonly identified MHH barriers were lack of awareness, forgetfulness, and unfilled sanitizers (each identified by four of five reviewers), followed by time constraints, lack of knowledge, skin irritation, and lack of washing stations (each identified by three of five). The most commonly identified BBE barriers were cold temperatures (identified by five of five reviewers), lack of knowledge (identified by four of five), forgetfulness, lack of accountability, lack of auditing, and the fact that parents are uncomfortable commenting about HCP non-adherence (each identified by three of five). The PICK charts identified potential implementations that could improve adherence as depicted in Figure 2. The three most optimal MHH-related implementations were: placing hand lotion in the NICU alongside signage that using it to alleviate skin irritation is permitted, improving parent education, and improving overall MHH signage. The three optimal BBE-related implementations were: a poster targeted at rolling up your sleeves, improving temperature regulation, and having secure pouches to store jewelry.

FIGURE 2: PICK charts illustrating potential implementations to improve adherence of Moments of Hand Hygiene (MHH) and Bare Below the Elbow (BBE).

MHH	High Impact	Low Impact	BBE	High Impact	Low Impact
High Effort	• Re-check visitor understanding at each visit • Revise MHH to include drawer in immediate care environment • Increase number of random audits • Develop technology signage on MHH awareness • Educational talks/seminars • Demonstration table for visitors on hand hygiene • Monthly reminders • Reorganize NICU environment • Standard parent educational quizzes • Redesign policy on visitor discussions re: MHH	• Increase number of sinks in NICU • Increase staffing • Development of online modules/ videos regarding MHH polices/ practices • Increase frequency of sanitizer fill checks	**High Effort**	• Weekly reminders on BEE guidelines • Improve temperature regulation in NICU • Ban the wearing of long sleeve clothing and any kind of ring • Develop seminar series on BEE guidelines • Provide lockers for HCP and visitors to keep valuables • Provide t-shirt (mandatory) for all HCP and visitors to wear in NICU	• Develop online modules • Ban sweaters
Low Effort	• Provide hand lotion bottles in NICU for HCP and visitors to use • Develop a sign that says "hand lotion = OK" • Develop a sign encouraging visitors to comment on HCP non-adherence to MHH protocols • Develop signs to increase MHH awareness • Increase location of sanitizer dispensers • Create stickers saying "have you sanitized?"	• Replenish hand sanitizers more often • Develop paper pamphlet on MHH • Increase number of hand sanitizers available in NICU • Develop better labeling for hand sanitizer bottles • Anonymous Suggestion Box/ feedback box for patients to provide feedback on HCP compliance to MHH practices	**Low Effort**	• Develop targeted posters (e.g. educational awareness, telling parents to comment on HCP non-adherence) • Distribute NICU specific Policy to all HCP and visitors • Provide jewelry pouch in locker/scrub pocket for all HCP and visitors to keep valuables in	• Develop paper pamphlet on BBE Guidelines and practices

DISCUSSION

This study evaluated hand-hygiene adherence according to PIDAC's NICU-specific MHH and BBE guidelines and identified resource-efficient solutions that may improve adherence. Among the MHH, adherence varied widely by moment and provider, with Moment 1A and 2 least adhered to, Moment 3 most adhered to, and nursing staff having better adherence than medical staff. As for the BBE guideline, adherence varied by body part and time, with forearm adherence least common and daytime adherence better than nighttime. Identified solutions to improving adherence included hand lotion stations, improved signage, a secure jewelry location, and improved temperature regulation.

The primary aim of the study was to observe adherence to NICU hand-hygiene guidelines. Prior literature describes that NICU MHH adherence may be as high as 79% [21], and routine audit data provided by the KHSC NICU ranged from 80-90% in previous fiscal years. Conversely, our study found an overall adherence rate of only 59%. Our study adds to the literature by directly addressing PIDAC recommendations and providing a stratified analysis of MHH and BBE adherence, whereas most prior studies and routine hospital audits do not. Our study sheds light on five specific findings. First, we found that adherence to Moments 1A, 1B, 2, and 4, and forearm adherence to the BBE guideline are all below 80%, which is an important threshold that seems to correspond with an infection rate of 1 infection per 100 NICU patient days [14]. Second, Moment 1B was more adhered to than Moment 1A, suggesting that HCPs may be more cognizant of interactions with the neonate than surrounding equipment. Third, Moment 3 was the only moment with greater than 80% adherence, which may be due to visible soiling of hands after body fluid exposure serving as a reminder to complete hand hygiene or the routine of completing hand hygiene after removal of Personal Protective Equipment which is used during potential body fluid exposures. Fourth, our analysis supports evidence from prior studies that suggest nurses/nursing trainees have better adherence than doctors/medical trainees [22]. Finally, with respect to the BBE guidelines, forearm and nighttime adherence were low, often due to HCPs wearing sweaters at nighttime. Wearing sweaters below the elbows is important to identify and avoid because hospital uniforms carry significant amounts of bacteria [23].

Another aim of the study was to identify adherence barriers and resource-efficient quality improvement solutions. Prior studies suggest that skin irritation caused by hand sanitization is a barrier, and this resulted in the suggestion of hand lotion dispensers throughout hospitals [24]. Educational tools, such as teaching modules, explicit training sessions, and signage, have also been suggested to be effective [25-27]. Our study supports the idea that hand lotion and reminder signage may improve adherence in our institution. Our study adds to the aforementioned literature by identifying that a secure jewelry location and improved temperature regulation of the NICU in general may improve adherence. Moreover, parents reported discomfort with speaking up about witnessed non-adherence; whether this results from the busy NICU culture demands further investigation [28]. Some prior studies do suggest that having parents and patients speak up about hygiene non-adherence may prove to be a more sustainable solution than one-off educational reminders [29].

This study is not without limitations. First, there was no formal measure of intra- or inter-rater reliability. An initial mock observation shift and use of qualitative observations with periodic observer discussions were conducted to limit inter-rater reliability. As well, HCPs and parents may have been aware of observation efforts, creating a Hawthorne effect. In addition, this study proposes interventions but does not implement them or assess their actual effectiveness. Finally, the low response rate for the HCP questionnaire (29%) may cause non-response bias. Future studies might see a better response rate with various questionnaire administration modalities (e.g., web-based, mobile-based, and in-person), shorter survey length, and survey completion incentives.

Despite these limitations, our study has three primary strengths. First, it signifies the difference between routine hand hygiene audits versus environment and workplace-specific audits. One crucial finding was that adherence to MHH 1A and 1B were both low. Though not explicitly identified in our observation or questionnaires, it is important to acknowledge how low adherence may trigger guideline creators like PIDAC to reconsider the boundaries of the neonatal and immediate care environments. Another strength was including patient families. Our study adds perspective to the limited existing literature, which includes visitor data and interventions for hand hygiene [29-32]. This is important as NICUs have transitioned to a family-integrated care methodology, where families provide direct care beyond just skin to skin [30]. A final strength is that data was collected from researchers who were not part of the clinical team, so they could observe and provide thematic analysis without bias.

Overall, hand-hygiene adherence varied widely by moment and provider for the MHH, and body part and time for the BBE guideline, suggesting value in targeted interventions. Notably, nursing staff had better MHH adherence than medical staff. This study supports certain interventions identified by prior literature (e.g., hand lotion stations and improved signage), while proposing new interventions (e.g., secure jewelry location and improved temperature regulation of the NICU in general) that can inform future quality improvement efforts.

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ORIGINAL ARTICLE

Knowledge to action: Needs assessment to enhance support for infection control professionals across healthcare settings

Kasey Gambeta, RN, MN and Andrea Chambers, PhD

Affiliations: Both Kasey and Andrea work at Public Health Ontario, Canada

Corresponding author:
Kasey Gambeta
Public Health Ontario
350 Conestoga Blvd, Cambridge, ON, N1R 7L7 Canada
kasey.gambeta@oahpp.ca

ABSTRACT

Background: The purpose of this study was to describe needs of infection prevention and control (IPAC) professionals across healthcare settings in one region of Ontario, Canada to inform priorities for the development of resources and capacity-building activities.

Methods: An open survey targeting IPAC stakeholders working in diverse healthcare settings was disseminated through multiple methods, including Public Health Ontario's stakeholder management database. The survey was open from April 1 to June 30, 2019. IPAC inquiries documented by Public Health Ontario (PHO) staff between April 1, 2017 and March 31, 2019 were analyzed. The data collection tools and descriptive analysis were guided by the Knowledge to Action Cycle to identify gaps, understand barriers and opportunities, and preferred strategies for learning.

Results: The survey was completed by 135 IPAC stakeholders with 56% of respondents working in long-term care and retirement homes, 13% in hospitals, 11% in primary care, 10% in home care and 10% in other settings. Respondents reported that there is a need for more support to improve practices around environmental cleaning, surveillance and routine practices; however, findings varied by setting. An important theme focused on the need for strategies to inspire and motivate stakeholders to invest in infection prevention and control. A lack of support in this area was a top barrier selected by 40% of survey respondents, and 67% expressed interest in skill development in this area. While communities of practice, common-interest networking groups, are frequently facilitated by PHO to support stakeholders, this strategy was not preferred by respondents.

Conclusions: Future efforts to enhance support for IPAC can draw on these findings to help prioritize topics, understand barriers, and align with preferred methods for capacity building.

KEYWORDS: Needs assessment, knowledge-to-action, infection prevention and control, gap analysis, barriers to change, knowledge translation

INTRODUCTION

As the healthcare sector addresses the challenges of responding to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the causative agent of the Coronavirus disease of 2019 (COVID-19), it has been demonstrated that the importance of standardizing and improving infection prevention and control (IPAC) is more important than ever. Although efforts are currently focused on COVID-19 control, healthcare-associated infections (HAIs) of concern continue to persist and place a burden on the healthcare system.

While there have been a number of improvements to the adoption of evidence-informed IPAC practices across healthcare settings, gaps persist. There are a number of organizations working together to reduce HAIs through the adoption of best practices in IPAC. In Ontario, the Ministry of Health (MOH) develops legislation, regulations, standards, policies and directives to support strategic directions for the Ontario healthcare system. For example, they have defined standards for organizations to have IPAC programs that include specific requirements. Local public health units provide a range of supports to healthcare organizations including a focus on outbreak management and consultation on IPAC matters as outlined in the Ontario Public Health Standards. Public Health Ontario's Regional Infection Control Teams have specialized expertise in IPAC. This team provides scientific and technical advice on healthcare associated infections and emerging IPAC issues to the MOH, Public Health Units and directly to infection control practitioners. Within PHO, the IPAC Regional Support team model ensures IPAC coverage across the province through the placement of IPAC teams in five different regions. IPAC Regional Support teams provide support and consultation to respond to client requests and inquiries; introduce and disseminate PHO guidance resources and tools; support the implementation of IPAC initiatives to achieve best practice; facilitate networks and collaboration; and inform IPAC-related research. The work of the IPAC Regional Support Teams are guided by a number of factors including trends in IPAC inquiries; emerging issues; specific requests for support; and new best

Conflict of Interest Disclosure: None

practice documents developed by the Provincial Infectious Disease Advisory Committee.

PHO's IPAC work is influenced by the Knowledge to Action Cycle which was developed in Canada based on a review of 31 planned action theories to guide knowledge translation efforts [1]. It has been used extensively to guide needs assessments in the healthcare settings [2]. Early stages of the Action Cycle in this model emphasize the importance of focusing on gaps between current practice and recommended practice and taking the time to understand the nature of barriers and facilitators to practice change before selecting implementation strategies. The model also emphasizes the importance of involving stakeholders at all phases in the process. Therefore, to improve IPAC practices, it is necessary to have information on specific IPAC practices which stakeholders find challenging, and the barriers that are contributing to variations in practice. There has been a recognition that supporting healthcare professionals with IPAC best practices may require a behavioural science approach, acknowledging that practice change or improvement is influenced by a number of different determinants beyond knowledge and skill gaps [3,4,5]. Those who support IPAC programs have diverse educational backgrounds and responsibilities. This diversity further emphasizes the importance of understanding gaps in knowledge, skills and learning preferences that are needed to effectively build the capability and motivation of others to adopt IPAC best practices.

Relatively few studies have focused on describing the needs of IPAC stakeholders within Canada and most studies tend to focus on specific settings or practice areas, which present limitations for informing a comprehensive plan to support IPAC professionals across healthcare settings [6,7,8]. Prior to the COVID-19 pandemic, a study was conducted to describe needs of IPAC professionals across healthcare settings in one region of Ontario to inform IPAC Regional Support Team priorities for the development of further resources and capacity building. This region has 133 long-term care homes, 34 hospitals, and is a mix of rural and urban settings.

A secondary purpose was to assess participants' perceptions of the feasibility and utility of approaches informed by the Knowledge to Action cycle to better align the development of new resources and capacity building efforts with the diverse preferences and needs of stakeholders in one region of Ontario. This needs assessment was initiated and carried out prior to COVID-19 pandemic. The results will be discussed in the context of emerging IPAC issues.

OBJECTIVES

The objectives of this needs assessment were to: identify priority IPAC practices that are most in need of improvement; describe the types of barriers influencing practice change; gather information on gaps in IPAC knowledge and skills; and describe how stakeholders currently receive information, training and advice on IPAC practices and their preferences for receiving support.

METHODS

An online survey targeting IPAC professionals in this region was disseminated through multiple methods. The goal was to reach IPAC professionals working across all healthcare sectors, including: primary care (primary care medical clinics, community clinics and support services, community health centres, First Nations and Inuit Health Branch with Indigenous Services Canada), hospitals, long-term care homes, retirement homes, dental clinics, first responders, and home care (including home and community care). The survey was distributed by email to IPAC stakeholders in PHO's stakeholder relations management database (n = 1067). The online survey was also promoted by PHUs in the region, and the local IPAC-Canada chapter, a professional association that promotes best practices in IPAC through networking, education, and advocacy [9]. The survey was also disseminated by PHO staff at stakeholder meetings and education events. The survey was open between April 1, 2019 and June 30, 2019.

The survey collected information identifying the respondent's sector, job title, allocation of time spent on IPAC, IPAC training received, IPAC training desired, top three practice areas most in need of improvement, types of barriers to practice change, screening and surveillance practices, reprocessing practices and training, preference for receiving information and training, current use of IPAC resources, desired IPAC resources, and interest in skill development.

Development of the survey questions was informed by best practice recommendations for IPAC and existing IPAC training and resources available. The COM-B system, a framework for understanding behaviour change [10] was used to frame questions for stakeholders about the types of barriers that affect practice change in their organization. This model includes capability (knowledge, skills), motivation (beliefs, attitudes, role clarity, intentions, buy-in, risk perception, understanding consequences), and opportunity factors (physical environment and resources, social support and leadership) [10]. The survey included mostly multiple-choice questions incorporating some minor variations to tailor the response options by sector. An open-ended question was used to collect information on barriers to practice change. An additional open-ended question was used to identify other resources PHO could offer to better support IPAC practices at the respondents' facility.

Comments from the open-ended question about barriers were coded using predefined descriptive themes including: knowledge and skill, physical environment and resources, leadership support and culture, and motivation. Subthemes within each of these areas were then identified. Comments about resources PHO could offer in the future were grouped by setting and by common descriptive themes.

Stakeholder inquiries received by PHO from all sectors between April 1, 2017 and March 31, 2019, were reviewed. Inquiry analysis involved the identification of the most common topics within each stakeholder sector, followed by a classification of themes within those topics. Themes were

TABLE 1: Characteristics of online survey participants, n (%).						
	Total	Hospitals	Long-term care	Retirement homes	Primary care	Other[a]
	135 (100)	18 (14)	54 (40)	21 (16)	15 (11)	27 (21)
Role						
Nurse	19 (14)	1 (6)	11 (21)	1 (5)	5 (33)	1 (4)
Physician	3 (2)	--	2 (4)	--	1 (7)	--
Director	39 (29)	1 (6)	25 (47)	6 (30)	2 (13)	5 (19)
Manager/supervisor	28 (21)	2 (11)	4 (8)	10 (50)	2 (13)	10 (37)
ICP[b]	18 (14)	13 (72)	2 (4)	--	--	3 (11)
Other	11 (8)	--	3 (6)	--	3 (20)	5 (19)
No response	15 (11)	1 (6)	6 (11)	3 (15)	2 (13)	3 (11)
IPAC training[c]						
Yes	110 (81)	18 (100)	40 (74)	19 (90)	11 (73)	22 (81)
No	25 (19)	0 (--)	14 (26)	2 (10)	4 (27)	5 (19)
Full-time staff						
100% of time in IPAC	27 (20)	14 (78)	3 (6)	5 (24)	1 (7)	4 (16)
>/= 50% of time in IPAC	24 (18)	1 (6)	11 (21)	7 (33)	--	5 (20)
<50% of time in IPAC	73 (55)	--	38 (72)	9 (43)	12 (80)	14 (56)
Part-time staff						
100% of time in IPAC	2 (2)	1 (6)	--	--	--	1 (4)
>/= 50% of time in IPAC	--	--	--	--	--	--
<50% of time in IPAC	6 (5)	2 (11)	1 (2)	--	2 (13)	1 (4)

[a]Other includes home care, dental clinics and first response. [b]ICP = described a role in infection prevention and control. [c]Survey respondents were asked if those responsible for IPAC have received some form of formal/informal IPAC training.

TABLE 2: Practice areas in IPAC that are in most need of improvement at the participant's organization (respondents selected up to three), number of times selected (% of participants)						
IPAC Topic Area	Total	Hospitals	Long-term care	Retirement homes	Primary Care	Other[a]
	135 (100)	18 (14)	54 (40)	21 (16)	15 (11)	27 (21)
Surveillance	36 (27)	2 (5)	18 (15)	4 (8)	8 (15)	7 (14)
Environmental cleaning	44 (33)	4 (10)	23 (19)	15 (30)	9 (17)	6 (12)
Reprocessing	39 (29)	2 (5)	4 (3)	0 (--)	5 (9)	11 (22)
Construction, renovation, maintenance and design	52 (39)	5 (13)	5 (4)	1 (2)	3 (6)	9 (18)
Routine practices	9 (7)	6 (15)	17 (14)	10 (20)	10 (19)	2 (4)
Additional precautions	27 (20)	2 (5)	13 (11)	11 (22)	2 (4)	3 (6)
IPAC Programs and the Role of the ICP	15 (11)	2 (5)	17 (14)	3 (6)	10 (19)	5 (10)
Prevention of device-associated infections	23 (17)	7 (18)	9 (8)	6 (12)	1 (2)	2 (4)
Occupational health	18 (13)	6 (15)	8 (7)	0 (--)	3 (6)	2 (4)
Other practice area	13 (10)	4 (10)	4 (3)	0 (--)	3 (6)	2 (4)

Note: ICP = infection control professional.
[a]Other includes home care, dental clinics and first response.

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TABLE 3: IPAC topics participants indicated they personally require further training (respondents selected up to three), number of times selected (% of participants)

	Total	Hospitals	Long-term Care	Retirement Homes	Primary Care	Other[a]
	135 (100)	18 (14)	54 (40)	21 (16)	15 (11)	27 (21)
IPAC Programs and Role of the ICP	57 (42)	2 (5)	24 (17)	10 (16)	12 (19)	9 (13)
Routine Practices	44 (33)	2 (5)	13 (9)	10 (16)	12 (19)	7 (10)
Additional Precautions	41 (30)	5 (12)	14 (10)	10 (16)	3 (5)	9 (13)
Environmental Cleaning	61 (45)	3 (7)	22 (15)	13 (21)	10 (16)	13 (19)
Reprocessing	31 (23)	9 (21)	3 (2)	3 (5)	10 (16)	6 (9)
Surveillance	44 (33)	8 (19)	21 (15)	7 (11)	2 (3)	6 (9)
Microbiology	20 (15)	5 (12)	10 (7)	2 (3)	1 (2)	2 (3)
Occupational Health and Safety	32 (24)	0 (--)	16 (11)	5 (8)	5 (8)	6 (9)
Construction, Renovation, Maintenance & Design	31 (23)	6 (14)	12 (8)	2 (3)	6 (10)	5 (7)
Other practice area	16 (12)	2 (5)	8 (6)	0 (--)	1 (7)	5 (7)

[a]Other includes home care, dental clinics and first response.

compared to information collected in the survey to assess whether inquiries reinforced or contradicted survey results. Descriptive statistical analyses were performed using Microsoft Excel and Statistical Analysis System (SAS) statistical software package, version 9.3 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Table 1 describes the survey respondents including the settings they represent, their position, and allocation of time to IPAC related activities. The majority of respondents reported they worked in the long-term care and retirement homes.

The majority of survey respondents indicated that those responsible for IPAC have received some form of formal or informal IPAC training (81%) (Table 1). The rate of any training was highest in hospitals (100%) and lowest in primary care (73%) and long-term care (74%) (Table 1). The rate of formal training (e.g. post-secondary course) was highest in hospitals (83%), whereas other sectors were much more likely to have trained using informal resources (e.g. PHO online modules). Only 9% of respondents from non-hospital sectors reported formal training.

Areas for Improvement

Survey respondents were asked to select up to three practice areas in IPAC that are in the most need of improvement in their organization. Results varied by setting, with environmental cleaning (42%) and routine practices (33%) dominating (Table 2). Table 2 also shares the top three areas for each setting.

There were 344 inquiries sent to PHO from this region between April 1, 2017 and March 31, 2019 with 237 (69%) of these inquiries corresponding to the IPAC practice areas defined in Table 3. The majority of these inquiries were from public health (n = 121/237, 51%) followed by dental clinics (n = 54/237, 22.8%), primary care (n = 30/237, 12%), hospitals (n = 17/237, 7.2%), long-term care and retirement homes (n = 14/237, 5.9%), and home care (n = 1/237, 0.4%) (Table 4). Reprocessing was the most common topic among inquiries received from stakeholders over this two-year period (n = 141/237, 59.5%), driven by the large number of inquiries from public health units and dental settings.

Surveillance-Related Gaps

Respondents representing hospitals (n = 17) were the most likely to report admission screening with 100% reporting methicillin-resistant *Staphylococcus aureus* (MRSA) screening, 91% reporting vancomycin-resistant *Enterococci* (VRE) screening, and 41% reporting cabapenemase-producing *Enterobacteriaceae* (CPE) screening. A majority of LTCH respondents (n= 54) reported that they conduct admission screening for MRSA (93%), and VRE (78%). Only two percent of long-term care homes and retirement homes reported admission screening for CPE, and only 11% and 14% respectively reported ongoing screening during admission. Inquiries regarding antibiotic resistant organisms were among the most frequent topics posed to PHO from hospitals, long-term care homes, retirement homes, and dental settings.

TABLE 4: Feedback on top area of interest for skill development to improve IPAC practices (respondents selected up to three), number of times selected (% of participants).

Topic Area	Total	Hospitals	Long-term care	Retirement homes	Primary care	Other[a]
	135 (100)	18 (14)	54 (40)	21 (16)	15 (11)	27 (21)
Adult education principles	54 (40)	9 (50)	13 (24)	15 (71)	8 (53)	9 (33)
Creating compelling messages and clear calls to action	51 (37)	7 (39)	16 (30)	10 (47)	6 (40)	12 (44)
Techniques to get buy-in	86 (60)	15 (83)	37 (69)	12 (57)	7 (47)	15 (56)
Conducting needs assessment	47 (35)	4 (22)	20 (37)	6 (29)	7 (47)	10 (37)
Techniques to motivate and inspire your colleagues	91 (67)	12 (67)	39 (72)	16 (76)	13 (87)	11 (41)

[a]Other includes home care, dental clinics and first response.

TABLE 5: Description of barriers to practice change as described by survey respondents (respondents could select more than one area), n (%)[a]

	Total	Hospitals	Long-Term Care	Retirement Homes	Primary Care	Other[b]
	131 (97)	18 (14)	53 (40)	21 (16)	15 (11)	27 (21)
Knowledge and skill	19 (15)	1 (6)	10 (19)	5 (24)	1 (7)	2 (8)
Physical environment and resources	22 (17)	5 (28)	9 (17)	0 (--)	4 (27)	4 (17)
Leadership support and culture	9 (7)	1 (6)	1 (2)	2 (10)	4 (27)	1 (4)
Motivation	53 (40)	9 (50)	21 (40)	9 (43)	3 (20)	11 (46)
Other	15 (11)	1 (6)	8 (15)	2 (10)	1 (7)	3 (13)
None	13 (10)	1 (6)	4 (8)	3 (14)	2 (13)	3 (13)

[a]Four particpants did not provide a response
[b]Other = home care, dental clinics, first response

TABLE 6: Percent of survey respondents who preferred each method of receiving information and training (respondents selected their top 3 choices), number of times selected (% of participants)

	Total	Hospitals	Long-Term Care	Retirement Homes	Primary Care	Other[a]
	135 (100)	18 (14)	54 (40)	21 (16)	15 (11)	27 (21)
Online - webinar (live)	76 (56)	8 (44)	11 (20)	10 (48)	6 (40)	7 (26)
Online - modules	79 (58)	11 (61)	33 (61)	12 (57)	14 (93)	9 (33)
Printed materials/documents (e.g., FAQs, checklists)	50 (37)	7 (39)	18 (33)	11 (52)	8 (53)	6 (22)
In-person educational sessions (full day)	59 (44)	9 (50)	22 (41)	12 (57)	7 (47)	9 (33)
In-person educational sessions (1-2 h over several weeks)	65 (48)	5 (28)	19 (35)	8 (38)	3 (20)	1 (4)
Training workshops (e.g., case scenario based, hands on)	65 (48)	11 (61)	31 (57)	9 (43)	7 (47)	7 (26)
Communities of practice/ stakeholder networking groups	23 (17)	7 (39)	9 (17)	0 (--)	6 (40)	1 (4)
Other	1 (1)	1 (6)	0 (--)	0 (--)	0 (--)	0 (--)

[a]Other = home care, dental clinics, first response

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Reprocessing-Related Gaps

Fifty-three percent of survey respondents (n=133) indicated that their facility reprocesses medical devices and among this group, 25% reported staff at their facility are certified in reprocessing through the Medical Device Reprocessing Association of Ontario (MDRAO) or Canadian Standards Association (CSA). A large proportion of respondents indicated that they did not know whether or not a staff member was certified in reprocessing (37%). The highest rate of certification was in hospitals (n = 18, 72%). Just over half the respondents from retirement homes indicated that their facility reprocesses medical devices (n = 11, 52%); however, no respondents from retirement homes reported staff at their facility are certified.

Personal IPAC Improvement Needs

Survey respondents indicated up to three areas where they personally require improved knowledge and skills and this varied by sector (Table 3). The top four topics that were most selected for additional training across all stakeholder categories included: environmental cleaning (45%); IPAC programs and role of the ICP (42%); routine practices (33%); and surveillance (33%) (Table 3).

Hospital responses differed the most from other sectors. The top selections by hospital respondents included reprocessing (21%), surveillance (19%), and construction, renovation, maintenance and design (CRMD) (19%) (Table 3). In all other sectors, environmental cleaning (45%); and IPAC programs and role of the ICP (42%) were the top three selections by respondents.

Requested Resources

Survey respondents were asked an open-ended question about what additional resources could be offered to better support IPAC practices. There were a number of diverse responses that varied by healthcare setting. For example, respondents in hospital settings made note of guidelines for construction and renovation, updated Provincial Infectious Diseases Advisory Committee (PIDAC) guidelines, in addition to shorter learning modules on routine practices or additional precautions for front-line staff. In long-term care, there was an empahsis on the needs for resources on antimicrobial-resistant organisms that could be shared with residents and families in addition to simplified surveillance tools. One participant indicated a need for an online certification training for registered nurses in long-term care homes who have infection control responsibilities. There were 16 survey respondents (12%) that provided comments suggesting that they do not need additional resources.

Non-IPAC Specific Knowledge and Skill Needs

Survey respondents were asked to share levels of interest in further non-IPAC specific skill development aligning with different aspects of behaviour change. Table 4 presents an overview of levels of interest in each skill. The majority of survey respondents were interested in offerings on techniques to motivate and inspire colleagues (67%) and techniques to get buy-in (60%) (Table 4).

Barriers Influencing Practice Change or Improvement

Survey respondents highlighted motivation as the most common barrier to practice change in their organization (40%) (Table 5). There were also over 100 open-text comments about barriers to practice change. The majority of the open-text comments were barriers related to opportunity; specifically, the physical environment and resources, and motivation. Barriers that were about motivation to improve IPAC practices focused on buy-in or risk perception. For example, a respondent noted: "old habits die hard. When practice has been consistently below average with no serious outcomes, it is challenging to change perception and behavior." Barriers that were related to the physical environment and resources focused on access to supplies or the age of buildings. For example, one respondent noted: "[We are dealing with an] old building, shared common resident areas, shared resident washrooms. Less than ideal hand washing stations." There were a number of interesting reflections on the importance of leadership support and culture. For example, one responded noted: "Most managers and staff do not understand the importance and impact of IPAC. If the managers don't understand they are not directing their staff properly."

Preferences for Learning Format

Survey respondents identified their preferences for receiving IPAC information and training (Table 6). Overall, for survey respondents, online modules (58%) were the most commonly selected, followed by online webinars (56%) (Table 6). Sixty-one percent of respondents working in hospitals and 63% of respondents working in long-term care selected in-person options as their first choice.

DISCUSSION

A needs assessment was conducted to prioritize future supports for IPAC professionals working across different sectors. The needs assessment provided information that will be used to prioritize areas of focus for future initiatives. The needs assessment strongly supports the importance of tailoring supports, as the results demonstrated that practice gaps, barriers to change, and preferences for learning vary across sectors.

Areas where hospital participants identified a personal need for increased knowledge and skill differed the most from other sectors. The top areas for hospital respondents included reprocessing, CRMD, and surveillance. These may be considered more advanced IPAC skills. As was identified in the needs assessment, hospitals have higher rates of full-time, formally trained IPAC employees than other sectors, and therefore, tend to have more established and longer running programs. IPAC programs and role of the ICP, and environmental cleaning were top selections by respondents from non-hospital sectors. IPAC professionals working in non-hospital sectors may benefit from further training and supports on more foundational areas of IPAC.

There were a substantial number of inquiries related to reprocessing answered by PHO over the two-year observation period, and the survey identified that a large number of facilities do not have staff certified in reprocessing. This highlights an opportunity to disseminate information about available supports and the benefits of having staff certified in reprocessing.

Although best practice guidelines [11,12] identify that LTCHs should be conducting surveillance for CPE, only 2% of LTCHs are doing so. Further investigation should be done to identify why LTCHs are not initiating screening protocols for CPE. Further investigation into the barriers will help identify approaches to improve these practices.

Across all sectors, stakeholders face barriers to practice improvement that are related to motivation. There is a strong interest in further skill development around techniques to motivate and inspire colleagues and to secure buy-in from leadership. Stakeholders may benefit from support in this area, which focuses on identifying the specific motivational barriers that are contributing to practice gaps, and strategies that can be used to overcome these.

There were both similarities and differences in preferences for learning formats across sectors, indicating a need to target teaching and information sharing by sector. Online modules and webinars were rated highly by most sectors. Online modules may be preferred as they provide a learning opportunity that can be completed at any time, while webinars provide an opportunity for posing questions, and can be done at any computer. Communities of practice/ stakeholder networking groups were rated low by most sectors. Primary care respondents rated communities of practice (CoP) higher than other sectors, which may indicate fewer other opportunities to connect with colleagues across the province, as CoPs provide a venue for IPAC colleagues to network and discuss common interests.

There are a few limitations related to the distribution methods for the survey and overall response rate. There are important stakeholder groups that were not represented well by the survey including the dental setting, and the results are heavily weighted on respondents from long-term care. Given a fairly low response rate overall, those who did respond may be more likely to feel that supports in IPAC are lacking, than those who did not respond. For questions related to organizational practices, it is also important to note that the use of multiple methods to distribute the open survey could have resulted in more than one participant per organization.

It is important to take into consideration the potential for response bias in the use of an online surveys particularly when asking questions that apply to facility-level practices. There were several close-ended questions in this survey to help respondents overcome recall bias; however, there were free text options to ensure options were not missed and to encourage additional ideas.

As the survey only included participants in a particular geographical region, the results may not be applicable beyond this region. However, this region includes both rural areas and highly populated urban settings, and crosses seven public health units, which may create results that have some applicability beyond the region.

At the time of this report, there has been a significant rise in requests for support from PHO related to both foundational IPAC practices and requirements specific to the management of COVID-19. Although these topics have taken priority over the last year, the priorities identified within this needs assessment will still need to be addressed in the future. What the COVID-19 pandemic has also exposed, and what is in alignment with the findings, is that non-hospital sectors have less advanced IPAC programs and there is a significant need for support in long-term care and primary care. The primary care response rate was very low, potentially indicating a lack of engagement in IPAC. However, the COVID-19 pandemic saw a drastic increase in inquiries and support requests from primary care settings, potentially indicating an increasing understanding of the importance of IPAC, and identifying a lack of current IPAC supports and resources in this settings. Further work must be conducted to better understand the current capacity of IPAC programs in primary care settings. The COVID-19 pandemic has also highlighted the importance of the physical environment and resource-related barriers to the successful implementation of best practices, such as the ability to physical distance, which only 17% of respondents indicated as a barrier within their facility prior to COVID-19.

Despite these limitations, this needs assessment provided an opportunity to expand connections with IPAC professionals in this region, helped identify priority areas to further explore, and also challenged assumptions about the needs of IPAC stakeholders in this region. The results of this needs assessment will be used to plan initiatives in the surveyed region and to inform initiative planning in other regions where PHO provides support.

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ORIGINAL ARTICLE

Improving patient, family, and visitor hand hygiene on a paediatric oncology/hematology/bone marrow transplant unit

Joanna Lo[1]; Yilei Luan[1]; Zerlyn Lee[1]; Lisa Jacques[2]; Lisa Krueckl[2,3]; Jocelyn A. Srigley[4,5]

[1] *Faculty of Medicine, University of British Columbia, Vancouver, Canada*
[2] *BC Children's Hospital, Vancouver, Canada*
[3] *Vancouver Coastal Health, Squamish, Canada*
[4] *Department of Pathology and Laboratory Medicine, BC Children's Hospital and BC Women's Hospital + Health Centre, Vancouver, Canada*
[5] *Department of Pathology and Laboratory Medicine, University of British Columbia, Vancouver, Canada*

Corresponding author:
Dr. Jocelyn Srigley
BC Children's Hospital Microbiology Laboratory
4500 Oak Street, Room 2G9
Vancouver BC, V6H 3N1, Canada
Tel: 1-604-875-2000 ext. 5208
jocelyn.srigley@cw.bc.ca

ABSTRACT

Patient and visitor hand hygiene (HH) interventions have been demonstrated to reduce the rate of healthcare-associated infections. Observational audits on the oncology/hematology/bone marrow transplant inpatient unit at British Columbia Children's Hospital indicated that patient, family, and visitor HH was sub-optimal with a compliance rate of 3.3%. Despite creating interventions aimed at improving this, the post-intervention rate only increased to 4.2% (not significant, $p>0.05$). Future work will include investigating barriers to accessing and utilizing these resources.

KEYWORDS: Hand hygiene, paediatrics, quality improvement

INTRODUCTION

Paediatric oncology, hematology, and bone marrow transplant (BMT) patients are at high risk of acquiring healthcare-associated infections (HAIs), potentially resulting in significant morbidity and mortality. In a Canadian point prevalence survey of paediatric inpatients, 8% were found to have an HAI, with a trend towards increased risk among patients on hematology and oncology units [1].

Patients' hands are frequently colonized with pathogens [2], and patient hand hygiene (HH) initiatives have been shown to decrease transmission of these pathogens [3]. However, patient and family/visitor HH is often overlooked as part of HAI prevention efforts [2-4]. Published studies have consistently reported sub-optimal patient HH rates [3], making it evident that this is an important target for quality improvement.

A baseline assessment conducted at our hospital revealed low patient, family, and visitor HH rates. In addition, only 38% of participants reported that healthcare workers (HCWs) had talked to them about HH, and 93% preferred soap and water to alcohol-based hand rub (ABHR) [5], despite ABHR being more effective and less irritating to hands than soap and water [6]. The objective of this project was to improve patient, family, and visitor HH rates through the use of nursing education and patient and visitor resources, which were designed to address the identified gaps.

METHODS

Study setting

This quality improvement project was conducted at the oncology/hematology/BMT unit at British Columbia Children's Hospital (BCCH), the province's tertiary, academic, acute care centre for paediatric patients. As determined by the Alberta Research Ethics Community Consensus Initiative (ARECCI) screening tool, a commonly used resource in many jurisdictions for assessing ethical considerations of projects, ethical approval was not required as this was a quality improvement project.

Data collection

Patient, family, and visitor HH rates were obtained through direct observation by three covert medical students who were trained according to provincial best practice guidelines [6], and used an electronic tool for anonymous data collection. Audit data were recorded according to the four moments of HH adapted for patients, families, and visitors by the BCCH Infection Prevention and Control team [7]. Baseline data were collected in May 2018, and post-intervention data were collected between April and May of 2019.

Development of hand hygiene interventions

Various interventions were designed by medical students, informed by results of a cross-sectional survey of patients and visitors on inpatient units at BCCH in 2018 [8,9]. The survey

included both quantitative and qualitative responses designed to identify facilitators and barriers of HH. We also performed literature reviews, and held meetings with unit stakeholders to get their input. Three interventions were developed: an educational activity package for patients (Figure 1), an information pamphlet for adults (Appendix A) and a nursing checklist (Appendix A). Activities were created for different age groups, including comics, crosswords, word searches, and colouring pages. The nursing checklist contained key teaching points to be addressed with patients and visitors upon admission, including HH moments and use of ABHR.

Implementation of hand hygiene interventions

The interventions were implemented by the unit's quality improvement lead and an infection control practitioner, who provided educational sessions over the course of four months to instruct nurses on how to use the checklists and materials developed for patients and families. Incorporation of HH education on existing checklists and provision of pamphlets in new diagnosis binders and admission packs were implemented in an effort to include HH education as part of standard teaching on the unit.

Data analysis

Quantitative audit data were compiled and HH rates were reported as a percentage for the time period prior to intervention implementation and the period during and following implementation. Chi square tests for significance were used to compare the rates.

RESULTS

There was a total of 302 HH observations made, with 251 being of visitors and 51 of patients. The overall HH rate prior to implementation of the interventions was 3.3% (Figure 2), with 183 observations made (six washes and 177 misses). In comparison, the post-intervention rate was 4.2% with a total of 119 observations (five washes and 114 misses). The difference between the two rates was non-significant (p-value=0.68).

DISCUSSION

Patient, family, and visitor HH was clearly sub-optimal in our project, consistent with the literature [3], and there are few interventions proven effective to improve HH in this population. Interventions used in other studies have been similar to the multimodal approach for improving HCW HH compliance, with provision of ABHR and education being the most common components [3]. Although other studies suggest that these interventions improved HH rates and decreased HAIs among patients, most of these studies had sub-optimal study design and heterogeneous outcomes [3]. Our prior work indicates that standard interventions such as posters and pamphlets are ineffective in increasing HH [7].

Although HH increased post intervention, it remained low and lacked statistical significance. Barriers inhibiting the success of patient and family/visitor HH interventions must be identified and addressed. One potential issue in our project was the need to also take into account HCW behaviours and attitudes towards patient and family/visitor HH in order to develop more effective interventions. Although the interventions developed in our project were well-received by nurses at the educational sessions, sustained implementation of strategies and resources appeared to be limited. One way to approach this may be to more robustly involve nurses in the development of interventions through a frontline ownership approach to better understand what can be embedded within their existing workflows. Further insight could be obtained through the collection of feedback from nurses regarding their opinions around the resources already introduced. Interestingly, there was a perception among nurses that they were doing a good job of educating about HH despite survey data showing that the majority of patients/visitors did not recall hearing anything about HH from HCWs. This may be a good opportunity to utilize the teach-back method [10], to ensure patients/visitors understand the teaching and retain the information better.

The main limitation of this project is the before-after design. The lack of a control group limits the ability to determine cause and effect, although it is less relevant in this case since there was no change in hand hygiene post intervention. Second, process measures such as completion of the checklists were

FIGURE 1: Sample of the activity package

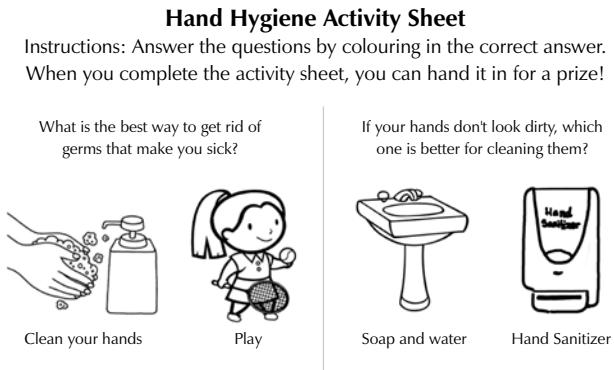
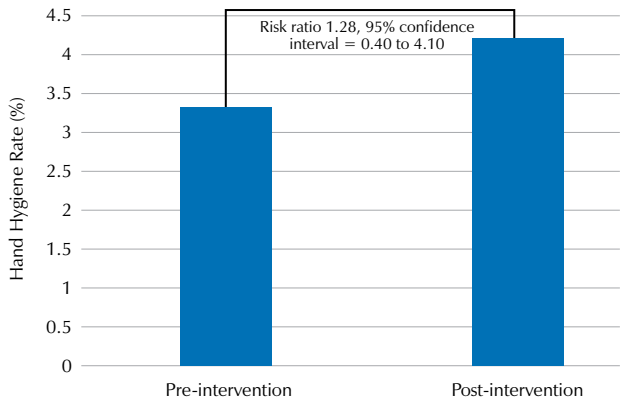


FIGURE 2: Patient and visitor hand hygiene rates



not included. Third, although the medical students who were performing HH observations received the same training, inter-rater reliability was not formally determined between them. Finally, generalizability of results to other settings and populations is not likely to be possible.

Future work should focus on barriers preventing nurses from providing HH education to patients and families/visitors, as well as seeking other innovative strategies to change behaviour. Conducting staff focus groups using a frontline ownership approach may help to improve uptake of the intervention and inform next steps. It would also be instructive to analyze the missed opportunities, as they may reveal barriers such as lack of, or inappropriate placement of ABHR dispensers, or gaps in knowledge regarding the moments of HH.

CONCLUSION

While much importance is placed on HCW HH to prevent HAIs within the oncology, hematology, and BMT setting, the focus needs to be broadened to include patient and family/visitor HH practices. Despite our interventions, HH rates continued to be low, indicating that re-evaluation and further innovation will be required to improve patient, family, and visitor HH rates.

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APPENDIX A: NURSING CHECKLIST

Date:_____

Patient, Family, and Visitor Hand Hygiene Checklist

Why are we teaching patients, families, and visitors about hand hygiene? Patients, families, and visitors understand that hand hygiene is important, but they often do not know *when* or *how* they are supposed to clean their hands, especially in the hospital environment. In a survey conducted on the BCCH Oncology Inpatient unit in May 2018, only 14.3% of patients, families, and visitors reported that healthcare workers had spoken to them about hand hygiene. This could be due, in part, because education is often provided during the initial diagnosis which is a very stressful time for families and they may not hear or remember. Audit data also indicated that only 2.8% of patients, families, and visitors actually cleaned their hands when they were supposed to. Because of this low rate, it is important to educate patients, families, and visitors about the importance of hand hygiene in preventing the spread and acquisition of healthcare-associated infections, which kill 8,500-12,000 Canadian patients every year. This checklist and tools were developed to assist and standardize education provided to families and patients.

Patient and Visitor Hand Hygiene Education Checklist on Admission:

Interventions	RN Initials
Review important moments for hand hygiene in the hospital: ☐ Before entering and after exiting patient rooms or clinic areas ☐ Before eating or feeding (including breastfeeding) ☐ Before taking or giving medication ☐ Before entering the kitchen, playroom, or other shared areas ☐ After using the toilet or commode ☐ After changing a diaper	
Teach patients/visitors when to use Alcohol-Based Hand Rub (ABHR) and when to use Soap & Water: ☐ ABHR for when your hands are NOT visibly dirty ☐ Soap & Water for when your hands are visibly dirty and/or you are on Contact Plus precautions ☐ Emphasize that ABHR is the gold-standard because it kills infectious organisms on contact and contains moiturizers to protect your skin	
Demonstrate hand hygiene technique with ABHR or Soap & Water to patients/visitors (see "How to Rub!" posters)	
If your *patient* is on additional precautions, explain that they are not allowed to use shared spaces on the unit (e.g., kitchen, playroom). If the patient is on Contact Plus or Airborne precautions, *family members* also should not use shared spaces.	
Activity sheets printed and given to patients (preschool and school-aged children)	
Hand hygiene pamphlet given to and reviewed with patients, families, and visitors	

Patient/Guardian Signature _____ the above information has been reviewed.

Please remind patients, families, and visitors about the importance of hand hygiene whenever opportunities arise throughout their hospital stay

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ORIGINAL ARTICLE

Epidemiology of viral respiratory infections and preventative measures in high-acuity units

Sameer S. Kassim MBBChBAO, MSc, DTHM&H, DipRCPath[1,2], Jared Bullard MD, FRCPC[2,3,4]; and Allison McGeer MD, FRCPC[5]

[1] *Department of Family Medicine, Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada*
[2] *Department of Medical Microbiology & Infectious Diseases, Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada*
[3] *Department of Pediatrics & Child Health, University of Manitoba, Winnipeg, Manitoba, Canada*
[4] *Cadham Provincial Laboratory, Winnipeg, Manitoba, Canada*
[5] *Department of Microbiology, Sinai Health System, Toronto, Ontario, Canada*

Corresponding author:
Dr. Sameer S. Kassim
Cadham Provincial Laboratory
750 William Avenue
Winnipeg, Manitoba
Canada, R3C3Y1,
Tel: 204-945-1306,
Fax: 204-786-4770
kassims@myumanitoba.ca

ABSTRACT

We retrospectively studied the epidemiology and preventative measures in adult and paediatric patients admitted to high-acuity units in Winnipeg, Manitoba. A total of 307 specimens were received, respiratory viruses were detected in 112 individual patient charts (39.4%). The aetiology varied by age-group with mixed viral and bacterial infection, or multiple viral infections noted in 33.3% and 39% in adults and paediatric patients, respectively. Respiratory syncytial virus (RSV) and rhinovirus were detected in 23% and 13% of paediatric patients, whereas influenza and parainfluenza were detected in 6.4% and 5.9% of adult patients, respectively. Influenza vaccination was noted in the charts of 7.8% of adults and 55.8% of children. In total, 34 (58%) paediatric patients and 11 (22%) adult patients had documented infection control orders, with 31 (92%) and four (36%) of these meeting regional guidelines, respectively. This study showed divergent viral aetiology based on age-group, as well as an opportunity to improve healthcare personnel knowledge and documentation of vaccination and infection control protocol.

KEYWORDS: Vaccine, prevention, infection control measures, respiratory virus, healthcare personnel, intensive care units.

INTRODUCTION

Viral respiratory tract infections (vRTI) are usually acute self-limited illnesses, but can cause severe disease in adults and children with underlying chronic illnesses, which may require admission to intensive care units (ICU) [1].

Influenza and other respiratory viral infections have guidelines for diagnosis, treatment, chemoprophylaxis, as well as vaccination and infection control protocols to reduce the risk of transmission in Canada and the United States. [3,4]. Current studies have focused on different facets of this clinical entity, however there are striking differences in the aetiology, clinical case definitions, and management of vRTIs in patients admitted to adult and paediatric ICUs [1]. For example, a study by Keledis *et al.*, showed that the most common cause of viral pneumonia in adults is influenza virus type A and B, however, those who were immunocompromised were more likely to have viral pneumonias caused by respiratory syncytial virus (RSV), cytomegalovirus (CMV), herpes simplex virus (HSV), varicella-zoster virus (VZV), adenovirus and rarely measles. In contrast, rhinoviruses and coronaviruses circulate in the paediatric communities [2]. Furthermore, clinical case definitions were noted to vary in their sensitivity and specificity depending on the case definition applied to a vRTI and the population studied. A study by Jiang *et al.*, showed that the case definitions such as Acute Respiratory Infection (ARI) demonstrated under calling the number of cases in hospitalized patients [5]. Finally, prior to the COVID-19 pandemic, limited evidence was available in the published literature describing preventative measures such as documentation, adherence rates and implementation of infection control practices in intensive care pertaining to viral respiratory tract infections.

Thus, the objective of this study was two-fold: 1. To describe the aetiology and applicability of clinical case definitions for vRTIs detected in adult and paediatric ICUs and 2. To describe the documentation and use of preventative measures, including vaccination and implementation of infection control protocols in the ICU.

METHODS

We retrospectively reviewed results of viral respiratory testing for patients admitted to ICUs at seven hospitals in Manitoba, Canada between October 1, 2016 to May 30, 2017. The hospitals included were two tertiary care facilities, one woman's and paediatric hospital and four community hospitals representing 64 distributed critical-care beds, 10 of which were fully staffed beds in community centres in the adult program and 10 paediatric and 60 neonatal beds, in the paediatric and woman's hospital, respectively.

TABLE 1: Characteristics of study patients, clinical definitions, management and outcomes

Category	Sub-category	Comparator Groups		p-value
		Adult (n=51)	Pediatric (n=59)	
Age		58.8 (IQR 21) years	1.4 (IQR 1.2) years	<0.001
Gender	**Male**	26 (50.9%)	38 (64.4%)	0.18
Presenting illness	**Respiratory Disease**	38 (74.5%)	47 (79.7%)	0.24
	Cardiac Disease	0 (0.0%)	5 (8.5%)	
	Neurological Disease	0 (0.0%)	4 (6.8%)	
	Sepsis/Other*	13 (25.5%)	3 (5.1%)	
Chronic Underlying Illness	**Hematological**	1 (1.9%)	1 (1.7%)	1.00
	Immunological	1 (1.9%)	0 (0.0%)	0.46
	Cardiovascular	28 (54.9%)	9 (15.3%)	<0.001
Viral Etiology	**Influenza**	12 (6.4%)	4 (3.4%)	0.001
	Parainfluenza	11 (5.9%)	6 (5.0%)	
	Rhinovirus	10 (5.3%)	15 (13%)	
	Coronavirus	7 (3.7%)	3 (2.5%)	
	HMPV	5 (2.7%)	0 (0.0%)	
	RSV	3 (1.6%)	27 (23%)	
	Other	3 (1.6%)	6 (5.0%)	
Nosocomially Acquired Viral Infection (symptom onset >72h after admission)		4 (7.8%)	3 (5.1%)	0.70
Mixed Viral/Bacterial OR Multiple Viral Pathogens Detected		17 (33.3%)	23 (39.0%)	0.57
Clinical Definition Met	**ARI****	37 (72.5%)	45 (76.3%)	0.67
	CDC ILI***	15 (29.4%)	15 (25.4%)	0.67
	WHO ILI&	7 (13.7%)	8 (13.6%)	1.00
ID Consult Requested		6 (11.8%)	23 (39%)	0.002
Change in Management Suggested by Infectious Disease Specialists during ICU admission		3 (50.0%)	15 (65.2%)	0.64
Length of Stay in the ICU (days)	**All patients**	7.6±1.5	11.1±3.3	0.78
	Nosocomially acquired	11.3±2.9	22.7±8.1	0.19
Ventilation	**Intubation**	42 (82.4%)	36 (61%)	0.02
	Days intubated	6.4±1.7 days	12.6±5.2 days	0.02
	Positive Pressure	25 (49.0%)	25 (42.4%)	0.56
	Days with positive pressure	3.7±5.0 days	4.3±1.9 days	0.38
Days Of Therapy (Anti-bacterial)		10.1±0.8	10.1±1.4	0.59
Preventative Measures	**No Documentation of vaccination: this season**	47 (92.2%)	27 (44.2%)	<0.001
	No Documentation of vaccination: previous 3 seasons	51 (100%)	26 (42.6%)	<0.001
Antiviral Utilization	**Oseltamivir Use**	23 (45.1%)	9 (14.8%)	0.001
	Empiric treatment started in 72h of admission	19 (82.6%)	7 (77.8%)	1.00
Infection Prevention Control	**Documented Order Written**	11 (22.0%)	34 (57.6%)	<0.001
	Order meeting regional IPAC guidelines	4 (36.4%)	31 (91.2%)	<0.001
Clinical Outcomes Status at Discharge from Hospital	**Alive**	44 (86.3%)	54 (91.5%)	0.54
	Deceased	7 (13.7%)	5 (8.5%)	

* - Sepsis (def): presence of life-threatening organ dysfunction caused by a dysregulated host response to infection; pediatrics: dysfunction in two or more other organ systems. Other: trauma, renal or liver disease, suspected immunological or haematological disorder, undifferentiated cause at time of admission
** - Acute Respiratory Illness (ARI): acute onset of any of the following respiratory symptoms: cough, shortness of breath, sore throat or nasal congestion (runny nose or blocked nose);
*** - Centres for Disease Control – Influenza Like Illness (CDC-ILI): fever defined as body temperature ≥ 37.8 °C plus cough and/or sore throat in the absence of a known cause other than influenza
& - World Health Organization – Influenza Like Illness (WHO-ILI): fever defined as body temperature ≥ 38 °C plus cough and with onset within the last 10 days

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Tests were requested by emergency providers, admitting critical care physicians, and/or infectious disease consultants based on clinical suspicion. Nasopharyngeal swabs, endotracheal swabs and/or bronchoalveolar lavage specimens were sent for analysis. All specimens were tested utilizing the qualitative SeeGene Allplex™ (RV16) assay, which detects: influenza A (H1, H1pdm09, H3), influenza B; respiratory syncytial virus A, B; adenovirus; enterovirus; parainfluenza virus (1-4); metapneumovirus; bocavirus and coronavirus (NL63, 229E, OC43).

Regional infection control protocols were derived for the adult and paediatric programs, respectively, and reflect best evidence-based practice guidance and standardized infection prevention and control practices across all facilities in the health region. The manuals are developed by the infection prevention and control committee and contain policies, operational directives, and protocols which are reviewed on an annual basis. These manuals are based on Accreditation Canada requirements, Public Health Agency of Canada recommendations and critical or practice changing literature. Infection control orders are documented either on specific infection control order sets, or on general orders if unavailable for all hospitals participating in this study.

Charts of patients with positive results were reviewed to identify risk factors, symptoms and signs of infection, antimicrobial usage, documentation of influenza vaccination, outcomes and application of regional infection control (IC) guidelines. Data was collected and entered into a secure excel spreadsheet by SSK; statistical analysis was performed using IBM SPSSv21. Differences were compared using X^2 and Wilcoxon Rank sum tests. All p-values were two-sided with significant set at 0.05. This study was approved by the University of Manitoba-Research Ethics Board and the Health Information Privacy Committee – Government of Manitoba (2017/2018-55).

RESULTS

370 respiratory tract specimens (nasopharyngeal swabs/aspirates and bronchoalveolar lavage) were submitted for virus detection, 188 from adults (>=18 years), and 119 from children. At least one virus was detected in 112 individual patients (39.4%). 112 charts were available and reviewed. Two records were incomplete and excluded from analysis. The demographics, application of surveillance definitions, management and outcomes are summarized in Table I. A significant difference in viral aetiology was observed between adult and paediatric patients (p<0.001). The number of patients with more than one virus detected or mixed viral/pathogenic respiratory bacteria detection were similar (adult [17, 33.3%] vs. paediatric, [23, 39%], p=0.57). Only four adults (7.8%) and three (5.1%) paediatric viral infections were hospital-acquired (respiratory symptoms ≥72 hours after admission), none were identified as influenza A or B. The majority of patients admitted to ICUs met the clinical definition of acute respiratory illness (ARI), however, less than one-third met either the WHO or CDC influenza-like illness (ILI) definitions (Table. 1) [5]. No difference was noted between adult and paediatric patients. A total of 23 (39%) paediatric patients had an infectious disease consult compared to only 12% of adult patients (n=6) with positive respiratory specimens (p=0.002).

Influenza vaccination history in the current season was documented in 3.9% (n=2) of adults and none of the paediatric vaccine-eligible group (p=0.001). Empiric antiviral agents were used 23 (45.1%) and nine (15.3%) of adults and paediatric patients respectively. Most antivirals were started within 72 hours of symptom onset.

Finally, only 42.3% of patients had documented infection control (IC) orders. There was no significant difference between the number of orders placed in community facilities vs. tertiary facilities (30.8% vs. 45.9%, p=0.17), however, there was a difference between the number of orders meeting guidelines between the types of facilities, i.e., the appropriate precautions were applied to the syndrome or pathogen being queried during admission (e.g., contact and droplet precautions for the investigation of viral respiratory tract infections). The community hospital orders met guidelines in 12.5% of orders compared to 92.3% of orders in teaching hospitals (p=0.001). Among children, 34 (58%) had IC orders, 31 (92%) met infection control guidelines. Among adults, 11 (22%) had orders, and four (36%) met guidelines.

DISCUSSION AND CONCLUSION

Viral respiratory infections are a common cause of death in North America. It is estimated that influenza alone is responsible for approximately 12,200 hospitalizations and 3,500 deaths in Canada annually [6]. Our multi-centre study shows significant differences in epidemiological, microbiological and clinical management of adults and pediatric patients in whom a diagnosis of vRTI is queried.

Respiratory viruses elicit similar symptom profiles from the individuals. To date, there have been several prospective cohort studies to determine the performance of case definitions in the hospital setting [5]. However, these surveillance definitions are not intended to be applied for clinical case management. Our study shows that ARI may be a useful definition when considering a respiratory viral infection in the intensive care unit, and maybe a useful tool for improved case finding. This study also showed that the majority of care providers did not document evidence of vaccination in patients with detectable vRTIs and only provided antivirals in a limited number of cases; a finding that has been corroborated by other studies [7,8]. Finally, there was limited documentation of infection control protocols on ICUs. Just over half of paediatric charts had documented evidence compared to less than one-quarter of adults and fewer than 36% of adults had orders matching regional guidelines.

This study is limited by its retrospective nature and small sample size. Viral testing was not systematic and may have varied by site and between children and adults. In addition, we were unable to determine what level of preventative measures were performed retrospectively if undocumented.

Vaccination and infection control protocols are implemented at the provincial and institutional level and variations may occur. The strength of our study is that the infection prevention and control policy is standardized across our health region. However, vaccination documentation and documentation of infection control protocols could be included as part of ICU checklists across all health regions and individual hospitals, which would lead to improved case management and harmonization IPAC control measures.

vRTIs are common with detection increasing within the ICU setting. Our study showed differences in vRTIs between adult and paediatric patients and detected hospital-acquired transmission was noted to be uncommon. Infection control orders were sub-optimally documented in ICUs. Healthcare providers are the link to promoting vaccine uptake, appropriate prescribing of antimicrobials and mitigation of viral propagation. This study highlights the need for further research into respiratory viral illness in ICUs, and barriers with regard to the implementation of infection control measures especially in light of rapidly changing viral burdens. Moreover, the present observations could be compared with other Canadian or other worldwide hospitals.

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