

Assessing the Mpox and Infection Prevention and Control Knowledge of Personal Service Establishments' Operators in Metro Vancouver Regional District of British Columbia

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ABSTRACT

Background

Mpox virus, formerly known as the Monkeypox virus, is a re-emerging pathogen that causes the infectious disease Mpox. Mpox was designated as a public health emergency of international concern by the World Health Organization due to its rapid spread outside West and Central Africa. Personal service establishments (PSEs) could be a setting for exposure to Mpox because some of their services involve direct contact with their patrons. The aim of this research was to investigate the infection prevention and control (IPAC) and Mpox knowledge levels among PSE operators and to determine the associations between IPAC knowledge, Mpox knowledge, years of experience, and point-of-service risk assessment.

Methods

The study was conducted using a self-administered online survey via Survey Monkey and results were analyzed using NCSS 2023 statistical software. The study focused on eligible PSEs in the Metro Vancouver Regional District. The survey link was disseminated via myBCIT email and Beauty Council BC's social media accounts. The survey comprised 16 close-ended questions across 4 sections (i.e., demographics, point-of-service risk assessment, Mpox knowledge, and IPAC knowledge).

Results

A total of 1823 personal service workers and operators have responded to the survey. However, only 1745 of 1823 completed the survey. The data indicated that among the participants 56.48% were female, 39.24% were male, 3.47% selected other, and 0.81% preferred not to answer the question. Moreover, 52.77% of the respondents had 5-10 years of experience. Among the respondents, 692 provide health spa services, 572 provide nail services, 562 provide massage services, 516 provide face painting services, 461 provide waxing services, 350 provide makeup services, and 3 selected "other". Lastly, 83.18% of the respondents had IPAC training, which is mainly from "Internet or online course" (872 respondents), "Guidelines by the BC Ministry of Health" (812 respondents), and "On the job from co-workers/management" (728 respondents). On the other hand, the inferential statistics revealed that there were statistically significant associations between Mpox knowledge and the number of years of experience ($P = 0.0005$) as well as between Mpox and IPAC knowledge levels of PSE operators ($P = 0.0000$). Additionally, the practice of point-of-service risk assessment was found to be significantly associated with the IPAC knowledge level of PSE operators ($P = 0.0000$). However, no statistically significant association was found between the practice of point-of-service risk assessment and the number of years of experience as a PSE operator ($P = 0.1449$).

Conclusion

The study found that having adequate IPAC knowledge results in higher knowledge of Mpox, and operators with sufficient IPAC knowledge are more likely to assess their clients' skin for infection. The results of the study suggest that IPAC training should be required for all PSE operators to prevent the spread of communicable diseases including re-emerging pathogens like Mpox. Proper IPAC training and Mpox awareness are crucial to prevent the spread of Mpox in any community setting like PSEs.

Keywords: Mpox, Infection Prevention and Control, Personal Service Establishment, Metro Vancouver Regional District, Regulations, British Columbia

INTRODUCTION

Due to various factors (e.g., overpopulation, human migration, risky behaviors or practices, global warming, and climate change), there is a rise of emerging and re-emerging pathogens in different countries outside its endemic setting. One of these re-emerging pathogens is the Mpox virus (MPXV), formerly known as the Monkeypox virus. The terminology was changed by World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) on November 28th, 2022 (1,2). MPXV causes the infectious disease Mpox. Between the 13th and 21st of May 2022, the WHO designated Mpox as a public health emergency of international concern (PHEIC). This is due to its rapid spread outside of its endemic setting, West and Central Africa (3). In Africa, it was primarily transmitted via zoonosis. However, the clade II African strain has been primarily spreading via person-to-person transmission and has been responsible for the global Mpox pandemic. The WHO released a statement that the Mpox pandemic has affected 106 countries, territories, and areas, including Canada (4)

PSEs could be a setting for exposure to the disease because some of their services involve direct contact with their patrons. According to National Collaborating Centre for Environmental Health (NCCEH), no studies are currently linking MPXV transmission in PSEs (5). However, most PSEs cater services to many people daily — potentially exposing them to several risk factors for MPXV transmission (5). These risk factors include indirect and direct contact with an infected individual that may occur in different PSE services. PSE services such as body massage, health spa, waxing, face painting, and makeup involve procedures with prolonged one-on-one interactions, direct dermal contact, and using different tools that touch the skin such as applicators, brushes, towels, or sheets (5).

Furthermore, MPXV skin rash or lesions can be easily recognized by PSE workers. Besides the skin rash, Mpox-infected individuals can also present flu-like symptoms. As a part of the point-of-service risk assessment, PSE workers

must not perform a personal service if their patrons show Mpox symptoms (5,6). The main preventative measures against Mpox are to reduce contact with the lesions and physical distancing from infected individuals. These measures will eliminate the risk of contracting the disease via direct contact — direct dermal contact and respiratory transmission (7). Thus, PSE operators and workers may be able to protect themselves and their patrons from MPXV and aid in preventing the spread of the disease (5).

LITERATURE REVIEW

Personal Service Establishment (PSE)

PSEs are a continuously expanding industry encompassing various services, including invasive and non-invasive procedures (8). Various risks can be associated with this type of service. Regulated Activities Regulation B.C. Reg. 161/2011 states that PSE "means an establishment in which a person provides a service to or on the body of another person, and includes a barbershop, beauty parlour, health spa, massage parlour, tattoo shop, sauna and steam bath." (9). Aside from full-body massage parlors, PSE also includes other services that require direct contact with patrons such as Esthetics (facial, skin, and body therapy), full-body waxing, face painting, makeup, and shaving (10). Health risks or injuries vary depending on the sanitary condition of the establishment, the infection control practices in place, the type of tools or equipment being used in the services, the actual procedures of the services, and the health condition of the patrons and workers (8).

BC Legislation and Guidelines on PSEs

According to the Regulated Activities Regulation, pursuant to BC Public Health Act (PHA) [SBC 2008] CHAPTER 28, PSEs fall into the regulated activities. BC PHA outlines the duties of the PSE operators. Section 18 of the BC PHA states that

- “(1) An operator who engages in a regulated activity must take reasonable care to
- (a) prevent health hazards from arising in the course of the regulated activity, and

(b) respond to health hazards that arise, including mitigating harmful effects of the health hazard.

(2) An operator who is an employer must ensure that employees are adequately trained and sufficiently equipped to recognize, prevent and respond to health hazards that may arise when engaging in a regulated activity.

(3) An operator who engages in a regulated activity must comply with any requirement or duty set out in a regulation respecting the regulated activity.”(11).

Although the BC PHA did not mention specific training or certifications that PSE operators and workers should have, the BC PHA emphasized that adequate training pertains to the knowledge of the operators/workers in preventing and mitigating health hazards. For instance, the operator and workers should be aware of proper disinfection or sterilization procedures for their tools or equipment.

Additionally, as for the cleaning of the premises and the tools or equipment in the establishment, the Regulated Activities Regulation requires PSEs to have a water supply. Section 3 of the Regulated Activities Regulation states that “An operator of a personal service establishment must not operate the establishment unless there is, on the premises of the establishment,

(a) an adequate supply of hot and cold water at all times for operating and cleaning purposes, and

(b) an adequate and conveniently located hot and cold-water hand washing facility, with ancillary equipment.” (9).

Due to the ambiguity of the BC PHA regarding the “adequate training” needed by PSE operators, the "Guidelines for Personal Services Establishments" was created by the Ministry of Health's Health Protection Branch to provide direction and training to the PSE operators and workers on the prevention of health hazards (10). The guideline outlines the following: Facility Aspect, Operation Requirements, Classification of Instruments/Equipment, and

Cleaning, Disinfection, and Sterilization. This guideline can be used by the operator to train their employees to prevent the occurrence of health hazards and identify health hazards and apply appropriate corrective actions. For instance, if the PSE worker observed that their patron has a skin infection, they should let the patron know that they are not allowed to carry out the personal service to them. Additionally, if their tools had direct contact with the patron's infected skin, proper cleaning and disinfection process should be immediately done. Ultimately, PSE operators' training and knowledge about the guidelines, most importantly Infection Prevention and Control measures, is significantly crucial in the prevention of the occurrence of health hazards.

Traditional Risks and Diseases Associated with PSEs

Personal service methods have the potential to expose patrons and/or PSE workers to a range of diseases. The degree of health concerns is determined by how invasive the service is. For example, methods that involve surface treatments have different risks compared to procedures that pierce the skin.

For surface treatments, makeup application and waxing are good examples. To apply makeup (e.g., lipstick, mascara, eye shadow, and foundation), a variety of tools including brushes, cotton balls, tissues, and facial sponges are used (12). While for waxing services, single-use applicators (e.g., spatula and cloth strip) are used to apply the warm wax (or sugar) on the skin and instantly pulled away from the skin that removes the hair (12). Both services can result in the risk of getting infections. Applying makeup can cause infection through broken skin or exposed mucous membranes (e.g., scratches, cuts, and acne wounds). The risk of infection may be enhanced by waxing due to the possibility of damaging the skin and exposing the mucous membrane (12). In these events, pathogens can use those sites for entry and infection. Pathogenic microbes can potentially come from different sources, which include:

- Use of contaminated makeup or wax
- Use of contaminated equipment or tools

- The patron's skin microflora spreading into the damaged skin or exposed mucous membrane
- Contaminated environment (e.g., air containing contaminated aerosols)
- Unhygienic practices (e.g., soiled PSE workers' hands) (12)

Various skin infections include fungal (e.g., *Candida* spp. and ringworm), bacterial (e.g., *Staphylococcus aureus* and *Pseudomonas aeruginosa*), and viral (e.g., herpes simplex virus) (12). Reports on the outbreak of methicillin-resistant *Staphylococcus aureus* (MRSA) infections are recorded in PSEs offering makeup or waxing services (12).

As opposed to surface treatments, invasive procedures like tattooing have greater risks. Tattooing utilizes sterile needles to inject dyes or inks into the skin. When a person gets a tattoo, the skin is physically damaged and potentially introduces contaminants into the bloodstream, which increases the risk of infection. The needle can introduce pathogens, which can cause mild infections and chronic diseases. Pathogenic microbes can potentially come from different sources, which include:

- Contaminated water, which is used for diluting the ink
- Use of contaminated or improperly sterilized equipment or ink
- The patron's skin microflora spreading into the damaged skin or exposed mucous membrane
- Unhygienic practices (e.g., soiled PSE workers' hands) (12)

Potential infections include various skin and blood-borne infections caused by pathogens like Hepatitis B and C viruses, human immunodeficiency virus (HIV), *Mycobacterium* spp., and *Candida*. Reports of non-tuberculous mycobacterial (NTM) outbreaks caused by tainted ink were recorded. NTM infection can cause various diseases such as respiratory disease (e.g., lung disease) and eye infections (e.g., keratitis) (12).

Mpox Virus, Symptoms, and Mode of Transmission

Etiological agent

Like the other orthopox viruses (e.g., smallpox, camelpox, and cowpox), MPXV has an envelope and linear double-stranded DNA. It is under the Poxviridae family and orthopoxvirus genus (7). In 1958, Mpox was first identified in monkeys in a primate research laboratory at State Serum Institute in Copenhagen (13,14). While in 1970, in the Democratic Republic of Congo, a 9-year-old patient was the first human case of Mpox (13,14). Currently, there are two known distinct clades of MPXV — clade I (Central African clade) and clade II (West African clade). The clade II strain is responsible for the current global Mpox pandemic (15). The Clade I strain is the more virulent strain and has a high mortality rate. While the Clade II strain is the less virulent strain, which causes mild symptoms (15).

Mode of Transmission and Incubation Period

The Mpox virus has two primary modes of transmission, namely: zoonotic and person-to-person transmissions. For zoonotic transmission, humans can be infected via direct contact with the bodily fluid of infected animals or by parenteral transmission, which is a bite from an infected animal (7). On the other hand, person-to-person transmissions can be further divided into 2 types: direct and indirect. Direct transmissions include the following:

- Direct dermal contact, which is skin-to-skin contact with the intact scabs or lesions of an infected person
- Direct contact with bodily fluids (e.g., semen and saliva) of an infected person via sexual activities, including oral, penetrative, and non-penetrative sex
- Direct respiratory transmission, which is contact with relatively large droplets (>5–10 µm) from coughing and sneezing
- Vertical transmission, which is the transmission from an infected mom to her baby via the placenta (7,16)

The indirect transmission includes contact with fomites such as contaminated linens, clothes, or any items that come in contact with infected bodily fluids or scab debris (7). The MPXV

incubation period can last between 5 to 24 days (13).

In a non-clinical setting, an office, one study performed surface sampling via swabbing. This was done to check if the workspace environment, specifically the high-touch surfaces, was contaminated by an infected individual in the prodromal phase. The study found that 3 out of 34 swab samples tested positive for MPXV. All 3 positive samples were from the infected individual's desk area (i.e., desk, keyboard, and telephone) (17). Even though the viral loads were low in those positive samples, the data proves the potential for indirect transmission (e.g., fomite transmission) of Mpox.

On the other hand, in a clinical setting, one study performed various sampling methods to check for environmental contamination in the doffing area of personal protective equipment (PPE) and the isolation rooms for hospitalized confirmed Mpox cases with active lesions (18). These methods include surface and air samplings. For the surface sampling, Copan UTM swabs were used, targeting high-touch areas (e.g., floor, door handle, television remote control, patient call bell, shower handles, and light switch), air vents, unlikely touched areas, and staff's PPE. For the air sampling, Sartorius air samplers were used. The air samplers were placed near the bed (1 m away and 1 m high) and slightly distant from the bed (1.5 m away and 2 m high). The study found that 56 out of 60 swab samples and 5 out of 20 air samples were positive for MPXV (18). These data show a high risk for fomite transmission and the potential for airborne transmissions.

PSEs are considered non-clinical setting because it is not under the jurisdiction of the BC Health Professions Act or regulated by any college (10). Based on the studies mentioned above about clinical and non-clinical settings, Mpox-infected clients, especially those with active rash or lesions, pose a risk because they may transmit the disease in PSEs via direct skin-to-skin contact with PSE workers, fomite transmission (e.g., infected tools or linens) or

airborne transmission (e.g., aerosolized respiratory fluids via coughing or sneezing).

Symptoms

Mpox has two clinical phases: prodromal illness and skin rash (15). The infection usually starts with a prodromal phase, which includes flu-like symptoms such as fever, headache, sore throat, cough, myalgia, malaise, sweats, chills, and inflamed lymph nodes, (13). Then, after 1 to 4 days, it progresses into more specific symptoms, a skin rash or active lesions. It starts as macules, which progress into papules, vesicles, and pustules that subsequently umbilicate, ulcerate, crust over, and lastly, desquamate (13,19). The disease is self-limiting and mild in most cases, lasting from 2 to 4 weeks (13). In PSEs, operators or workers should examine their patron's skin for lesions or pustules and assess if they have flu-like symptoms. **Figures 1** and **2** show the typical features of Mpox skin rash or lesions and their



stages.

Figure 1. Actual images of Mpox lesions (20).

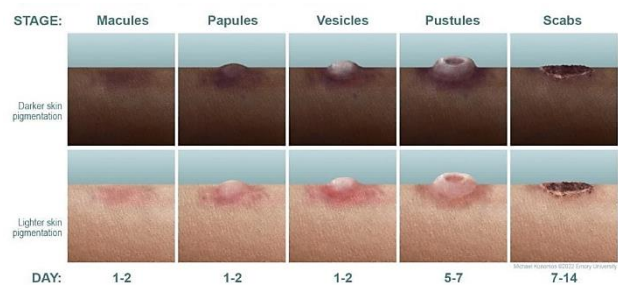


Figure 2. Stages of Mpox lesions (21).

Mpox Surveillance and Health Measures in Canada and BC

As of March 6th, 2023, there have been 1,465 confirmed cases in Canada — 196 in British Columbia (BC), 43 in Alberta, 6 in Saskatchewan, 1 in Manitoba, 691 in Ontario, 525 in Quebec, 1 in New Brunswick, 1 in Nova Scotia, and 2 in Yukon (22). In BC, as of March 6th, 2023, 196 confirmed cases were recorded in the 5 regional health authorities (RHA) — 157 in Vancouver Coastal Health (VCH), 25 in Fraser Health (FH), 7 in Island Health, 6 in Interior Health, and 1 in Northern Health (23). With provincial, territorial, and international health agencies' help, the Public Health Agency of Canada (PHAC) is monitoring the cases and preventing the further spread of Mpox in Canada (24). There is no data published yet about the specific public settings where Mpox cases are associated.

On the other hand, in BC, BC CDC is working with the Federal, Provincial, and regional health authorities in educating the public about the disease, especially the high-risk groups (e.g., gay, bisexual, and other men who have sex with men (gbMSM) and close contacts) (23). This group is at higher risk of getting Mpox due to their behaviors, which can easily spread the virus (i.e., direct contact with active lesions and contact with infected bodily fluids via sexual activities). However, regardless of gender or sexuality, anyone can contract Mpox as long as you got exposed to the disease. In PSEs, PSE operators are not allowed to ask for their client's gender or sexuality nor ask them to disclose their sexual behaviors. Having said that, PSE operators may encounter clients from high-risk groups (e.g., close contacts or gbMSM) that may be infected by the Mpox virus. With that, these clients might transmit the virus to PSE workers who offer services in which direct contact with skin is an integral part of their services (e.g., waxing, health spa, or massage); thus, risk will be present in these types of business establishments especially if the customers are infected by the Mpox virus.

BC CDC is also monitoring the cases via laboratory-confirmed cases and case and contact tracing activities (23). Educational materials

were disseminated on different platforms (e.g., social media, government websites, and television) to educate the public, not just the high-risk groups. Additionally, the health authorities immediately offered vaccines to prevent the further onward transmission of MPXV. However, due to limited supply, this vaccine is only being provided to eligible people (i.e., gbMSM and close contacts) (23).

Infection Prevention and Control Practices against Mpox

For preventing the transmission of Mpox, one study proposed a two-fold approach (7). The first goal includes health measures such as immediate treatment of infected people, vaccination of high-risk groups, and post-exposure management (e.g., contact tracing, quarantining, and treatments such as prophylactic vaccinations, postexposure modified vaccinia Ankara (MVA) vaccination and vaccinia immunoglobulin therapy). The good thing about the Mpox vaccination is we can easily achieve herd immunity. Since MPXV has a double-stranded DNA, its genomic material is more stable than RNA viruses (e.g., SARS-CoV-2 and influenza A virus), making the mutation rate slow; thus, making our vaccines effective against infection and achieving herd immunity (25). The second goal includes public health policy modifications, which will increase health communication and education funds on Mpox, availability of diagnostic tests and vaccines, and workforce for wider surveillance. (7).

These policy changes will greatly affect the community and organizational levels, which will aid in the prevention of the spread of Mpox. For instance, private companies will be able to adapt to the guidelines created by the government to prevent the spread of Mpox in the workplace. One study stated that a non-clinical company performed infection prevention and control procedures when an individual tested positive for MPXV (17). The infected employee was in the prodromal phase before self-isolation was done. Thorough cleaning and disinfection of surfaces and items (also known as the decontamination process), case and contact tracing, and post-exposure management (i.e.,

Imvanex® vaccine was given to contacts for post-exposure prophylaxis) were done to prevent the transmission within the office (17). The decontamination process, which was done by professionals, focused on items or surfaces that had direct contact with the infected person. It was done immediately because orthopox viruses are known for their environmental stability (17). Additionally, Mercer et al. stated that orthopox viruses like MPXV could be stable in scab or lesion debris, ranging from weeks to several months at ambient temperature (26).

Regardless of the work setting, this means that anyone who had contact with fallen scabs or had contact with contaminated items (e.g., linens) can get infected by the virus. With that, in a non-clinical setting like PSEs, operators, workers, and patrons, especially vulnerable patrons, are still at risk of contracting the disease — especially if they do not have adequate knowledge of Mpox and do not practice IPAC procedures.

Public Health Rationale and Significance of the Study

PSEs are potential sites of community transmission due to the close contact that operators have with their clients. Therefore, this study aims to assess PSE operators' knowledge of MPXV and IPAC practices, which will help in assessing the risk posed to PSE staff, PSE patrons, and the public. Having adequate knowledge of Mpox will enable operators to recognize the disease's specific symptoms. Also, having adequate knowledge of IPAX practices will ensure operators will be able to implement measures against Mpox and other diseases associated with PSEs. This was achieved by collecting primary data on the MVRD PSE operators in BC through an online self-administered survey.

METHODS AND MATERIALS

Materials Used

Various materials were used in this research study. These materials include a secured laptop with a password and internet access for searching PSE locations in BC and distributing survey questionnaires through myBCIT email,

Canva for making the Survey poster, QRCode Monkey for generating the Quick Response (QR) Code for the survey, Survey Monkey for data collection, Microsoft Office 365 Excel for organizing data and generating graphs and charts, and Number Cruncher Statistical Systems (NCSS) 2023 software for statistical data analysis (27–31).

Description of Standard Methods

This study used an online self-administered survey questionnaire to collect data. The survey was conducted online through Survey Monkey. A British Columbia Institute of Technology (BCIT) Survey Monkey license was used to develop and distribute the survey questionnaire to ensure that all the collected data will be stored in Canada. The survey was open from January 26th, 2023, until February 22nd, 2023. PSE inspection reports from VCH and FH were used to create a list of eligible — PSEs that passed the inclusion criteria — PSEs in the Metro Vancouver Regional District (MVRD). Then, the eligible PSE operators' email addresses were obtained by using the Google Search Engine. Using all PSEs' email addresses, a cover letter with a survey link attached and a QR code was sent via myBCIT email. Additionally, a non-government organization, Beauty Council BC, was asked to distribute the survey to PSE operators and workers in MVRD. Beauty Council BC posted the survey poster on their social media accounts (i.e., Facebook and Instagram), which included the survey link and a QR code. Ergo, the principal investigator reached out to potential participants by two methods (i.e., myBCIT email and Beauty Council BC to distribute it to PSE operators and workers) and sent out reminders or follow-ups to participants, which significantly increased the response rate. The survey link and QR code redirected willing participants to Survey Monkey, which contained the research consent form and the survey questionnaire. Additionally, all responses were received and recorded by Survey Monkey. The data was downloaded in a Microsoft Excel format and was imported and analyzed through the NCSS 2023 statistical software.

The survey comprised 4 sections, which included demographics, point-of-service risk assessment, Mpox knowledge, and IPAC knowledge — having a total of 16 questions. These questions were close-ended questions and provided the options of “prefer not to say” or “I do not know” if a person does not feel comfortable answering a certain question. Also, the option of “Other (please specify)” was added to specific questions, which accommodated information not included in the options. The questions were made to be clear, simple, and relevant to the research project’s goal. The survey took approximately 5 minutes to complete. Lastly, the participants were given the option to enter their email addresses into a draw to win a \$100 electronic gift card (E-gift card).

Inclusion and Exclusion Criteria

This study included anyone who is an operator that offers a health spa, massage (excluding registered massage therapists), waxing, face painting, nail services, and make-up services, which were publicly advertised personal service establishments in MVRD, British Columbia, Canada. Anyone who is outside of this inclusion criterion was excluded. Participants were made aware of this criterion in the research consent form before they proceeded to the survey questionnaire.

Ethical Considerations

A cover letter and consent form with information on the study's goals, how the data would be used, and any risks to the participants were attached prior to the questionnaire, which guaranteed the participants that the study was ethically carried out. The online survey was hosted and run by Survey Monkey, which has its own security measures. Additionally, participants were made aware that their participation in the study was entirely voluntary and that they have the right to leave at any point. At the beginning of the survey questionnaire, participants were given the option to give voluntary consent or decline to participate. Also, participants were given a choice to enter a prize draw by entering their email addresses. Most importantly, all data gathered for this study will stay confidential. Lastly, the cover letter, consent form, and questionnaire were reviewed

and approved by the BCIT Research Ethics Board, which ensured that the research complied with BCIT’s Research Ethics guidelines.

RESULTS

Descriptive statistics

The study collected multichotomous ordinal and nominal data. The first section of the questionnaire was used to collect multichotomous ordinal (e.g., age and years of experience) and nominal (i.e., gender and type of personal service) data for demographics. The second section was used to determine if the operators practice a point-of-service risk assessment. Moreover, the third and fourth sections were used to assess the operators’ knowledge level of Mpox and IPAC, respectively. **Appendix D** outlines the knowledge score scale, which was categorized as “Very knowledgeable”, “Moderately knowledgeable”, “Somewhat knowledgeable” and “Not knowledgeable”. The knowledge score scale used a four-point scale that was adapted from Likert Scale (32). Moreover, survey data was downloaded in a Microsoft Excel format to generate preliminary descriptive statistics. Descriptive statistics were presented in pie charts or bar graphs to indicate the responses of the participants. By doing so, the reader will be able to picture the data and identify the discussion's main point.

A total of 1823 personal service workers and operators have responded to the survey. However, only 1745 of 1823 completed the survey. Of the 1745 respondents, 132 skipped the question and 1613 responded to the question. Of 1613 who answered the question, 56.48% (911) were female, 39.24% (633) were male, 3.47% (56) selected other, and 0.81% (13) preferred not to answer the question (**Figure 3**).

Of the 1745 respondents, 116 skipped the question and 1629 responded to the question. Of 1629 who answered the question, 56.66% (929) were from the age group “20-30 years”, 28.91% (471) were from the age group “Greater than 30 years”, 13.69% (223) were from the age group “Less than 20 years”, and 0.74% (12) preferred not to answer the question (**Figure 4**).

Of the 1745 respondents, 123 skipped the question and 1622 responded to the question. Of 1622 who answered the question, 52.77% (856) had 5-10 years of experience, 31.20% (506) had less than 5 years of experience, 15.29% (248) had greater than 10 years of experience, and 0.74% (12) preferred not to answer the question (**Figure 5**).

Of the 1745 respondents, 119 skipped the question and 1626 responded to the question. Of 1626 who answered the question, 692 provide health spa services, 572 provide nail services, 562 provide massage services, 516 provide face painting services, 461 provide waxing services, 350 provide makeup services, and 3 selected other (i.e., hair services) (**Figure 6**).

Of the 1745 respondents, 128 skipped the question and 1617 responded to the question “Do you have any IPAC Training”. Of 1617 who answered the question, 83.18% (1345) answered “Yes”, 14.53% (235) answered “No”, and 2.29% (37) selected “I do not know” (**Figure 7**).

Of the 1745 respondents, 131 skipped the question and 1614 responded to the question. Of 1614 who answered the question, 872 respondents got their training from the “Internet or online course”, 812 respondents got their training from the “Guidelines by the BC Ministry of Health”, 728 respondents got their training from “On the job from co-workers/management”, 468 respondents got their training from being an “Apprentice”, 149 preferred not to answer the question, and 1 selected “Other” (i.e., Schooling) (**Figure 8**).

Of the 1745 respondents, 41.78% (N = 729) were very knowledgeable of Mpox and 38.34% (N = 669) were very knowledgeable of IPAC, 28.71% (N = 501) were moderately knowledgeable of Mpox and 24.30% (N = 424) was moderately knowledgeable of IPAC, 20.80% (N = 363) was somewhat knowledgeable of Mpox and 24.93% (N = 435) was somewhat knowledgeable of IPAC, and 8.71% (N = 152) was not knowledgeable of Mpox and 12.44% (N = 217) was not

knowledgeable of IPAC. The result of this study is contrary to what Alshahrani et al. found in their study, which assessed the Mpox knowledge of the general population in Saudi Arabia (33). According to Alshahrani et al. (2022), their survey found that the Saudi population had inadequate knowledge of Mpox and disease transmission. Moreover, only about 231 (48%) of 480 survey respondents had adequate Mpox knowledge (33). However, the study was done in a general population, which do not have IPAC training. Whereas PSE operators in MVRD have IPAC training that has a statistically significant association with Mpox knowledge.

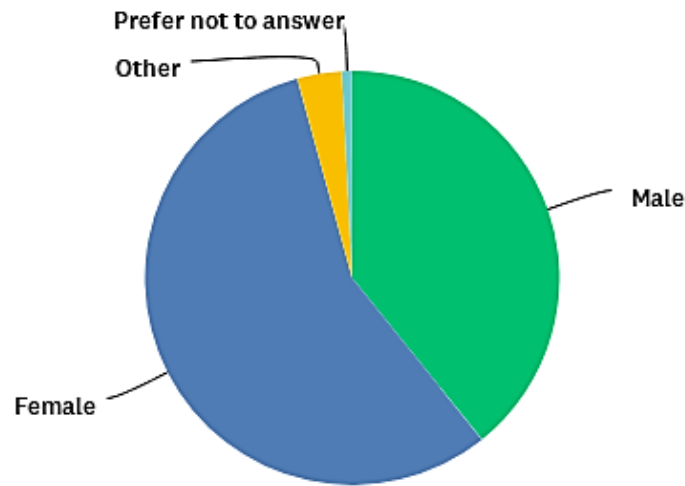


Figure 3. Gender of the respondents.

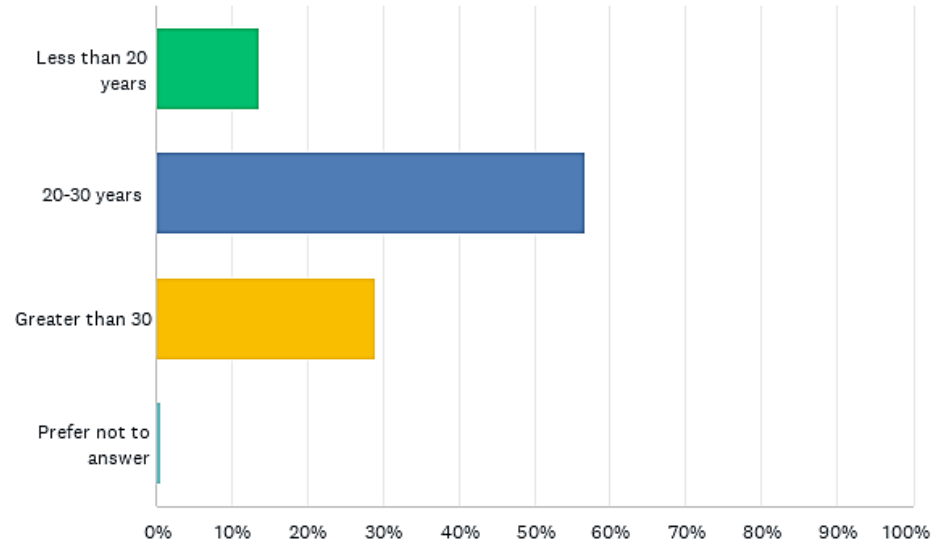


Figure 4. Age group of the respondents.

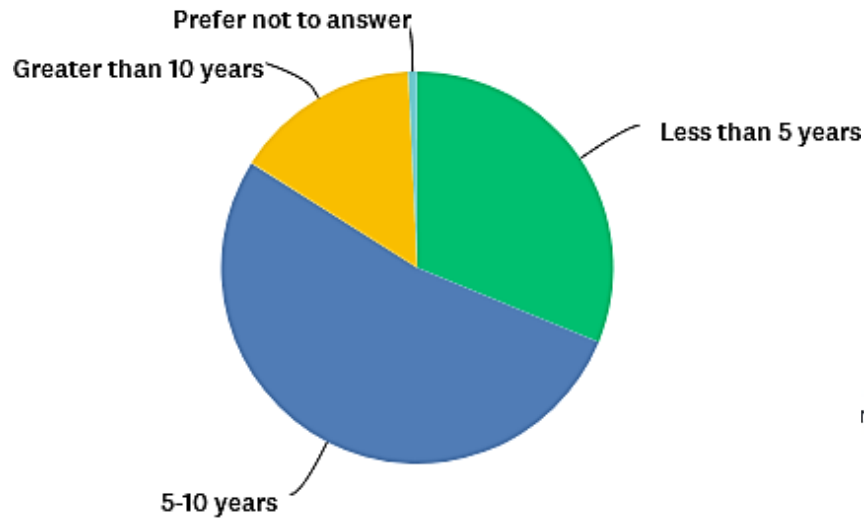


Figure 5. Years of experience of the respondents.

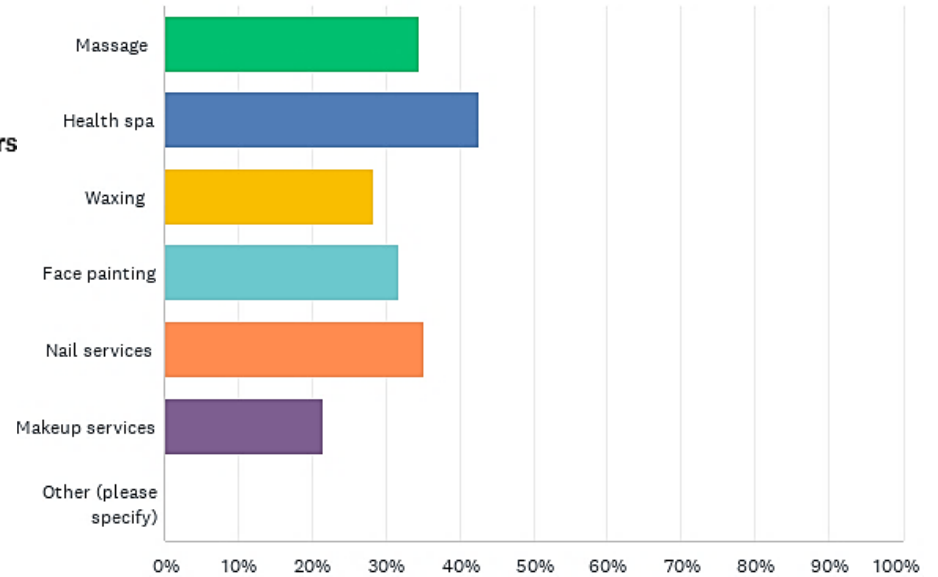


Figure 6. Type of personal services the respondents provide.

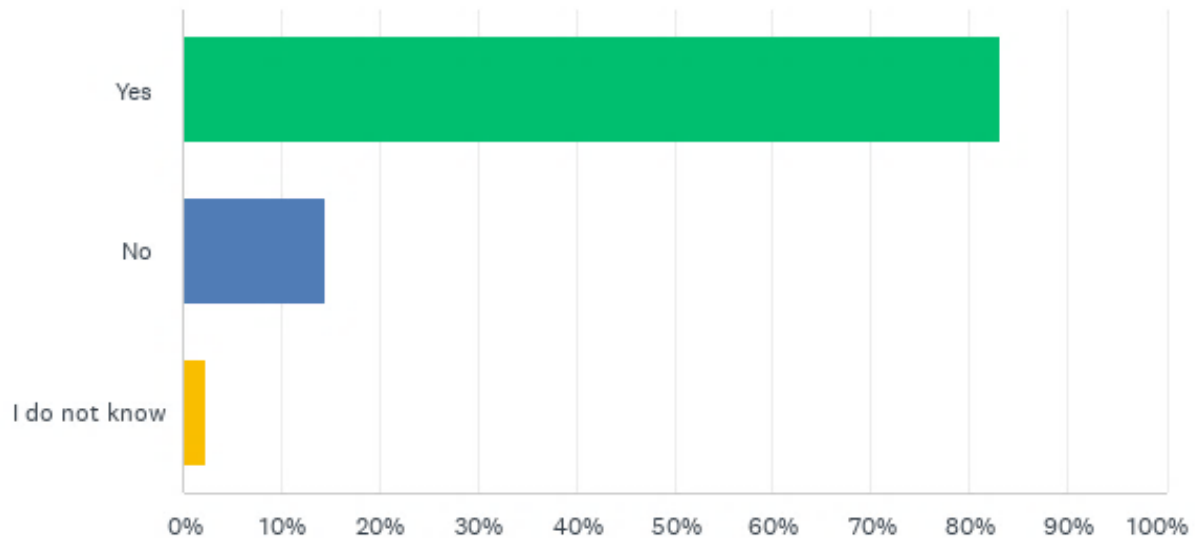


Figure 7. Percentage of respondents that have IPAC training.

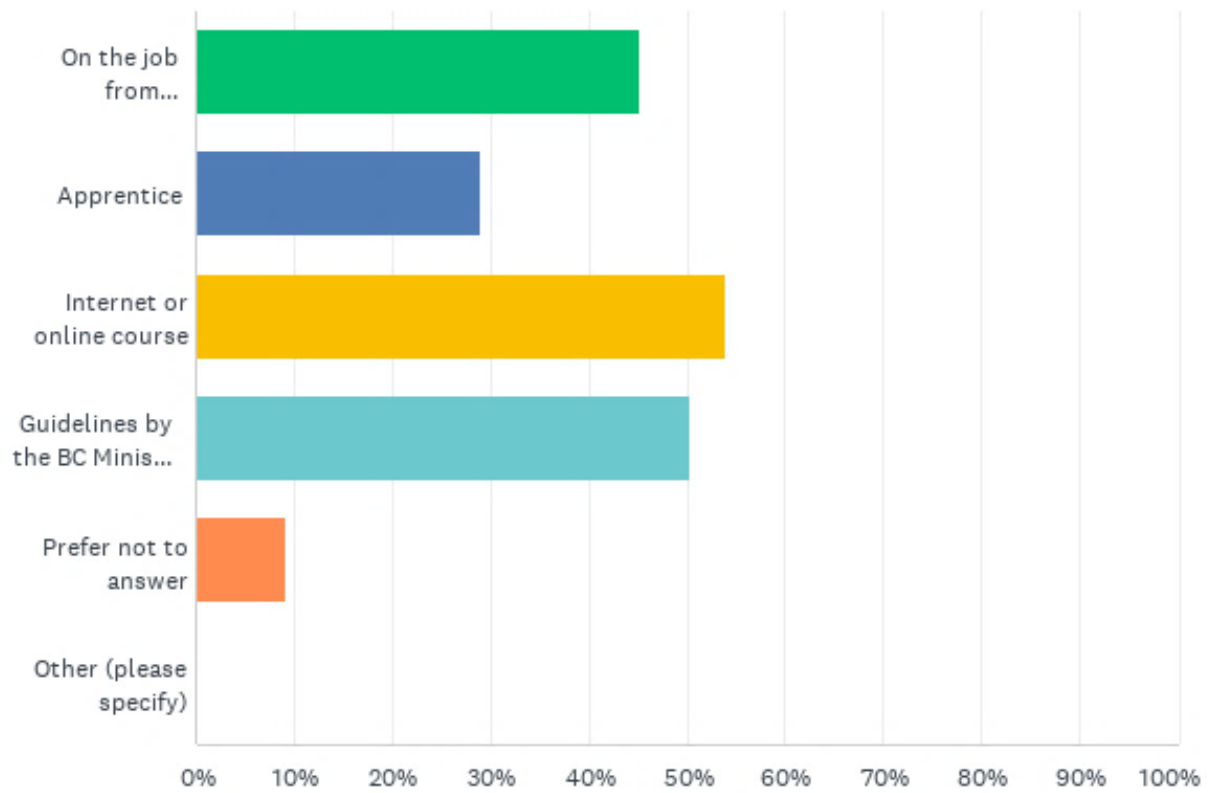


Figure 8. Sources of IPAC training of the respondents.

Inferential statistics

Inferential Statistics were carried out using NCSS 2023 statistical software. The collected data were analyzed and interpreted using Pearson’s Chi-square (χ^2), which determined if there are significant associations between two variables. (e.g., years of experience and Mpox knowledge). The test of significance was run at

an α -value (significance level) of 0.05 (5%) to determine the significant findings of the data. Null and alternative hypotheses were formulated about the associations between groups of data. The hypotheses were listed in **Table 1**.

Table 1. Summary of inferential statistics results.

The Null (H₀) and Alternative Hypothesis (H_a)	Statistical Test Used	P-value	Conclusion
<p>H₀₁: Mpox knowledge and the number of years of experience as a PSE operator are not associated.</p> <p>H_{a1}: Mpox knowledge and the number of years of experience as a PSE operator are associated.</p>	<p>Pearson’s Chi-square (χ^2)</p>	<p>0.0005</p>	<p>Reject H₀₁ and conclude that there is a statistically significant association between Mpox knowledge and the number of years of experience as a PSE operator.</p>
<p>H₀₂: The practice of point-of-service risk assessment and the number of years of experience as a PSE operator are not associated.</p> <p>H_{a2}: The practice of point-of-service risk assessment and the number of years of experience as a PSE operator are associated.</p>	<p>Pearson’s Chi-square (χ^2)</p>	<p>0.1449</p>	<p>Accept (do not reject) H₀₂ and conclude that there is no statistically significant association between the practice of point-of-service risk assessment and the number of years of experience as a PSE operator.</p>
<p>H₀₃: Mpox knowledge and IPAC Knowledge Levels of PSE Operators are not associated.</p> <p>H_{a3}: Mpox knowledge and IPAC Knowledge Levels of PSE Operators are associated.</p>	<p>Pearson’s Chi-square (χ^2)</p>	<p>0.0000</p>	<p>Reject H₀₃ and conclude that there is a statistically significant association between Mpox knowledge and IPAC Knowledge Levels of PSE operators.</p>
<p>H₀₄: The practice of point-of-service risk assessment and the PSE Operators’ IPAC Knowledge Level are not associated.</p> <p>H_{a4}: The practice of point-of-service risk assessment and the PSE Operators’ IPAC Knowledge Level are associated.</p>	<p>Pearson’s Chi-square (χ^2)</p>	<p>0.0000</p>	<p>Reject H₀₄ and conclude that there is a statistically significant association between the practice of point-of-service risk assessment and the PSE Operators’ IPAC Knowledge Level.</p>

DISCUSSION

The main purpose of this study was to assess the IPAC and Mpox knowledge of PSE operators and to determine the associations between IPAC knowledge, Mpox knowledge, number of years of experience, and point-of-service risk assessment. This study found that there were statistically significant associations between Mpox knowledge and the number of years of experience as a PSE operator, between Mpox and IPAC knowledge levels of PSE operators, and between the practice of point-of-service risk assessment and the PSE operators' IPAC knowledge level.

Mpox Knowledge and Years of Experience

The statistically significant association between Mpox knowledge and the number of years of experience as a PSE operator indicated that years of experience can significantly affect their knowledge level of the re-emerging pathogen, Mpox. The collected data suggested that PSE operators who had 5-10 years of experience were the most knowledgeable group on Mpox among PSE operators. With years of experience as a PSE worker and/or operator, greater awareness and greater understanding of infection control practices are being acquired by PSE operators, which is important in preventing the spread of Mpox. Also, with their years of experience, they may have encountered other similar diseases that will aid in developing a better understanding of the disease symptoms (e.g., rash or lesions) and transmission of the disease. On the other hand, it is crucial to note that experience alone does not necessarily equate to knowledge or expertise. PSE operators/workers with less experience in infection control may have received more recent training or education on the topic or may have a greater interest in disease prevention in PSEs. Therefore, while experience in infection control in PSEs may provide a foundation of knowledge and skills that can be applied to Mpox prevention and control, it is not the sole determinant. Various factors such as education, training, and ongoing professional development also play important roles (7).

Mpox and IPAC Knowledge Levels

Furthermore, the statistically significant association between Mpox and IPAC knowledge levels of PSE operators indicated that infection control knowledge level determines the knowledge level of re-emerging pathogen, Mpox. The collected data suggested that PSE operators who were very knowledgeable about IPAC were the most knowledgeable about Mpox. Infection control knowledge can certainly affect Mpox knowledge, as the transmission of Mpox can be influenced by infection control practices. Knowledge of infection control measures such as hand hygiene, use of personal protective equipment, and disinfection protocols — which are all part of the infection control plan of PSEs — can help prevent the spread of Mpox and other infectious diseases (34). In addition, PSE operators and/or workers with adequate knowledge of infection control practices may be better equipped to identify symptoms of Mpox and implement appropriate measures to prevent further disease transmission such as refusing to provide personal services to symptomatic patrons.

Overall, it is crucial to keep in mind that having knowledge of IPAC measures does not always guarantee being knowledgeable about Mpox. Therefore, while infection control knowledge can be helpful in preventing the spread of Mpox, educational materials (e.g., pamphlets containing symptoms and modes of transmission of Mpox) and proper training (e.g., courses offered by private agencies such as Beauty Council BC) may be necessary to fully educate and increase the awareness of PSE operators/workers in regard to Mpox (7). A study stated that the regulations in Virginia and California, US require personal service establishment operators to be licensed, trained, and/or certified in order to operate (35). Whereas in Canada, no provinces require IPAC-specific training or certifications.

Point-of-Service Risk Assessment and IPAC Knowledge Level

Lastly, the statistically significant association between the practice of point-of-service risk assessment and the PSE operators' IPAC knowledge level indicated that being

knowledgeable about infection control practices significantly affects their behavior of practicing risk point-of-service risk assessment. The collected data suggested PSE operators who were very knowledgeable about IPAC were practicing the point-of-service risk assessment the most among PSE operators. Risk assessment is a critical step in infection prevention and control, as it involves assessing the client's skin for signs of skin infections and screening for other symptoms of Mpox, which can aid in the prevention of disease transmission in PSEs (6). A PSE operator/worker with adequate IPAC knowledge may be more likely to recognize the importance of implementing an infection control plan, which includes the point-of-service risk assessment. In addition, knowledge of infection control practices can help PSE operators/workers develop effective risk mitigation strategies, such as enhancing environmental cleaning and disinfection and promoting hand hygiene (36). Being knowledgeable about infection control practices is an important component of effective point-of-service risk assessment and plays a critical role in preventing the spread of Mpox.

Point-of-Service Risk Assessment and Years of Experience

On the other hand, statistical analysis of the survey data indicated that there was no association between the practice of point-of-service risk assessment and the number of years of experience as a PSE operator. The data collected indicated that regardless of the number of years of experience, PSE operators were practicing the point-of-service risk assessment. This means that most operators check for signs of infections in their clients' skin regardless of their years of experience. Additionally, several factors may explain these data such as operators being motivated to practice point-of-service risk assessment as a way to protect themselves, their clients, and their business reputation. While years of experience may not directly impact the practice of point-of-service risk assessment, it could still affect other aspects of infection control. For instance, PSE operators with more experience may have a better understanding of infection control principles and may be more knowledgeable about emerging pathogens like

Mpox. Ergo, it is still important for PSE operators to receive regular training and education on infection control practices to ensure that they are providing safe and healthy services to their clients (7,36). Overall, even though there is no statistically significant association in these variables, this is still a promising finding since it shows that PSE operators are making significant efforts to stop the spread of infectious diseases, even though they do not have extensive training in infection control.

LIMITATIONS

The study was a self-administered online survey. Therefore, the principal investigator was not present with the respondents while they completed the questionnaire. There is a chance that the respondents might have used other sources to answer the questions that assessed their IPAC and Mpox questions; therefore, it may not accurately reflect the respondent's IPAC and Mpox Knowledge levels. Moreover, it may have created a bias for IPAC-trained and enthusiastic PSE operators by asking the Beauty Council BC to distribute it to PSE operators and workers in their network, which have sufficient IPAC training. Lastly, an in-person survey was not done to retain the anonymity of the participants. If this is done, there would be more honest and more valid responses because respondents would not have the opportunity to use the internet or other resources to search for answers, especially for the Mpox and IPAC knowledge questions.

KNOWLEDGE TRANSLATION

The results from the study suggest a positive correlation between years of experience, IPAC, and Mpox Knowledge levels. This suggests that PSE staff with more experience and knowledge may be better equipped to identify patrons with Mpox symptoms and implement appropriate infection control measures to prevent further transmission. But experience alone does not necessarily translate to better infection control practices. In other words, even if someone has extensive experience in the field, they may not necessarily be implementing best practices when

it comes to controlling the spread of infectious diseases (e.g., Mpox). Other factors (e.g., quality of training and ongoing professional development) may affect the staff's behavior. Therefore, it is important to consider the nature of the services that they provide and the resources available to support their work. Additionally, the results from this study can advocate for the reinforcement of IPAC training and the practice of point-of-service risk assessment of PSE operators and workers. It is essential to continually update and refine infection control measures based on new information and best practices to ensure that effective measures are in place to prevent the spread of re-emerging pathogens like Mpox. Moreover, infection control practices like assessing clients' skin before carrying out a personal service are crucial in the prevention of transmission in the community. These measures will ensure the best possible health outcomes for PSE patrons, PSE staff, and the public.

The research study's data can also be used to increase the funding for awareness campaigns and seminars for emerging and re-emerging pathogens (e.g., Mpox), availability of diagnostic tests and vaccines against emerging and re-emerging pathogens, and an increase in the healthcare workforce for better surveillance systems. It may also emphasize the need and aid in changing policies to require proper training or certification for infection control for all PSE operators. A good example of regulated certification is the FOODSAFE Level 1 and 2 or equivalent food safety training for food service establishment (FSE) operators in BC and across Canada. Having said that, it will help us prepare and prevent epidemics from happening, which can be caused by emerging and re-emerging pathogens like the Mpox virus.

FUTURE RESEARCH

The following are recommended ideas for future research projects:

- a. Comparing data with other regional districts and other provinces regarding Mpox and IPAC knowledge levels.
- b. Include new personal services (e.g., tattoo and body modifications) that have direct

contact with the client's skin, which were not accounted for in the inclusion criteria.

- c. The study can be used in a more general population (e.g., British Columbians) to know the baseline knowledge of the general population who does not have IPAC training.
- d. Survey of the general population regarding other emerging and re-emerging pathogens associated with PSEs (e.g., methicillin-resistant *Staphylococcus aureus* (MRSA), Carbapenemase-producing organisms (CPO), or other antimicrobial-resistant microbes).

CONCLUSION

PSEs may involve direct contact with the client's skin and may cause direct and/or indirect transmission of diseases such as Mpox. Having said that, IPAC practices are very important to prevent the transmission of diseases. The survey results provided evidence that having adequate knowledge of IPAC has an impact on the Mpox knowledge level and the practice of point-of-service risk assessment. It is found that having adequate IPAC knowledge resulted in higher knowledge of Mpox. Moreover, operators who were adequately knowledgeable about IPAC are more likely to assess their client's skin for infection. Lastly, the results from this study can promote the importance of IPAC training in response to emerging and re-emerging pathogens by requiring IPAC training for all PSE operators. Policy changes will take time and a lot of evidence-based proposals and discussion. However, the results of this study could convince policymakers to require IPAC training in PSEs. The spread of communicable diseases (e.g., Mpox) in any community setting like PSEs could be prevented by having awareness and proper IPAC training.

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ABBREVIATIONS

- BC – British Columbia
- BC CDC – BC Centre for Disease Control
- BCIT – British Columbia Institute of Technology
- BC PHA – BC Public Health Act
- CPO – Carbapenemase-producing organisms
- FH – Fraser Health
- FSE – Food Service Establishment
- GBMSM – Gay, bisexual, and other men who have sex with men
- HIV – Human Immunodeficiency Virus
- IPAC – Infection Prevention and Control
- MPXV – Mpox virus
- MVA – Modified Vaccinia Ankara
- MVRD – Metro Vancouver Regional District
- MRSA – methicillin-resistant *Staphylococcus aureus*
- NCCEH - National Collaborating Centre for Environmental Health
- NCSS – Number Cruncher Statistical Systems
- NTM – Non-tuberculosis Mycobacterial
- PHAC – Public Health Agency of Canada
- PHEIC – Public Health Emergency of International Concern
- PPE – Personal Protective Equipment
- PSE – Personal Service Establishment
- QR – Quick Response
- RHA – Regional Health Authority
- VCH – Vancouver Coastal Health
- WHO – World Health Organization

COMPETING INTERESTS

The authors declare that they have no competing interests.

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