

Assessing Infection Prevention and Control (IPAC) Knowledge of Tattoo Artists of British Columbia

Jagjeet Singh¹

Helen Heacock²

1. Lead Author, B. Tech. Student, School of Health Sciences, British Columbia Institute of Technology, 3700 Willingdon Ave. Burnaby, BC, V5G 3H2

2. Supervisor, School of Health Sciences, British Columbia Institute of Technology, 3700 Willingdon Ave. Burnaby V5G 3H2

Abstract

Background

Tattooing has become very popular in the past 30 years. The prevalence of tattoos has increased such that approximately twenty percent of Canadians have at least one tattoo. The Personal Services Establishments (PSEs) industry in BC lacks stringent regulations. Tattoo studios are a significant part of the PSEs industry. Tattooing includes invasive procedures and as such, has the potential for spreading many types of infections. Proper Infection Prevention and Control (IPAC) procedures are required to minimize the risk of infections. The British Columbia Ministry of Health (MoH) guidelines for PSEs provide direction for IPAC, however, these guidelines are not enforceable by Environmental Health Officers. Therefore, the IPAC knowledge of tattoo artists in the absence of stringent regulations and its relationship with various other factors should be assessed to gauge any deficits in knowledge and identify opportunities for education.

Methods

A self-administered online survey questionnaire was created using Survey Monkey. The survey link was sent via email to tattoo studios and artists across British Columbia (BC). Cover letters with a scannable QR code linking to the survey were also dropped off at tattoo studios in the Metro Vancouver area. Multiple choice and close and open-ended questions in the survey collected information about demographics, years of experience, and IPAC knowledge. The collected data was analyzed using NCSS 2021 statistical software.

Results

Among the 40 respondents who completed the survey, 45% were male and 47% were females. Respondents from the age group 30-39 years comprised 57% of those surveyed. 22% of the participants had 5-10 years of experience as a tattoo artist whereas 35% had more than 10 years. Results showed 27% of the respondents did not have any IPAC certification, and 37% of the respondents said that the internet was a source of their IPAC knowledge whereas 62% said their knowledge came from MoH guidelines. Chi-square analysis showed no association between IPAC certifications and IPAC knowledge. However, a statistically significant association was found between IPAC knowledge and years of experience.

Conclusion

Although those with more years of experience as a tattooist lead to greater IPAC knowledge, inconsistent training and knowledge amongst tattoo artists would support EHOs' role as an educator to ensure consistent IPAC procedures throughout the tattoo services industry. This also suggests that the development of a certification program designed for tattoo artists would be beneficial.

Keywords: Personal Services Establishments, Tattoo studios, Infection Prevention and Control, Regulations, British Columbia.

Introduction

The history of tattooing in Canada predates the arrival of European settlers in North America. There was a time in history when tattoos were considered “undesirable” and a symbol of-rebellion. But over the last 30 years, tattoos have gained wider popularity and are now considered a display of art(1). According to a study conducted in 2011, 1 in 5 Canadians have at least one tattoo and 1 in 10 Canadians have multiple tattoos. Amongst Canadians, British Columbians are more likely to get a tattoo compared to other provinces(2). Tattooing is an invasive procedure, so the fact that approximately one-quarter of British Columbians are likely to get at least one tattoo raises concerns about infection prevention and control (IPAC) and the safety of clients at tattoo parlours/shops. Tattoo parlours and shops are considered a Personal Service Establishment (PSE) in British Columbia (BC). PSEs are covered under the Regulated Activities Regulation of the Public Health Act (PHA) of BC. However, the regulation provides very minimal authority to the Environmental Health Officers (EHOs) to prevent the spread of infection in PSEs. The majority of IPAC practices at PSEs are based on the guidelines provided by the local health authorities and are not enforceable by EHOs. Additionally, PSEs are usually inspected only once a year by EHOs. So, the monitoring of their operations and practices is only a snapshot in time – around 1 hour in 365 days. Therefore, the prevalence of tattoo artists in BC who have the required knowledge of IPAC needs to be determined in the absence of stringent regulations and frequent inspections. A literature review was conducted to find evidence of the type of infections prevalent in PSEs, their routes of transmission, and existing regulations.

PSEs and Tattooing as a PSE

Personal Service Establishment means an establishment in which a person provides a service to or on the body of another person and includes barbershops, beauty parlours, health spas, massage parlours, tattoo shops, saunas, and steam baths (3). It also includes hair, skin, and nail services like manicures, pedicures, cosmetic laser services, shaving, tanning, aromatherapy floatation tanks, and body modification services such as body piercing, micro pigmentation, tattooing and tattoo removal(4). Tattooing involves making patterns on the skin using dye or ink with the help of needles and other instruments(5).

Public Health Significance

Tattooing procedures include penetrating the skin. The tattoo ink penetrates the dermis and contacts blood vessels(5). Pathogens can be present in the tattoo ink, on non/poorly sterilized instruments, on the outer skin of the person getting the tattoo or on the skin of the tattooist. These pathogens can enter the dermis or blood of the person getting a tattoo during the procedure and lead to skin diseases or other blood-borne diseases. The tattoo site can also get infected post-procedure if proper aftercare is not provided(6).

Infections/Diseases Associated with Tattoo Parlours

Dyes and colours used for tattooing can inherently contain microorganisms. In a study conducted on 39 different opened and unopened bottles of dyes, a substantial number had a clinically relevant number of pathogens in them. These organisms included species of *Pseudomonas* and *Staphylococcus*. Contamination often occurs with dilution with tap water or inadequate sanitation practices. Transfer of ink from larger stock to smaller non-sterile cups is

another high-risk practice and can also add microorganisms. Therefore, higher microorganism populations are common for opened bottles(6). There have been documented cases of *Non-Tuberculosis Mycobacterium* (NTM) species associated with the dilution of dyes with non-sterile water(7). Conaglen et al identified 71 confirmed and 71 probable cases of NTM associated with tattoo infections in Scotland. NTM infection is typically represented by papules, pustules, and nodules on the skin at the tattoo site(8).

Skin infections caused by *Methicillin-Resistant Staphylococcus aureus* (MRSA) have also been reported. In 2006, a cluster of MRSA cases in tattoo recipients was reported by the Centre for Disease Control and Prevention (CDC). MRSA is transmitted from person to person if poor personal hygiene and improper glove use is practiced by a tattoo studio artist(9). MRSA infection is typically represented as abscesses and pustules on the skin.

These skin infections have the potential to cause a systemic infection which can lead to bacteremia, septicemia, and organ failure. Porter et al in 2003 reported a death that was caused by a septic shock following a traditional Samoan tattoo in New Zealand(10).

Transmission of blood-borne and environmental pathogens using non-sterile needles and reuse of single-use needles is another concern. Ghorpade A. in 2003 concluded that infection of NTM species was associated with the use of non-sterile needles in India(11). Viral Infections like Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) have been documented following the use of contaminated needles by unprofessional artists(7). Symptoms of Hepatitis viral infection can include fever, jaundice, loss of appetite, nausea, vomiting,

and dark urine. In severe cases, cirrhosis of the liver can lead to hepatocellular carcinoma(12). Studies show HIV can also be transmitted with tattooing and there have been 2 documented cases of human immunodeficiency virus (HIV) transmission with tattooing in prison(13). However, there were also some confounding factors such as the use of needles for drug administration. Symptoms of HIV infection include fever, rashes, muscle pain, fatigue, and swollen lymph nodes. HIV infection can stay latent for long periods. The most severe result of HIV is the development of acquired immunodeficiency syndrome (AIDS) which leaves the affected individuals vulnerable to many other infections(14). Sergio et al concluded that despite the confounding factors, sufficient evidence exists to demonstrate the association of poor infection control with tattooing and the transmission of HBV and HCV. HIV is also very likely to be transmitted(13).

Some of these infections can have high morbidity and mortality rates, thus, they can pose a heavy burden on the health care system. The risk of these complications from tattooing can be significantly lowered by aseptic techniques and tattoo artists' knowledge of IPAC. According to a study conducted by McGuire (2006), only 19 percent of the 32 tattooists and piercers of British Columbia who participated in the study reported having a previous education in IPAC. However, the study did not test the actual knowledge of IPAC processes (15). Wong (2018) found a statistically significant association between having a course on bloodborne pathogens and correctly identifying bloodborne pathogens in a study conducted on the microbladers of BC. Microblading is also a procedure that includes penetrating the skin and injecting pigments (16). In another study conducted on tattooists, microbladers and permanent

make-up artists of BC by Hansen (2017), 90 percent of the 30 respondents agreed that formal training should be required before being allowed as a tattooist. 43 percent of them agreed that certification should be made a requirement to operate the sterilization equipment (17).

The National Collaborative Centre for Environmental Health (NCCEH) published a summary of infections associated with PSEs. In almost all investigated outbreaks, the environmental pathogens associated with poor infection control practices were associated with the outbreak. The following outbreaks were highlighted in the NCCEH report(18)

Outbreaks

Place	Pathogen	Number of individuals affected	Possible source of infection
US*	<i>Mycobacterium haemophilum</i>	2	Municipal water used in the rinse solution
US	<i>Mycobacterium chelonae</i>	6	Municipal water used to dilute ink
France	<i>Mycobacterium chelonae</i>	48	Municipal water used to dilute ink
US	<i>MRSA</i>	44	Infected Tattooists, use of non-sterile tools, unhygienic practices
UK**	<i>HBV</i>	34	Non-sterilization of needles between use
UK	<i>HCV</i>	11	Likely to have occurred at a tattoo parlour

Table.1 Summary of Outbreaks Associated with PSEs

*The United States of America

** The United Kingdom

The burden of PSE infections

Dieckman, R 2016 stated that most infections acquired after tattooing procedures are minor and self-limiting(6). Therefore, most infected individuals do not seek medical attention and cases of infection go unreported. In a study conducted by Quantara et al in 2011, 86% of the 463 young adults who participated in the study said that they did not report the complications they experienced after getting tattoos(19). According to Shaw, K. (2016), there was no data available on the cost associated with infection and disease from PSEs in Canada (20). So, it can be concluded that most infections that get transmitted at PSEs go unreported and the

real incidence and prevalence of PSE infections/diseases is unknown in Canada.

Current Regulation and Guidelines for PSEs in BC

PSEs are designated as regulated activities under the Regulated Activities Regulation of the PHA. The PHA has different provisions to prevent health hazards in regulated premises. The PHA defines health hazard as

- “(a) a condition, a thing or an activity that
 - (i)endangers, or is likely to endanger, public health, or
 - (ii)interferes, or is likely to interfere, with the suppression of infectious

- agents or hazardous agents,
- or
- (b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that
 - (i) is associated with injury or illness, or
 - (ii) fails to meet a prescribed standard in relation to health, injury or illness”

Under section 18(1) of the PHA, operators of all premises who engage in regulated activities are mandated to take appropriate action to prevent health hazards. Furthermore, under section 18(2), the operator must also ensure that their employees are adequately trained to recognize and prevent health hazards (3) Section 3 of the Regulated Activities Regulation mandates the availability of hot and cold water and handwashing stations as follows:

- “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.”

Scrutinizing these regulations for practical applications by EHOs reveals that the regulations do provide the authority to control health hazards at PSEs but none of them cover the details of infection prevention requirements and the enforcement action that can be taken to prevent the violation. Additionally, the

PHA’s training requirement for the employees is very vague. There is no training program appropriate for PSE operators that is accepted or recognized by the act, unlike the FOODSAFE certification requirement that has been mandated for all food premises operators under the Food Premises Regulation of the PHA(3).

To provide PSE operators with more detailed information on IPAC, the BC Ministry of Health (MOH) has issued guidelines for PSEs. These guidelines are much more comprehensive and provide information on facility design, cleaning, disinfection, sterilization, and record keeping(4). The guidelines are designed to guide the decision-making of the operators and to provide EHOs with a document to use while conducting inspections of PSEs. However, these guidelines are not enforceable by EHOs. Many operators might not adhere to these guidelines as there is no legislative obligation.

Purpose of Study

It is evident that tattoo studios can be a place for the transmission of many infections. Almost all infections can be prevented by adequate IPAC. Therefore, the purpose of this research was to determine the level of IPAC knowledge amongst tattoo artists in BC in the absence of stringent legislative requirements and to find any association between IPAC knowledge level and IPAC certification, years of experience, and age group. This was achieved by collecting primary data on tattoo artists of BC using a survey questionnaire.

Materials and Methods

Materials Used

This study used a laptop with internet access to search tattoo studio locations in BC and to

distribute survey questionnaire via emails, a printer to print the cover letters for in-person participant recruitment, Survey Monkey software (Survey Monkey, 2021), Microsoft Excel software to collect and organize data, and NCSS software for data analysis (21).

Standard Method

This study used a survey questionnaire to collect data. A BCIT Survey Monkey licence was used to develop and distribute the questionnaire to ensure that all the collected data is stored in Canada. The survey was available from January 20, 2022, to February 10, 2022. Tattoo studios were randomly selected all over British Columbia and every studio that offers tattooing services had an equal opportunity to be selected for the study. A list of tattoo studios across BC and the official email addresses of studios and their tattoo artists was created using the Google search engine. Every other tattoo studio/artist on the list was randomly selected for the study. A link that referred willing participants to the research consent form and the survey was sent in the email. Cover letters for participant recruitment were printed with a scannable QR code linking to the survey. Willing participants could scan the QR code to read the consent form and complete the survey questionnaire. The principal investigator visited the tattoo studios in the Metro Vancouver area in-person to drop off the cover letters. All responses were received and recorded by Survey Monkey.

The questionnaire included 13 questions. The first question asked for voluntary consent to participate in the study. Two questions collected demographic information about age and gender. The next ten questions collected data about years of experience as a tattoo artist, source of IPAC knowledge, IPAC certification status and assessed IPAC knowledge. All the questions were multiple choice. Participants were

given the opportunity to write their answer in an “other” option where none of the given choices best described the participant’s situation. Participants had the option to select “Prefer not to answer” for questions collecting information about age, gender, years of experience and IPAC certification status. For all the questions that assessed IPAC knowledge, participants had an “I do not know” option to discourage any guessing for the correct answer. There were seven knowledge testing questions in total and participants who answered at least six of them correctly were considered to have an “adequate” knowledge of IPAC whereas anyone who answered less than six questions correctly was considered to have “inadequate” knowledge. Participants were expected to finish the questionnaire within five minutes.

Inclusion and Exclusion Criteria

This study has been conducted on “anyone who is a tattoo artist at a publicly advertised personal service establishment in British Columbia”. Anyone who is outside of this inclusion criteria was excluded. Participants were made aware of this criterion in the research consent form before they proceeded to the actual questionnaire.

Ethical Considerations

To ensure that this study was conducted ethically, a cover letter was attached before the questionnaire which provided the information about the purpose of the study, use of collected data, and risks to the participants. Participants were also informed that their participation was completely voluntary, and they could withdraw from the study at any point. At the beginning of the questionnaire, participants had the opportunity to provide voluntary consent or not participate. The cover letter, consent form and the questionnaire were submitted

to BCIT Research Ethics Board for approval before the commencement of the study.

Results

Descriptive Statistics

The study collected multichotomous, ordinal and nominal data about age and years of work experience, and nominal data about gender, IPAC certification, and IPAC knowledge. A total of 165 tattoo artists were contacted and requested to participate in the study and 47 of them agreed to fill out the questionnaire. However, only 40 of those 47 responses were selected to be included in the study as seven of the participants did not answer any other question than agreeing to participate in the study. All data was displayed as bar charts and pie charts by Survey Monkey. Data was exported and stored in MS Excel.

Of the 40 respondents, 45 % (N=18) were males, 47% were females (N=19), 5% selected other (N=2) and 3% (N=1) preferred not to answer. Participants of all ages completed the questionnaire. A majority of the respondents (57%) (N=23) were from the age group 30-39 years. 10% (N=4) of the respondents were 18-24 years, 15% (N=6) were 25-29 years, and 17% (N=7) were 40-50 years old. There were no respondents under 18 years or over 50 years of age.

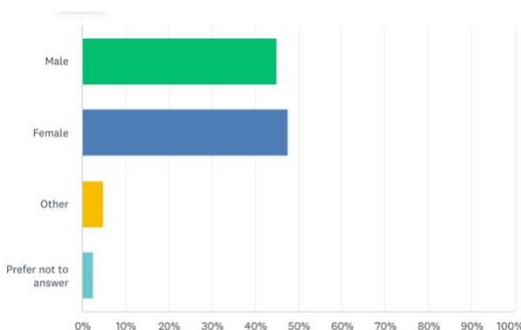


Figure.1 Gender of Respondents

In regards to the number of years of experience as a tattoo artist, 10% (N=4) had less than 1 year, 32% (N=13) had 1-5 years, 22% (N=9) had 5-10 years, and 35% (N=14) had more than 10 years of experience.

When asked about IPAC certification status, 5% (N=2) of the respondents said they had an IPAC certificate from a college or university, 5% (N=2) said BeautySafe, 27% (N=27) did not have any certification, 10% (N=4) preferred not to answer and 65% (N=26) said they had a certificate from other online courses. Respondents had the opportunity to specify the course that they have taken if they selected others. Out of the 26 who selected “other”, 17 said they had a training certificate on blood-borne pathogens. Other responses included Red Cross courses, WorkSafe BC courses, and out of BC and out of Canada education.

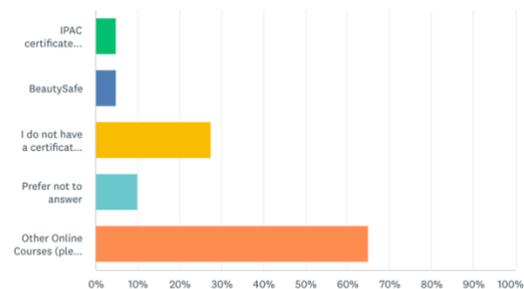


Figure.2 Types of certifications held by tattoo artists

In regards to the source of IPAC knowledge, 50% (N=20) said their source of IPAC knowledge was from working as an apprentice, 60% (N=24) said co-workers/management, 37% (N=15) said the internet, 62% (N=25) said Guidelines by the Ministry of Health BC, and 25% (N=10) selected other.

Of the 40 respondents, 70% (N=28) had adequate knowledge and 30% (N=12) had inadequate knowledge of IPAC.

Inferential Statistics

Hypotheses were formed about the associations between groups of data.

Hypotheses are listed in Table 2. The chi-square test was used to test whether an association exists between two variables

(22). The test of independence was run at an alpha level of 0.05 (5%).

The Null (Ho) and Alternative Hypothesis (Ha)	P-value	Conclusion
Ho: IPAC certification status and the IPAC knowledge of tattoo artist are independent. Ha: IPAC certification status and IPAC knowledge of tattoo artist are dependent.	0.3853	Do not reject Ho and conclude that IPAC certification and IPAC knowledge of tattoo artist are independent. Not having an IPAC certificate does not necessarily mean inadequate IPAC knowledge.
Ho: IPAC certification status and age of the tattoo artist are independent. Ha: IPAC certification status and age of tattoo artist are dependent.	0.1651	Do not reject the null hypothesis and conclude that IPAC certification and age of the tattoo artist are independent. There is no specific age group that had better IPAC knowledge.
Ho: Number of years of experience as a tattoo artist and IPAC knowledge are independent. Ha: Number of years of experience as a tattoo artist and IPAC knowledge are dependent.	0.0220	Reject the null hypothesis and conclude that number of years of experience as a tattoo artist and IPAC knowledge are dependent. Respondents with longer experience had a better IPAC knowledge. There is a potential for alpha error as P-value is very close to 0.05.

Table.2 Chi-square analysis of Null (Ho) and Alternative (Ha) Hypothesis

Discussion

The main purpose of this study was to assess the IPAC knowledge of tattoo artists in the absence of stringent legislative requirements for IPAC certification and to explore associations between IPAC knowledge and IPAC certification, age of tattoo artist, and years of experience. This study has indicated that there is no association between IPAC certification and IPAC knowledge of tattoo artists, nor between IPAC knowledge and age. However, statistical analysis indicated that there is an association between the number of years as a tattoo artist and IPAC knowledge. Artists who have been working in the industry for a longer period had a better understanding and knowledge of IPAC. These findings were contrary to a study conducted on microbladers of BC (16)

where no association was found between the years of experience and pathogen knowledge of microbladers. This contradiction might have occurred due to the majority of microbladers included in the study having a course taken in bloodborne pathogens. Despite the results of statistical analysis, this study has revealed many important aspects of the tattoo industry.

The collected data suggested that 70% of the tattoo artists who participated in this study had adequate knowledge of IPAC. This was reassuring as an ample majority of tattoo artists were able to provide their services safely. It becomes even more important as many people find hygiene and sanitary conditions of a PSE a very important factor when choosing a facility (23). A vast

majority of artists also had certification in IPAC. It should also be noted the type of certification they possessed varied widely, especially amongst the respondents who selected “other online courses” as the IPAC certification they had. It indicates that most artists working in the industry are willing to get certified but there might be a lack of a standardized targeted course that is exclusively designed for tattoo artists.

It was also found that more than 60% of tattoo artists follow the MoH Guidelines for PSEs(4) as a source of IPAC knowledge (Figure.3). These guidelines are used as a decision-making tool by PSE operators including tattoo artists and EHOs. As many tattoo artists use these guidelines it can be said that EHOs should continue using these guidelines as a guiding tool for ensuring IPAC at tattoo studios. The MoH should also ensure that the guidelines are regularly updated to cover newer and evolving aspects of the PSEs industry.

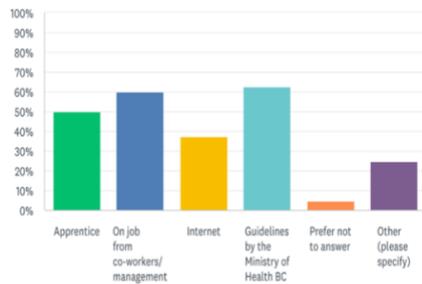


Figure.3 Respondents’ Source of IPAC Knowledge

Limitations

There were a few limitations experienced by the investigator while conducting this study with respect to materials and methods used. The link to fill in the questionnaire was sent in the emails of tattoo artists/studios in BC. Surveys sent in emails only receive up to 30 percent of responses (24). As such, the

response rate to this survey was low. The principal investigator also visited the tattoo services premises in-person to drop off the cover letters. Individuals identifying with the field of environmental health can be perceived as “enforcement officers”. Thus, the artists might have been reluctant to participate.

The survey questionnaire was self-administered. Therefore, the investigators were not present with 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 knowledge, thereby not accurately reflecting their IPAC knowledge. In-person administration of surveys might have yielded more honest responses, but this method was not feasible due to safety risks posed by the ongoing COVID-19 pandemic. Additionally, given the large number of tattoo studios/salons in BC, the number of received responses was relatively small, therefore, it might not reflect the true level of IPAC knowledge amongst the tattoo artists in the province. If the study is conducted on a large sample size, the results may vary.

Knowledge Translation

From the results of this study, it is evident that there are a lack of specialized IPAC certification programs developed specifically for tattoo artists. The Canadian federal government had previously recommended that the staff of PSEs receive infection control knowledge from their local health units (25). Therefore, this study can be used to develop an IPAC certification program targeted specifically to tattoo artists. EHOs in their traditional roles teach courses such as FOODSAFE and Pool Smart to the operators of food service establishments and public pools respectively. An IPAC course for tattoo artists or PSEs workers, in general, can

become another part of such teaching programs.

Additionally, the MoH Guidelines (4) for PSEs were found to be an important source of IPAC knowledge for tattoo artists in this study. These results can be used to improve the guidelines. The guidelines do not provide IPAC information specific to tattooing procedures, instead, it outlines the PSEs procedures in general. The MoH can revise the document to include tattooing-specific procedures.

Future Research

The following are recommended ideas for future research projects:

- Survey of public about their knowledge of infections associated with tattooing.
- Comparison of PSEs' compliance history between two provinces with different regulations
- Comparison of compliance history between tattoo studios/artists with and without IPAC certification
- Repeat this study after the COVID-19 pandemic is over, using in-person interviews.

Conclusion

Tattooing is an invasive procedure and has the potential to spread many skin and bloodborne infections. The current regulations are not specific and the MoH guidelines are not enforceable by EHOs.

References

1. Natale J. The Impact of Tattoos in Modern Society. Untitled Magazine [Internet]. 2014 Mar 20 [cited 2021 Oct 10]; Available from: <http://untitled-magazine.com/the-impact-of-tattoos-in-modern-society/>
2. Two in Ten Canadians (22%), Americans (21%) Have a Tattoo [Internet]. Ipsos Reid. 2012 [cited 2021 Oct 10]. Available from: <https://www.ipsos.com/en-ca/news-polls/two-ten-canadians-22-americans-21-have-tattoo>
3. Public Health Act [SBC 2008] Chapter 28 [Internet]. Available from: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/08028_01
4. Ministry of Health. GUIDELINES FOR PERSONAL SERVICE ESTABLISHMENTS [Internet]. 2017 [cited 2021 Oct 14]. Available from: https://www2.gov.bc.ca/assets/gov/health/keeping-bc-healthy-safe/pses/pse_guidelines_final_nov_2017.pdf

Therefore, more stringent regulations should be in place to provide EHOs with better regulatory control of the premises offering tattooing services. Although this study could not establish a connection between a lack of regulation and inadequate IPAC knowledge, it has provided evidence that the IPAC certification courses taken by tattoo artists vary widely. No one certificate was identified to be targeted toward tattoo artists. The inconsistency in training might be creating inconsistency in various IPAC procedures, knowledge of which was not tested with a limited number of questions included in this study. Training becomes even more important when the study also provided statistically significant evidence that less experienced artists were less knowledgeable about IPAC procedures. While it may take time to develop targeted certification programs, this study supports EHOs' interventions at tattoo studios as an educator and as a source of credible knowledge to ensure public safety.

Acknowledgements

Special acknowledgements to British Columbia Institute of Technology Environmental Health Department for allocating a budget for this research project and to Helen Heacock and Dale Chen for providing guidance on this project.

Competing Interests

The authors declare that they have no competing interests.

5. Kazandjieva J, Tsankov N. Tattoos: dermatological complications. *Clinics in Dermatology*. 2007 Jul;25(4).
6. Dieckmann R, Boone I, Brockmann SO, Hammerl JA, Kolb-Mäurer A, Goebeler M, et al. The Risk of Bacterial Infection After Tattooing. *Deutsches Arzteblatt Online*. 2016 Oct 7;113(40):665–71.
7. Juhas E, English JC. Tattoo-Associated Complications. *Journal of Pediatric and Adolescent Gynecology*. 2013 Apr;26(2).
8. Conaglen PD, Laurenson IF, Sergeant A, Thorn SN, Rayner A, Stevenson J. Systematic review of tattoo-associated skin infection with rapidly growing mycobacteria and public health investigation of a cluster in Scotland, 2010. *Eurosurveillance*. 2013 Aug 8;18(32).
9. Hill MJ. Recognizing a new public health concern. *Dermatology Nursing*. 2006;18:326–326.
10. Porter CJW, Simcock JW, MacKinnon CA. Necrotising fasciitis and cellulitis after traditional Samoan tattooing: case reports. *Journal of Infection*. 2005 Feb;50(2).
11. Ghorpade A. Lupus vulgaris over a tattoo mark - inoculation tuberculosis. *Journal of the European Academy of Dermatology and Venereology*. 2003 Sep;17(5).
12. HHS, CDC, Ddid, NCHHSTP, DVH. The ABCs of Hepatitis – for Health Professionals [Internet]. Available from: www.cdc.gov/hepatitis
13. Nishioka SGDA, Gyorkos TW. Tattoos as Risk Factors for Transfusion-Transmitted Diseases. *International Journal of Infectious Diseases*. 2001;5:27–34.
14. CDC. About HIV [Internet]. 2021 [cited 2021 Oct 13]. Available from: <https://www.cdc.gov/hiv/basics/whatishiv.html>
15. McGuire E. Effectiveness of Autoclaves in Tattoo and Body Piercing Establishments in British Columbia. Student Capstone Project. 2006.
16. Wong E, Heacock H. Biological Hazards Associated with Microblading and Evaluation of its Infection Control Procedures and Wound Care. *BCIT Environmental Public Health Journal* [Internet]. 2018 [cited 2021 Nov 15]; Available from: <https://doi.org/10.47339/ephj.2018.56>
17. Hansen K, Heacock H, Eykelbosh A. The public health impact of infection control, sterilization and regulation in tattooing. The public health impact of infection control, sterilization and regulation in tattooing. *BCIT Environmental Public Health Journal* [Internet]. 2017 [cited 2021 Nov 15]; Available from: <https://doi.org/10.47339/ephj.2017.89>
18. Barn P, Chen T. Infections Associated with Personal Service Establishments: Piercing and Tattooing [Internet]. 2012 May [cited 2021 Nov 15]. Available from: https://ncceh.ca/sites/default/files/PSE_Infections_Piercing_Tattooing_May_2012_0.pdf
19. Quaranta A, Napoli C, Fasano F, Montagna C, Caggiano G, Montagna M. Body piercing and tattoos: A survey on young adults' knowledge of the risks and practices in body art. *BMC Public Health*. 2011;11.
20. Shaw K. Exploring beliefs and attitudes of personal service practitioners towards infection control education, based on the Health Belief Model. *Environmental Health Review*. 2016 Mar;59(1).
21. NCSS. NCSS 2021 Statistical Software [Internet]. Kaysville, Utah, USA; 2021 [cited 2021 Nov 15]. Available from: ncss.com/software/ncss
22. Statistics Solutions. Using Chi Square Statistic in Research [Internet]. 2021 [cited 2021 Nov 15]. Available from: <https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/using-chi-square-statistic-in-research/>
23. Liu K, Heacock H. Evaluating the Impacts of COVID-19 on the Perceptions of Hygiene and Sanitation in Personal Service Establishments in British Columbia. *BCIT Environmental Public Health Journal* [Internet]. 2021 [cited 2022 Apr 15]; Available from: <https://journals.bcit.ca/index.php/ehj/article/view/190>
24. Lindemann N. What is The Average Survey Response Rate? [2021 Benchmark] [Internet]. *SurveyAnyplace Blog*. 2021 [cited 2022 Mar 16]. Available from: <https://surveyanyplace.com/blog/average-survey-response-rate/#:~:text=Third%20on%20the%20list%20is,survey%20response%20rate%20by%2010%20>
25. Rideout K. Comparison of Guidelines and Regulatory Frameworks for Personal Service Establishments [Internet]. 2010 Sep [cited 2022 Mar 16]. Available from: https://ncceh.ca/sites/default/files/PSE_Guidelines_Comparison_Table_Sept_2010.pdf