Infection Control among Professional Tattooists in Minneapolis and St. Paul, MN

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SYNOPSIS

Objective. This study investigated infection control knowledge, beliefs, and practices of professional tattooists.

Methods. In a cross-sectional study of professional tattooists (*N* = 61), a self-administered questionnaire measured knowledge and beliefs related to bloodborne pathogen transmission and control and self-reported infection control procedures. The study also involved direct observation of the infection control practices of 25 tattoo artists.

Results. All respondents believed that bloodborne pathogens could be transmitted via tattooing, and most denied that trouble or expense were barriers to infection control. Knowledge about infection transmission and control was high and was positively associated with learning about infection control from a health official. Subjects were observed implementing an average of 44 of 62 recommended procedures. The percentage of recommended procedures used was negatively associated with years of tattooing experience.

Conclusions. Tattooists have an understanding of the risks associated with exposure to blood, but this knowledge is not fully operationalized in the workplace. Interventions should focus on needle disposal, handwashing, cross-contamination, and cleaning prior to sterilization. Tattooists with ≥10 years of experience are most in need of intervention. National guidelines for tattooing infection control and strategies for collaboration between public health officials and tattooists are needed.

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The popularity of tattoos has increased dramatically in recent years. Modern tattooing is performed with an electric machine; a cluster of rapidly oscillating needles deposits liquid pigment into the upper layer of the dermis, and minor bleeding generally occurs.[1] There is a theoretical risk of transmitting hepatitis B and hepatitis C via contaminated tattooing equipment, and the medical literature suggests tattooing as a risk factor for serological markers of both viruses.[2–6] Little is known, however, about tattooists' understanding or utilization of bloodborne pathogen precautions.

Only one study of tattooists' infection control practices has been published in the English-language literature. Goudey and Thompson surveyed registered tattoo artists in Victoria, Australia, inspected tattoo studios, and observed tattooing practices.[7,8] They reported that almost all study participants believed hepatitis B and hepatitis C could be transmitted via tattooing, but that only a third of studios exclusively employed single-use needles. However, two of 23 tattoo studios had no sterilizing equipment, frequent cross-contamination was observed, and there were deficiencies in cleaning and sterilization.

Using a similar design, we investigated infection control among professional tattooists in the Minneapolis and St. Paul, Minnesota, metropolitan area. The purpose of this research was to describe the infection control beliefs, knowledge, and practices of professional tattooists. The University of Minnesota Institutional Review Board approved the study, and written consent was obtained from all subjects.

METHODS

Professional tattooists at businesses in the seven-county metropolitan area of Minneapolis and St. Paul, Minnesota, formed the target population. Professional tattooists were defined as individuals who applied tattoos to humans at business establishments that advertised tattooing in the *Yellow Pages* or had storefront signs offering tattooing services to the general public. We excluded individuals who applied cosmetic tattoos that look like makeup ("permanent makeup") in beauty parlors as well as three tattooists who participated in pre-testing for this study.

We identified 75 eligible artists at 32 businesses in the study area and invited all to participate. The principal investigator (present author MJR) recruited subjects during visits to tattoo studios. There were two phases of data collection: first, participants completed written questionnaires; second, we observed a subset of respondents in their workplaces. Conducting the written survey first allowed us to win participants' trust before recruiting for the more intrusive observational phase. To minimize effects of the written survey on behavior, we scheduled observation for at least three weeks after survey completion. Data were collected from October 1999 through April 2000.

Instruments

A self-administered written questionnaire measured knowledge and beliefs about bloodborne pathogen transmission and control, and solicited self-reported data on infection control practices. The instrument included several items adapted from Goudey and Thompson[8] in addition to original items. An infectious disease physician and two physician consultants to tattooists' organizations evaluated the survey for face and content validity.

Using responses to 14 questions on disease transmission and control, we calculated an Infection Control Knowledge Score for each participant, representing the percentage of the 14 questions correctly answered. Similarly, we used responses to 22 items about equipment handling and disinfection to calculate a Self-Reported Infection Control Practice Score, representing the percentage of recommended practices each subject reported utilizing. In developing items, we consulted the Occupational Safety and Health Administration Final Rule on Occupational Exposure to Bloodborne Pathogens,[9] the National Environmental Health Association's Body Art Model Code,[10] materials from the Alliance of Professional Tattooists,[11] and tattooing guidelines from Health Canada.[12]

To collect observational data, we developed a checklist of behaviors and procedures used during tattoo setup, application, and cleanup. We modified, with permission, a tool developed by Goudey and Thompson for this purpose.[7] The three physicians who reviewed the questionnaire evaluated this tool for face and content validity, and we pretested it with a single artist on two occasions. From it, we derived an Observed Infection Control Practice Score for each artist, which represented the percentage of up to 62 recommended infection control procedures implemented during observation.

Data analysis

We performed descriptive analyses on all variables using SAS (Version 8.0). We carried out inferential analyses using a general linear mixed model and obtained parameter estimates via the least squares means method. The general linear mixed model controlled for lack of independence between subjects who worked at the same tattoo studio.

RESULTS

Sample

Sixty-one artists from 29 tattoo studios completed written questionnaires, representing 81% of the 75 artists who were invited to participate and 91% of the 32 known studios in the study region. Participants had a mean age of 32 years and an average of 10 years of tattooing experience. There were no statistically significant differences in sex distribution or average years of tattooing experience between participants and nonparticipants.

Only those who completed questionnaires were asked to participate in the observational phase. We observed 25 artists from 15 studios, representing 41% of survey participants. There were no statistically significant differences between those who participated in both phases of the study and those who participated only in the survey phase in terms of age ($p = 0.17$), years of tattooing experience ($p = 0.20$), Infection Control Knowledge Scores ($p = 0.23$), and Self-Reported Infection Control Practice Scores ($p = 0.73$).

Beliefs and knowledge

All subjects ($N = 61$) agreed that if they were not careful they could be infected with a bloodborne disease from a client, and only three (5%) felt that such a disease would be mild. Almost all ($n = 57$, 95%) agreed that they could spread a bloodborne disease between clients if they were not careful. Participants expressed positive opinions toward the potential benefits of infection control procedures: 58 of 61 (95%) felt that precautions could save their lives and 52 (85%) felt precautions could protect them from a lawsuit. Almost all tattooists disagreed that precautions were too expensive ($n = 59$, 97%) or too much trouble ($n = 60$, 98%).

Infection control knowledge was high (Table 1), with a mean Infection Control Knowledge Score of 90% (standard deviation [SD] = 9.3). Scores ranged from 64% to 100%, and 18 subjects (30%) had scores of 100%. Three-quarters ($n = 45$) knew that hepatitis B can live outside the body for several days, and most ($n = 55$) correctly answered that if the tattooist were exposed to both hepatitis B and HIV, s/he would be more likely to get hepatitis B. All but one ($n = 60$, 98%) appropriately affirmed that wearing gloves does not fully protect the artist from bloodborne diseases, and 57/60 (95%) correctly denied that precautions need to be taken only when tattooing a client known to have hepatitis. At least 90% of subjects correctly identified each of three needle sterilization techniques as inappropriate: boiling, dry heat, and soaking needles in bleach. The question most often answered incorrectly asked respondents to select either handwashing or wearing gloves as more important to preventing the spread of bloodborne pathogens; only half ($n = 29$) correctly chose handwashing.

Reported practices

The results suggest high levels of adherence to recommended techniques (Table 2). The mean Self-Reported Infection Control Practice Score for the 61 respondents was 83% (SD = 10.4), with a range of 50 to 100%. Thus, subjects reported using, on average, 18 of 22 recommended procedures.

In open-ended questions, participants were asked to describe their procedures for handling contaminated needles, the needle bars to which needles are soldered, and the tubes into which the needle bars are inserted when they are attached to the machine. Recommended procedures include either (*a*) disposal, or (*b*) cleaning with detergent by hand or in an ultrasonic cleaner and subsequent sterilization in an autoclave for at least 15 minutes at 121° C and 15 pounds per square inch (psi), or 10 minutes at 126° C and 20 psi, or 3 minutes at 134° C and 30 psi.[11,13,14] Forty-three of 55 respondents (78%) described procedures meeting or exceeding these criteria. Twelve (22%) did not meet these criteria for one or more reasons: no cleaning prior to sterilization ($n = 6$), inappropriate ultrasonic cleaner solution ($n = 6$), or sterilization method other than autoclaving ($n = 4$).

Most (87%) reported always employing single-use needles (Table 2). Of eight respondents who reported reusing needles, six provided information on their treatment of contaminated needles. Two of the six failed to meet the criteria for cleaning and sterilization. Of the 44 artists who provided information on disposal of used needles, 40 (91%) reported always placing them into a biohazard container. One melted used needles, and the others reported placing them either into the garbage, a coffee can, or an empty plastic bottle.

Observed practices

Of the 61 artists who completed written questionnaires, 25 were observed tattooing. The mean Observed Infection Control Practice Score was 71% (SD = 10.8), with a range of 45 to 84%. Thus, participants were observed using, on average, 44 of 62 recommended procedures. Results for selected items are presented in Table 3.

Compliance with individual items varied from 8 to 100%. In some situations a recommended procedure was not applicable or the observer did not have the

Table 1. Tattooists' beliefs and knowledge about bloodborne pathogens and control (*N* = 61)

	Agree strongly		*Agree somewhat*		*Neither agree nor disagree*		*Disagree somewhat*		*Disagree strongly*	
Survey item	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
If I'm not careful, I could *catch* a bloodborne disease from a client.	58	95	3	5	0	0	0	0	0	0
If I'm not careful, I could *spread* a bloodborne disease from one client to another.	52	87	5	8	1	2	1	2	1	2
Any bloodborne illness I might get from a client would be mild.	3	5	0	0	1	2	4	7	53	87
Using strict infection control practices is *too expensive.*	1	2	0	0	1	2	3	5	56	92
Using strict infection control practices is *too much trouble.*	0	0	0	0	1	2	1	2	59	97
Taking precautions against diseases while tattooing could save my life.	57	93	1	2	1	2	0	0	2	3
Good infection control practices could protect me from a lawsuit.	39	64	13	21	1	2	2	3	6	10

NOTE: Totals for each question may vary due to missing data. Percentages may not total 100% due to rounding errors.

Survey item (Correct answer)	*Percent answering correctly*
Hepatitis B could be spread by a tattoo artist who is not careful. (True)	100
Hepatitis C could be spread by a tattoo artist who is not careful. (True)	90
HIV (the AIDS virus) can live outside the body for several days. (False)	90
Hepatitis B virus can live outside the body for several days. (True)	74
Dry heat (such as an oven) is an appropriate method of sterilizing used needles. (False)	90
Used needles can be used again immediately after being cleaned in an ultrasonic cleaner. (False)	100
As long as you wear gloves, you can't get a bloodborne disease from a client. (False)	98
A steam heat autoclave can be used to effectively sterilize tattooing equipment. (True)	97
You only need to take precautions when tattooing someone who you know has hepatitis. (False)	95
If you open an autoclave bag containing two needle setups and remove only one, the other is still sterile and can be used later. (False)	95
Used needles are safe to use again after boiling them in water for 20 minutes. (False)	97
Soaking needles in bleach is an acceptable method of sterilization. (False)	92
If a tattooist were exposed to blood from a client who had *both* hepatitis B and HIV, which disease would he or she be *more likely* to get? (Hepatitis B)	92
Which is *more important* in preventing the spread of infection, wearing gloves or washing your hands? (Washing hands)	49

Table 2. Tattooists' self-reported compliance with infection control practices (*N* = 61)

Practice (Recommendation)	*Percent reporting use of recommended practice*
Reuse needles (Never)	87
Break needles off bars using my hands (Never)	97
Discard used ink cups after finishing a tattoo (Always)	98
Change rubber bands on machine after each client (Always)	52
Cover machine with a disposable plastic cover when tattooing (Always)	34
Wear gloves on both hands during tattooing (Always)	100
Use the same setup to tattoo a husband and wife (Never)	97
Use a steam heat autoclave (Yes)	93
Autoclave equipment in sealed bags (Yes)	91
Use color dots on autoclave bags to monitor the autoclave (Yes)	98
Spore test the autoclave (Yes, monthly)	45

opportunity to view it. The denominator used to calculate compliance with each procedure was the number of artists for whom the procedure was required and for whom there was an opportunity to observe this procedure.

In all cases the work surfaces in the tattooing area were clean. Only two artists (8%) had an appropriate sharps container in their work station, although in many cases one was present elsewhere in the studio. Twelve artists (50%) placed plastic sheaths over the tattoo machine during setup for the tattoo, as recommended by Health Canada.[12] Although 12 (55%) disinfected the tattoo machine during clean-up, three artists neither covered their machines with plastic before the tattoo nor disinfected them afterward. All artists used new disposable ink cups, into which the needles are dipped during the tattoo, and disposed of the cups upon completion of a tattoo. All used needles and tubes from sealed autoclave packages. When dispensing ink during the tattoo, two artists used procedures that could have potentially contaminated the multiple-use ink bottle. Almost two-thirds (n = 15) sprayed the tattoo site with liquid, which can lead to aerosolization of blood.

While tattooing, the artist may occasionally rinse the needles to remove ink and blood. Of 17 artists observed rinsing needles, one did not use clean technique. In this case, the tattooist rinsed needles in a solution potentially contaminated with blood from previous clients and continued tattooing with those needles.

Almost all tattooists (n = 23) wore gloves when touching contaminated surfaces. However, half (n = 12) were also observed cross-contaminating surfaces by, for example, touching paper towel dispensers, lamps, or their faces with contaminated gloves. Six did not wash their hands with soap and water before setting up for the tattoo. After the tattoo is completed, the artist usually takes payment and provides written care instructions to the client before cleaning up the work station, thus necessitating handwashing between tattoo completion and clean-up. Twelve subjects failed to wash their hands after completing tattoos, and seven failed to wash after cleanup. Three artists failed to wash their hands at any time before, during, or after the tattoo.

Bivariate analyses

Associations among Infection Control Knowledge Scores, Self-Reported Infection Control Practice Scores, and Observed Infection Control Practice Scores were assessed by linear regression. In addition, we investigated potential associations between these three outcome measures and subjects' training and experience via t-test for dichotomous independent variables and linear regression for continuous independent variables. Only the 25 subjects who participated in the observation phase were included in the analyses involving the Observed Infection Control Practice Score. For all other analyses, N = 61.

Observed Infection Control Practice Scores were negatively associated with years of tattooing experience: tattooists with 10 or more years of experience had lower scores than those with fewer than 10 years. There were no statistically significant differences in mean Infection Control Knowledge Scores, Self-Reported Infection Control Practice Scores, and Observed Infection Control Practice Scores between those who reported having taken a course in infection control and those who said that they had not taken a course. On the other hand, those who reported that health officials had provided them with all or part of their education on infection control had higher Infection Control Knowledge Scores ($p < 0.01$) and Self-Reported Infection Control Practice Scores ($p = 0.01$) than those

Table 3. Tattooists' observed compliance with infection control procedures (*n* = 25)

Practice (Recommendation)	*Percent in compliance*
Evidence of food or drink consumption in tattooing area (No)	33
Evidence of smoking in tattooing area (No)	79
Approved sharps container in tattooing area (Yes)	8
Work surfaces clean (Yes)	100
Person setting up washed hands with soap before setting up (Yes)	70
New rubber bands used (Yes)	28
New single-use disposable ink cups used (Yes)	100
Needles were in sealed autoclave bags or other sterile package (Yes)	100
Tubes were in sealed autoclave bags or other sterile package (Yes)	100
All items which will touch client placed on clean disposable drape (Yes)	71
Client's skin cleansed before procedure (Yes)	96
Razor disposed of (Yes)	100
Clean technique used for dispensing ointment (Yes)	86
Stencil or pen disposed of (Yes)	100
Plastic barrier placed on clip cord (Yes)	46
Plastic barrier placed on tattoo machine (Yes)	50
For color changes, needles rinsed using clean technique (Yes)	94
Tattoo site directly sprayed with any liquid (No)	38
Clean technique used when dispensing additional inks (Yes)	75
Wore gloves when coming in contact with potentially contaminated surfaces (Yes)	96
Touched unprotected environmental surfaces with contaminated glove or hands (No)	71
Touched own face or hair with gloves on (No)	83
Washed hands with soap and water after completing tattoo (Yes)	45
Gloves worn during clean up (Yes)	61
Left over inks discarded with containers (Yes)	100
Tattoo machine wiped or sprayed with disinfectant (Yes)	55
Chair wiped or sprayed with disinfectant (Yes)	82
Work area wiped or sprayed with disinfectant (Yes)	96
Beaker or cup removed from ultrasonic cleaner & discarded or sent for cleaning (Yes)	67
Washed hands with soap and water after clean-up (Yes)	68
Washed hands at least once, either before, during, or after tattoo (Yes)	84

NOTE: The denominator used to calculate compliance with each procedure was the number of artists for whom the procedure was required and for whom there was an opportunity to observe this procedure.

who received all of their instruction on infection control from sources other than health officials (Table 4).

We hypothesized that artists in studios with larger numbers of tattooists would share knowledge, thereby improving their practices. In fact, higher Infection Control Knowledge Scores were associated with larger numbers of artists in the studio ($p = 0.02$). However, neither Self-Reported Infection Control Practice Scores ($p = 0.85$) nor Observed Infection Control Practice Scores ($p = 0.84$) were associated with the number of artists in the studio.

There was a positive correlation between Infection

Table 4. Relationships between tattooists' backgrounds and their Infection Control Knowledge and Practice Scores

	Took a course in infection control			*Learned infection control from a health official*			*Tattooing experience*		
Scores	*Yes*	*No*	p	*Yes*	*No*	p	*<10 years*	*≥10 years*	p
Infection Control Knowledge Score (*N* = 61)									
Mean	91.9	88.4	0.14	91.5	86.1	< 0.01	90.9	87.4	0.11
95% CI	87.1, 96.6	84.9, 92.0		87.9, 95.1	82.1, 90.1		87.1, 94.6	83.4, 91.4	
Self-Reported Infection Control Practice Score (*N* = 61)									
Mean	85.2	82.6	0.29	85.5	80.1	0.01	84.6	81.7	0.19
95% CI	80.2, 90.2	78.9, 86.3		81.8, 89.3	75.9, 84.2		80.6, 88.7	77.4, 86.0	
Observed Infection Control Practice Score (*n* = 25)									
Mean	71.8	69.9	0.54	69.6	71.5	0.44	74.6	65.3	< 0.01
95% CI	63.8, 79.8	63.2, 76.7		62.5, 76.7	64.2, 78.8		68.5, 80.7	58.9, 71.8	

CI = confidence interval

Control Knowledge Scores and Self-Reported Infection Control Practice Scores ($p = 0.04$), but there was no statistically significant relationship between Infection Control Knowledge Scores and Observed Infection Control Practice Scores ($p = 0.44$), or between Self-Reported Infection Control Practice Scores and Observed Infection Control Practice Scores ($p = 0.15$).

DISCUSSION

The potential transmission of bloodborne pathogens through tattooing is an emerging public health issue. Tattooists participating in this study demonstrated awareness of the risks associated with blood exposure to themselves and their customers. They also demonstrated knowledge of disease transmission and control. The vast majority correctly identified effective and ineffective sterilization methods. Participants recognized the benefits of taking precautions and in general denied both expense and inconvenience as barriers. Their knowledge of infection control was surprisingly high, given that there are no federal tattooing standards and few opportunities for tattooists to gain more than a basic understanding of aseptic technique.

Although knowledge level was high, it was only partially operationalized in the workplace. While knowledge was associated with self-reported practice, it was not associated with observed practice. In addition, although those who had learned infection control from a health official had higher Infection Control Knowledge and Self-Reported Practice Scores than those who had not learned from a health official, they did not have better Observed Infection Control Practice Scores. The lack of association between Self-Reported and Observed Infection Control Practice Scores does not imply that participants were dishonest on the questionnaire because the questionnaire and observation instruments documented somewhat different practices, and because the small number of observed tattooists ($n = 25$) may provide inadequate statistical power for detecting an association.

Almost all artists employed several critical techniques, such as using sterile disposable needles, single-use ink dispensers, and gloves. Discussions with tattooists revealed an emphasis on sterilization, with less awareness of the potential for cross-contamination during tattooing. This suggests greater reliance on technology and less attention to personal behavior. For example, only half the artists knew that handwashing was more important than wearing gloves and this was manifested in the observed high compliance with glove use and lower compliance with handwashing. Some appeared to have a limited understanding of the difference between cleaning and disinfection, demonstrated by the improper use of a disinfectant instead of a detergent in the ultrasonic cleaner.[14] There seemed to be little awareness of the hazards of food and beverage consumption and smoking in the tattooing area. One artist touched a coffee cup with contaminated gloves during a tattoo and later drank out of this cup while smoking a cigarette, which could have introduced pathogens into his mouth.

The group most in need of intervention appears to be tattooists who have been in the profession for 10 or more years. These artists may have learned to tattoo before bloodborne pathogens were widely discussed in tattooing magazines and the popular media, and their current practices may be bound by habit. Our

finding that these more experienced tattooists had similar Knowledge Scores to those of the less experienced tattooists suggests that education alone may not be an effective intervention. Live demonstration and observation of practice with frequent reinforcement may be necessary to change ingrained habits.

Limitations

No attempt was made to weight procedures by their relative contribution to reducing disease transmission. Practice scores were simply calculated as the percentage of recommended procedures performed; thus a higher score might not always indicate safer practice than a lower score. Self-selection, prevarication, and the Hawthorne effect (people may alter their behavior when participating in a research study) may have occurred and most likely would have biased scores upward.

Recommendations

Additional studies should focus on barriers to implementation of infection control procedures. Studies of individuals performing cosmetic tattoos in beauty parlors and of tattooists working outside of legitimate businesses will also provide a fuller picture of the industry.

National guidelines for tattooing infection control are needed. Such standards would be useful to state and local officials as well as tattooists. The National Environmental Health Association's guidebook and model code on body art[10] and Health Canada's standards for tattooing[12] provide excellent resources for the development of such guidelines.

Public health oversight of tattooing should be expanded. In particular, health department inspectors should not only monitor facilities, but should observe tattooing procedures as well. We noted numerous deficiencies that could be discovered only during direct observation. Interventions should focus on: (*a*) eliminating needle reuse; (*b*) promoting understanding of contamination and cross-contamination; (*c*) encouraging handwashing; (*d*) teaching the differences between cleaning, disinfection, and sterilization; and (*e*) helping tattooists locate products such as appropriate disinfectants and sharps containers and services such as autoclave testing and disposal services for full sharps containers.

Before these steps can occur, however, public health officials must become aware of the unique nature of tattooing. Guidelines used in health care facilities do not always translate easily for use in tattooing facilities. Only through understanding the tattooing process can inspectors appropriately evaluate tattooing facilities and procedures. Therefore, health department officials should also be the targets of educational efforts. A collaborative effort involving tattooists, public health officials, legislators, medical professionals with knowledge of tattooing practices, and the public is needed to advance the level of tattooing safety to protect the public and tattoo artists alike.

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