WORKING GROUP ON BEST PRACTICE FOR HARM REDUCTION PROGRAMS IN CANADA

Best Practice Recommendations

FOR CANADIAN PROGRAMS THAT PROVIDE HARM REDUCTION SUPPLIES TO PEOPLE WHO USE DRUGS AND ARE AT RISK FOR HIV, HCV, AND OTHER HARMS: 2021

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Suggested reference:

Strike C, Miskovic M, Perri M, Xavier J, Edgar J, Buxton J, Challacombe L, Gohil H, Hopkins S, Leece P, Watson, T, Zurba N and the Working Group on Best Practice for Harm Reduction Programs in Canada.Best Practice Recommendations for Canadian Programs that Provide Harm Reduction Supplies to People Who Use Drugs and are at Risk for HIV, HCV, and Other Harms: 2021. Toronto, ON: Working Group on Best Practice for Harm Reduction Programs in Canada. 2021.

Foreward

This 2021 version presents user-friendly, evidence-based, national best practice recommendations. The goal of the Best Practice Recommendations is to improve the effectiveness of programs that deliver harm reduction supplies to people who use drugs and are at risk for human immunodeficiency virus (HIV), hepatitis C (HCV), hepatitis B (HBV), overdose and other harms. These updated recommendations are a tool to transfer knowledge to develop, review, redesign, and evaluate programs. We hope to enable programs to use evidence to move towards best practices, if these are not already in place. While the ideal program would distribute all the supplies covered in the 2021 edition, an inability to do so should not be used to discourage development and implementation to the best of a program's ability.

What is new in this version?

In contrast with Best Practices Parts 1 and 2 (Strike et al., 2013; Strike et al., 2015), this version focusses only on the distribution and disposal of **injection, smoking and snorting supplies.** We updated the pre-existing versions by searching for and integrating any new scientific evidence related to the distribution and disposal of injection, smoking and snorting equipment. We also removed any content (e.g., prevalence, incidence, distribution statistics) that was out of date. The evidence summary at the end of each chapter was revised as necessary based on the new search results. We re-organized the order of the chapters to focus first on needles and then on smoking and snorting supplies and disposal. At the beginning of each chapter, we re-organized the best practice statements into three categories (i.e., distribution, education, and disposal). Evidence about hot and cold drug preparation methods (i.e., filter chapter) and the importance of heating drug solutions (i.e., cooker chapter) to reduce transmission of HIV and other pathogens were added. **To the statements about safer injecting and safer smoking education, we added overdose prevention education. We added a new chapter about the distribution of straws for snorting drugs.**

This edition was peer reviewed by experts with lived/living experience, front-line service workers, program managers, provincial distribution program managers, policy makers, knowledge translation managers and scientists.

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Chapter 1: Needle and syringe distribution

Recommended best practice policies to facilitate use of a sterile needle and syringe for each injection:

DISTRIBUTION

- Distribute needle and syringes based on the quantity requested by clients with no limits
- Distribute needles and syringes without requiring exchange of used. One-for-one exchange is never a recommended practice
- Offer a variety of brands, sizes, gauges, types and/or volumes
- Offer a sterile cooker, sterile water, filter and alcohol swab with each needle provided
- Provide multiple locations and distribution through peer networks

EDUCATION

- Educate about the correct, single person use of needles and syringes
- Educate about different brands, sizes, gauges, types and/or volumes and correct use
- Educate about the risks of sharing and use of non-sterile supplies
- Educate about the ways to prevent overdose and transmission of HIV, HCV, HBV and other pathogens
- Educate about proper disposal practices to avoid accidental needle stick injuries

DISPOSAL

- Dispose of used needles and syringes in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how needles and syringes are used

Needles are used to inject drugs into veins (i.e., intravenous), muscles (i.e., intramuscular), and under the skin (i.e., subcutaneous). To inject drugs with a needle, the drugs are first mixed with water to form a solution in a container ('cooker'/ spoon) and then heated. After the solution has cooled, it is drawn into the needle and syringe through a filter. When multiple people are sharing a drug solution, the solution may be drawn from a common container into multiple needles/syringes or the solution may be squirted from one needle/syringe through the front or back of another needle/syringe (also known as frontloading or backloading, respectively). There is a risk of disease transmission when any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens.

To reduce the risk of transmission from contaminated needles, clients need to use a new needle each time they inject. Many needle and syringe programs (NSPs) distribute sterile needles; that is, needles that are free from microorganisms, including pathogens, and come in commercially sealed packages that have never been opened. If a package has been opened or damaged and its seal broken, the needle may no longer be sterile. If a needle has been used and has been cleaned (which can be done with a variety of cleaning agents), the needle is not sterile. Only a process of sterilization that effectively kills all microorganisms results in a sterile needle. Needle cleaning practices performed by people who inject drugs may reduce the number of pathogens found in and on used needles, but most of these practices cannot effectively remove all pathogens.

Evidence of needles and syringes as vectors of HIV, HCV, and HBV transmission

Injection with a previously used needle puts people who inject drugs at high risk for infection with pathogens such as HIV, HCV, and HBV. Studies have found evidence of these viruses in used needles.

Abdala and colleagues found that under laboratory conditions HIV can survive in blood in syringes with attached needles for up to 30 days or longer (Abdala et al, 1999). Their studies show that recovery of viable HIV is affected by factors including volume of blood, storage temperature, and duration of storage (Abdala et al., 1999; 2000; Heimer & Abdala, 2000). At temperatures between 4oC and 22oC, HIV was recovered following storage for up to 42 days (Abdala et al., 2000; Heimer & Abdala 2000). Among needles collected from shooting galleries in Florida, 20% to 94% of visibly contaminated needles showed evidence of HIV (i.e., HIV-1 antibodies, proteins, RNA, DNA; Chitwood et al., 1990; Shah et al., 1996; Shapshak et al., 2000). In New Haven, Connecticut, samples of needles were tested and showed varying prevalence of HIV proviral DNA depending on the source: among the "street" needles tested, prevalence of HIV was 67.5% (n=160), for "illegal exchange" needles it was 62.8% (n=180), and for "shooting gallery" needles it was 91.7% (n=48; Heimer et al., 1993). Among returned NSP needles, the prevalence of HIV was 63.9% when the program opened in November 1990 (Heimer et al., 1993) and declined to 41.1% by May 1992 (Kaplan & Heimer, 1994; 1995). The presence of HIV antibodies suggests that a previous user was HIV-positive. It should be noted that the presence of HIV RNA, DNA, and proviral DNA indicate that virus particles are present in the needles, but the virus may or may not be infectious.

Bell et al. (2019) found a similar association between sharing needles and syringes and HIV infection among people who use drugs. In their cross-sectional study of 127 participants, they found that sharing needles along with other injection drug preparation equipment, increased risk of HIV transmission (Bell et al., 2019). The researchers also found an association between sharing injection drug preparation equipment and HIV infection in the absence of needle/syringe sharing (Ball et al., 2019).

Similar to HIV, HCV can be transmitted via blood-to-blood contact; however, it is ten times more easily transmitted through a contaminated needle than HIV (Kiyosawa et al., 1991; Mitsui et al., 1992). In an Australian study, Crofts et al. (2000) detected the presence of HCV RNA in rinses from 70% (14 of 20) of the needles collected from 10 injecting sites. HCV may remain viable in syringes for prolonged periods of time and has been observed to survive up to 63 days in tuberculin syringes; HCV survival appears to vary depending on syringe type, time, and temperature (Paintsil et al., 2010). Pouget et al. (2011) conducted a systematic review of studies reporting HCV seroincidence as part of the HCV Synthesis Project. Results of their meta-analysis found an association between HCV seroconversion and syringe sharing (PRR = 1.94, 95% CI) 1.53, 2.46). In their meta-regression analysis, studies reporting a higher HCV seroprevalance in the sample population found larger effects of syringe sharing on HCV seroconversion (Pouget et al., 2011). Studies have documented the disproportionately high rates of HCV found among people who inject drugs such as cocaine or share injection paraphernalia, compared to those who do not (Krajden, Cook & Janjua, 2018).

HBV is a resilient and virulent virus. HBV can survive in dried blood at room temperature for at least a week and is easily transmitted through needle sharing (Thompson et al., 2003). According to the Public Health Agency of Canada (PHAC), HBV can survive in dried blood for weeks and remain stable on environmental surfaces for at least a week (https://www.who.int/news-room/fact-sheets/detail/hepatitis-b). However, HBV can be prevented by an effective vaccine (https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/page-7-hepatitis-b-vaccine.html).

The risk of transmission is greater in the context of needle sharing among people who inject drugs than it is for accidental needlestick injuries that occur in the community. For example, a Montreal study found that there were no HIV, HCV, or HBV seroconversions among 274 community pediatric needlestick injuries (Papenburg et al., 2008).

Evidence of risk behaviours

Reductions in needle sharing have been documented in some jurisdictions in Canada. However, needle sharing continues to occur and the prevalence of this practice varies across the country.

Data from Canadian studies shows that the percentages of people who inject drugs with a used needle has varied from just under 9% to 27% (Fischer et al., 2005; 2006; PHAC, 2006; Tarasuk et al., 2020). Phase 4 of the I-Track study found that 11.6% of participants injected with used needles and/or syringes in the six months prior to the interview. The authors identified that among participants who reported using borrowed needles in the past 6 months, the majority (85.2%) reported borrowing needles and syringes from peers (Tarasuk et al., 2020). Despite this, 90.1% of participants also reported engaging with a needle and syringe distribution program, in the year prior to the study (Tarasuk et al., 2020). This same study found that 52.7% injected in public spaces, creating barriers for maintaining safe injecting practices (Tarasuk et al., 2020). Unpublished data from a survey, administered by the B.C. Harm Reduction Program in 2019 found that 8% of 283 people who injected drugs in the past 6 months used a needle previously used by someone else (BCHRC survey, 2019). Nolin (2018) reported that out of a sample of 2431 people who inject prescription opioids in Quebec, 33% reported injecting with used equipment. Injecting prescription opioids was associated with reports of 'doing a wash' with filters, injecting heroin, consuming prescription opioids by non-injection routes and being HCV positive (Nolin, 2018). As noted by Broz et al. (2018), PWID may falsely perceive using new syringes for every injection as sufficient while continuing to prepare 'loads' and rinse shots for themselves and others with used syringes.

In a study conducted in the United States, injection risk practices and access to harm reduction resources and materials were examined among PWIDs living in nonurban areas (Grau, 2016). On average, participants both in urban and non-urban areas frequently re-used their own syringes. Reported risk behaviours in the previous 30 days included: sharing drug (52.3%), sharing of drug mixing (33.8%) or rinse water (31.2%). The authors noted that PWIDs who live in nonurban areas were not being reached by harm reduction programs because of limited hours of operation, geographical distance, limited advertising in nonurban areas, and that existing programs may not meet the needs of nonurban populations of PWIDs (Grau et al., 2016).

Pacquette & Pollini (2018) conducted a systematic review to understand injection drug use and its role in the development of HIV and HCV. They identified studies that reported rates of syringe sharing from 13%- 44.4%% (Akselrod et al., 2014, n=454; Grau et al., 2016, n=462; Heimer et al., 2014, n=454; Zibbell et al., 2014, n=123). Studies showed an association between syringe sharing and difficulty accessing sterile equipment, particularly in nonurban regions (Pacquette & Pollini, 2018; Des Jarlais et al., 2015).

Epidemiologic data provide evidence of HIV, HCV, and HBV transmission risk associated with needle sharing. Toronto data from a WHO study (1991-1994) show that sharing injection equipment in the previous 6 months was associated with higher HIV prevalence (OR=2.0 $p<0.01$; Millson et al., 2005). In Ottawa, data from two studies show that injecting with a used needle was a predictor of HIV infection at baseline. In the Ottawa POINT Project, participants with a history of injecting with a used needle had a three-fold elevated risk for HIV infection (AOR=2.8; 95%CI: 1.3-6.1; Leonard et al., 2005). The SurvIDU Study (1996-2003) found a three-fold elevated risk among women (AOR=3.0; 95%CI:1.3-7.1) and a slightly lower risk for men (AOR=2.5; 95%CI: 1.6-3.7; Millson et al., 2005). HIV seroprevalence was also associated with backloading in a study with 660 people who inject drugs in New York City (OR=2.2; 95%CI: 1.5-3.1; Jose et al., 1993).

Data from a cross-sectional study of 437 "street youth", aged 14-25 years (200 people who inject drugs) in Montreal (1995-1996) show that injecting drugs was an independent risk factor for HCV infection (Adjusted OR=28.4; 95%CI: 6.6-121.4; Roy et al., 2001). In Seattle, needle sharing among a cohort of 317 people who inject drugs was associated with a three-fold increased risk of HCV seroconversion at one-year follow-up (RR 2.94; 95%CI: 1.6-5.3; Hagan et al., 2001). Similarly, a cross-sectional study of 308 young people who inject drugs in San Francisco found that risk factors for HCV anti-bodies included ever borrowing a needle (OR=2.56; 95%CI: 1.18-5.53) and daily injecting (OR=3.85; 95%CI: 2.07-7.17; Hahn et al., 2001). To reduce the risk of sharing syringes, distribution of different colours of syringes may enable PWID who inject with others to keep track of their own needles (Centre d'Acceuil et d'Accompagnement à la Réduction des risques pour Usagers de Drogues, 2020)

If the needle or syringe used for the preparation and transfer has been previously used, blood or other residues can be transferred along with the shared drugs. Backloading (as well as frontloading) refers to a method of transferring a drug solution. For instance, among participants in a Seattle study who reported injecting with a used needle during the one-year follow-up period, backloading was associated with a two-fold non-significant risk of HCV seroconversion (RR 2.1, 95%CI: 0.9-4.5;) (Hagan et al., 2001). Furthermore, among a cohort of 353 young people who inject drugs in Chicago who tested HCV negative at baseline, receptive needle sharing and backloading were associated with elevated non-significant risks of seroconversion (Thorpe et al., 2002).

HBV transmission is a concern for people who inject drugs and who have not been immunized or are not immune due toprevious exposure to the virus. In the cross-sectional study of Montreal "street youth", participants who had a history of injection drug use (n=200) had 3.5 times the rate of HBV infection of those who reported no drug use, after controlling for immunization status (AOR=3.5, 95%CI: 1.5-8.3; Roy et al., 1999).

The HBV vaccination schedule varies from jurisdiction to jurisdiction, but routine HBV immunization is recommended for all children and pre-exposure HBV immunization is recommended for high-risk groups (https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/page-7-hepatitis-b-vaccine.html#a1)

Correlates of risk behaviours

Knowing the correlates of risk behaviours enhances understanding of why needle sharing may continue.

Distributive sharing (i.e., passing on a used needle to someone else) and receptive sharing (using a used needle to inject) are associated with some similar factors including perceived risks and type of injecting partners (Bailey et al., 2007; Golub et al., 2007; Foley et al)

Data from British Columbia suggest that unstable housing is associated with risk behaviour, such as needle sharing (Corneil et al., 2006; Gibson et al., 2011). Those without stable housing may engage in risk behaviours including using used syringes to avoid encounters with the police or others on on the street (Wagner et al., 2010).

Age appears to be an important correlate as well. Young people from marginalized populations (including Indigenous, LGBTQ2SQ+, and street involved) are especially vulnerable to risk factors that increase the likelihood of acquiring HIV and HCV (unpublished data/personal communication, Challacombe). Young, travelling people who inject drugs may engage in more risk behaviours, including more sexual and injecting partners and backloading syringes (Hahn et al., 2008). Data from Vancouver suggests that people who inject crystal methamphetamine may be younger and show more risk behaviours like syringe borrowing and lending (Fairbairn et al., 2007). Other data suggest that young people who inject methamphetamine may be more likely to share syringes (Marshall et al., 2011).

A study conducted in Quebec among 5,476 PWID showed that more male (20%) and female (11%) sex workers had injected with a pre-used syringe than did males (5%) and females (3%) who were not involved in sex work (Campeua et al., 2017). Injecting mainly with strangers and reporting having lent used syringes was more frequently reported among male and female sex workers than others (Campeau et al., 2017).

Increased risk of HIV and HCV transmission are associated with backloading (Hagan et al., 2001), longer injecting careers (Hahn et al., 2001), crack or cocaine use (Millson et al., 2005; Monterroso et al., 2000; Roy et al., 2001) and frequent or 'binge' injecting (Millson et al., 2005; Thorpe et al., 2002; Hahn et al., 2001).

Risk behaviours are influenced by social network characteristics, such as network size and peer norms regarding injecting (De et al., 2007; Golub et al., 2007; Latkin et al., 2010; Shaw et al., 2007; Wylie et al., 2006). Also, vidence indicates that injecting in public settings is associated with increased injection related risks. For example, a prospective cohort study conducted in Vancouver, Canada provides evidence that public injecting is a strong precursor to injection-related infections such as HIV or HCV (Ickowicz et al., 2018). Among 626 HIV-seropositive PWID, 34% had injected in public spaces (Ickowicz et al., 2018). Similar findings were reported by a cross-sectional study in Scotland that reported an association between public injecting and HIV, HCV and skin and soft tissue infection as well as risk of overdose (Trayner et al., 2020).

Incidence and prevalence of HIV, HCV and HBV among people who inject drugs in Canada

Tracking and estimating numbers of HIV, HCV, and HBV infections in the general population and in specific exposure categories is challenging, especially on a national scale.

Phase 4 of the I-Track study reported an HIV prevalence rate of 10.3% among 2383 individuals who used drugs in Canada (Tarasuk et al., 2020). Only 82.9% reported being aware of their status (Tarasuk et al., 2020). The Public Health Agency of Canada estimated that there were an estimated 1,960 (range 1270-2670) in 2014; 2,165 (range between 1,200–3,150) in 2016 and 2,242 (1,080-3,850) in 2018 (PHAC, 2020) new HIV infections in Canada. In Canada, the estimated HIV incidence rate among PWID slightly increased from 5.5 per 100,000 population in 2014 to 6.0 per 100,000 population in 2016. Among all new infections in Canada, it was estimated that 11.3% in 2016 and 13.9% in 2018 acquired their infection through injection drug use (PHAC, 2018; PHAC, 2020). In 2018, it was estimated that 312 of the new infections were among people who inject drugs (PWID)

Almost half of all Canadians who have ever tested positive for Hepatitis C were people who injected drugs (PHAC, 2019). In most provinces and territories, reported HCV infections are not differentiated into acute and chronic status. A report from 2019, published by Health Agency of Canada, reported an 11.1% decline in HCV infections between 2008-2019 (PHAC, 2019). In 2017, 11,592 cases of HCV infection (31.7 person per 100,000 population) were reported in Canada. HCV infection rates were consistently higher among males than females between 2008 and 2017. More than 60% of people who ever tested positive for Hepatitis C were men. The highest overall rates of HCV infection were reported in: Saskatchewan (61.7 per 100,000), British Columbia (46.5 per 100,000), Manitoba (46.1 per 100,000) and the Yukon (45.4 per 100,000 population) (PHAC, 2019).

Updated results from Phase 4 of the I-Track project indicate that among 2383 participants, 90.9% had been tested for HCV at some point in their lives, 64.2% tested positive for HCV antibody, 36.9% had detectable levels of HCV RNA and 50.1% were aware of their RNA positive status (Tarasuk et al., 2020).

Data on HBV infection from the provinces and territories are sent to the Canadian Notifiable Disease Surveillance System (CNDSS) by provincial and territorial health authorities regularly; however, reporting practices across the country are inconsistent and risk factor information has not always been collected (PHAC, 2011; PHAC, 2019). The rate of reported acute HBV infection cases decreased from 0.7 to 0.5 per 100,000 between 2008 and 2017, with rates stabilizing in the past 5 years. The rate of reported cases of chronic HBV infection per 100,000 population decreased in both males and females from 13.9 in 2011 to 11.4 in 2017. These represent diagnosis rates and not prevalence or incidence rates (PHAC, 2019).

Other health-related harms

Injecting with a used needle, including one's own needle, puts people at risk for other infections as well as skin and vein damage (Kaushik et al., 2011; Khalil et al., 2008; Lloyd-Smith et al., 2010). Injecting with a needle contaminated with bacteria and debris can lead to various infections such as endocarditis, septicemia, and potentially syphilis. When prescription opioids are injected, the excipients (non-medicinal ingredients such as cellulose, starch, corn starch, lactose, gelatin, stearic acid, arnauba wax, povidone, polyethylene glycol, magnesium silicate) are also injected. Some of these excipients are non-water-soluble and when injected in a vein, they can cause upper extremity complications, livedoid or necrotic lesions (which could ultimately lead to amputation) or pulmonary embolism (Noel, Dube & Tremblay, 2015)

A study by Morrison et al. (1997) showed that injection-related harms were common among people who inject drugs recruited from NSPs in Glasgow. Among the 147 participants in the study, 21% had abscesses (i.e., injection site infections), 49% had thrombosis (i.e., vein clots), 84% had bruising at an injection site(s), and 87% had other injection-related problems such as fasciitis (i.e., deeper injection site infection), arterial damage and/or limited venous access. In the four weeks prior to the survey, 52% of participants had no contact with a health service other than an NSP and 30% had not attended a health service in the past 6 months. Among those reporting current injection-related problems, only 27% had recently sought assistance, and those who did not seek assistance stated that these issues were normal (62%) or they were reluctant to seek assistance because of unpleasant past experiences (28%). When the NSP referred people who inject drugs, 34% did not attend the service to which they were referred. Morrison et al. (1997) concluded that people who inject drugs will avoid seeking treatment until faced with a crisis and that NSPs need to be more proactive and encourage clients to seek medical assistance.

Among a sample of 200 people who inject drugs in Sydney, participants reported using on average (mean) 3.1 injection sites on the body in the past 6 months (Darke et al., 2001). Fully 97% reported a history of injection-related problems with a mean of 2.3 injection-related issues in the past 6 months including scarring/bruising (84%), lumps/swelling (64%), difficulty injecting (49%), and hitting an artery (10%). More recently, Salmon et al. (2009) examined self-reported data from 9552 people who inject drugs and who registered to use the supervised injection facility in Sydney and found that 26% (2469) of the sample had experienced injection-related problems and 10% (972) had experienced injecting-related injury and disease. The most common injection-related problems were trouble finding a vein (18%), prominent scarring or bruising (14%), and swelling of the hands or feet (7%). The most common injecting-related injury and disease were abscesses or skin infection (6%), thrombosis (4%), septicemia (2%), and endocarditis (1%; Salmon et al., 2009). Other injection-related harms such as wound botulism (Passaro et al., 1998), vascular complications (Woodburn & Murie, 1996), and eye infections (Shankland & Richardson, 1998) have been reported in the literature as well.

Convenience, ease of access, skill, and other factors influence the choice of injection sites. As well, vein damage and infections can reduce the accessibility of some veins and lead people to inject into other sites on the body (https://www.catie.ca/en/practical-guides/hepc-in-depth/prevention-harm-reduction/safer-injection). The places where people inject into their bodies can increase or decrease the chances of damage, injury, and infection. Commonly used sites for injection include: the arms, legs, neck, groin, fingers, toes, and abdomen. However, some sites are safer and less likely than others to lead to injury and/or infection.

Injection into the jugular vein in the neck is especially risky given the potential for serious health-related harms, including venous trauma and infection. Hoda et al. (2008) sought to examine the prevalence and risk factors associated with jugular injection among a sample of people who inject drugs in Vancouver. Among the 780 participants included in the analysis, 198 (25%) reported jugular injection in the last 6 months. Factors independently associated with this practice included being female, daily heroin use, daily cocaine use, needing help with injecting, and sex-trade involvement (Hoda et al., 2008).

Groin injection is also considered a risky practice as the potential for venous damage and other complications is high. Using ultrasound scanners, Senbanjo et al. (2012) performed 160 groin scans in 84 people who inject in the groin from community drug treatment centres in South-East England. The scanning revealed significant femoral vein damage in 72.5% of the groins scanned; "severe" or "very severe"' damage in 41.8% of the veins. Estimated time to developing femoral vein damage varied widely, including ranges of 1 to 116 months for minimal damage and 12 to 240 months for very severe damage (Senbanjo et al., 2012). Another study that compared 67 people who inject in the groin with severe femoral vein damage and 86 people with minimal/moderate damage reported that severe femoral vein damage was associated with longer duration of groin injection, using lower gauge needles, benzodiazepine injection, history of and recurrent deep vein thrombosis (DVT), having a depressed groin scar, and chronic venous disease (Senbanjo & Strang, 2011). Needle size and DVT were found to be the main predictors of severe damage.

Using data from 92 people who inject drugs and who attended an NSP in Bristol, United Kingdom, Maliphant and Scott (2005) reported on the prevalence of groin injection. Of those interviewed, 51% injected into the femoral vein. The mean length of time from first injection to groin injection was 7 years; however, a small number started this practice early in their injection career. Ease of access and perceived lack of other usable or convenient sites encouraged groin injection. Fear of losing a hit or difficulty injecting with the non-dominant hand deterred rotation of injection sites. Other studies have also found that people who inject drugs may turn to groin injecting once venous access becomes difficult (Harris & Rhodes, 2012). In a qualitative study of 44 people in the United Kingdom who inject crack-heroin speedballs, Rhodes et al. (2007) reported that older and longer-term injectors viewed groin injecting differently than younger injectors; the former saw it as a "last resort" whereas the latter tended to give reasons for injecting in the groin. Some participants explained that groin injection results in a 'better rush' and can be discreet and convenient. While most seemed aware of health risks and complications, participants explained some strategies they use to reduce risk when using the groin as an injection site (e.g., seeking help from others).

In a comprehensive review of bacterial infections in people who use drugs, Gordon and Lowy (2005). highlighted their important findings. Most of the bacterial infections in people who inject drugs were a result of germs that are on the surface of their own skin, use of dirty needles, failing to clean skin before injecting, as well as "booting" (flushing and pulling back during injecting), which may increase risk of abscess formation (Gordon & Lowy, 2005). Other factors that were linked to soft tissue infection and infection in other parts of the body included lack of injecting experience, skin popping (subcutaneous or intramuscular injection), repeated injection into soft tissue, use of tap water and saliva for mixing drugs, injection of speedballs, higher frequency of injecting, and needle licking which may double the risk of cellulitis or abscess formation (Gordon & Lowy, 2005).

Needle licking before injection may be a relatively common practice. One study of 40 people who inject drugs reported that 13 had said that they lick their needles before injecting (Deutscher & Perlman, 2008). Reasons behind this practice were varied and included ritualistic practices, "cleaning" the needle, enjoying the taste of the drug, and checking the state of the needle. HCV has been found in saliva (Ferreiro et al., 2005; Hermida et al., 2002; Lins et al., 2005; Wang et al., 2006) and HBV has also been detected in saliva (Hui et al., 2005; van der Eijk et al., 2004). Therefore, it might be possible that licking needles prior to injection can contaminate the needles with these pathogens that then could be transmitted if the needles were shared. Licking may also contaminate needles with bacteria and oral flora. People who lick their needles prior to injection may be at increased risk for abscesses or cellulitis (Binswanger et al., 2000).

Khalil et al. (2008) reviewed cases of skin and soft tissue abscesses treated in an emergency department between 2005 and 2007 and conducted a literature search of skin and soft tissue abscesses in people who inject drugs. They presented a treatment algorithm for skin and soft tissue abscesses in people who inject drugs and reported that the type of drugs injected (such as heroin-cocaine mixtures), injection technique, attendant circumstances, and immunological status were important factors for the development of abscesses.

There have been reports of abscesses infected with MRSA (Methicillin Resistant Staphylococcus Aureus) related to injecting drugs. MRSA is a bacterium that is resistant to many antibiotics and requires careful medical management. Stenstrom et al. (2009) reported that 54% of the soft tissue infections in a Vancouver-area emergency department tested positive for the pathogen and a risk factor for an MRSA-related-soft tissue infection was injection drug use (OR=4.6, 95% CI 1.4-16.1). Huang et al. (2008) reported a similar association between MRSA and injecting drugs. Lloyd-Smith et al. (2010) reported that 29% of community-recruited people who inject drugs had wounds and that more than a quarter (27%) tested positive for MRSA. Further, wound botulism outbreaks have been reported among people who inject black tar heroin (Kaushik et al., 2011).

Injection drug use can lead to infective endocarditis (inflammation of the heart tissues due to an infection). The risk of developing this condition may be increased by the presence of abscesses and a previous diagnosis of the condition (Gordon & Lowy, 2005). Infections within the circulatory system such as in the heart, veins, or in the general bloodstream (sepsis or bacteremia) are very serious and require immediate hospitalization.

An international report of syphilis transmission associated with needle sharing has highlighted the potential for transmission through this route (Loza et al., 2010). Infection with syphilis places an individual at an elevated risk for contracting HIV or HCV because of the ulcers associated with this disease.

Finally, each time a needle is used the point becomes duller (or "barbed") and injecting with a dull needle can cause skin, tissue, and vein injury, as well as infection including abscesses, cellulitis, and vein collapse.

Needle distribution policies

Policies that limit the number of needles distributed limit the effectiveness of NSPs to prevent HIV and HCV transmission (Bluthenthal et al., 2007a; Heimer et al., 2002; Shaw et al., 2007; Small et al., 2010). NSP one-for-one exchange policies, whereby programs give clients one new needle for each used needle returned, reflect restrictive and unsatisfactory practice. Ideally, NSPs should distribute sufficient needles to provide a new sterile needle for each injection (i.e., 100% coverage; Brahmbhatt et al., 2000; Tempalski et al., 2008).

Bluthenthal et al. (2007b) examined data from 24 NSPs in California and observed five types of exchange, ranging from least to most restrictive:

- unlimited needs-based distribution
- unlimited one-for-one plus some additional syringes
- per-visit limited one-for-one plus some additional syringes
- unlimited one-for-one
- per-visit limited one-for-one

They found that lower percentages of syringe coverage (<50%) were associated with increased odds of both receptive and distributive syringe sharing. They also found that NSP clients with percentage of syringe coverage of 150% or more were significantly less likely to share syringes than those with coverage between 100% and 149%, suggesting that achieving greater than 100% coverage may maximize benefits. These authors found that NSPs with less restrictive policies provided more syringe coverage to clients. According to Turner et al. (2011), high NSP coverage (defined in their study as greater than or equal to 100% needles per injection) coupled with receiving opioid substitution therapy (OST) can substantially reduce the odds of new HCV infection among people who inject drugs.

While 100% coverage may not always be feasible, the move away from exchange policies towards distribution policies that allow clients access to more needles is an important goal. Canadian evidence includes a study of syringe sharing and lending and HIV incidence among a cohort of 1228 people who inject drugs in Vancouver (Kerr et al., 2010). Further evidence comes from a survey of 435 people who inject drugs in Winnipeg which found that people who had difficulty accessing new syringes were 3.6 times more likely to share used ones (Shaw et al., 2007).

In Ontario, the vast majority of NSPs (including all core NSP programs) no longer follow one-for-one exchange policies, in accordance with best practice recommendations (Strike et al., 2011). Providing clients with the number of needles they request is more likely to meet the recommendation for a new sterile needle for each injection, thereby reducing the risk of disease transmission. This may involve bulk distribution, as some clients may prefer to stockpile needles to ensure they have sufficient sterile needles on hand (Strike et al., 2005). Some people may also collect needles for peer distribution – an important secondary distribution strategy to reach people who inject drugs who may not use NSPs (Bryant & Hopwood, 2009).

Those potentially affected by NSP exchange policies include homeless people who may not have needles to exchange and/or are unable to store needles until they attend an NSP. In a study of three US cities, Green et al. (2010) found that factors associated with transitions to direct NSP use included homelessness and police contact involving drug use equipment possession. Homelessness was associated with moving away from direct NSP use. Police contact was associated with beginning and maintaining direct NSP use, although there were transitions away from direct NSP use for some types of clients in cities that had a syringe distribution policy change. Other research has found that people may be unwilling to carry needles due to fear of police contact (e.g., Cooper et al., 2005; Maher & Dixon, 1999), so police contact in the context of NSP policy changes may have different impacts on NSP use.

Meeting client preferences for needle type

People who inject drugs have individual preferences for needle gauge, syringe volume, and brand, and may not use NSP services if they cannot obtain their preferred types. Needles with a higher gauge are thinner (i.e., have a smaller diameter) than needles with a lower gauge. People who inject drugs have preferences for needle type and brand based on experience (Benedetti & Mary, 2018; Buxton et al., 2008; Zule et al., 2002). Benedetti and Mary (2018) identify that injection drug use needles should aim to be between ½ or 5/8 inches in length. The use of thin and short needles is recommended over longer and small gauge (i.e., thicker) needles as they minimize the risk of vein or tissue damage (Benedetti & Mary, 2018). To minimize the need for multiple injections, substances which require higher volumes of water should be used with 3cc syringes (Benedetti & Mary, 2018). The following are commonly utilized syringes for varying substances: heroin (1/2 cc or 1cc), cocaine (1/2 cc or 1cc), hydromorphone (1cc or 3cc), crack (1cc), speedball (1cc), fentanyl (3cc), oxycodone (1cc or 3cc), hydromorph contin (controlled release hydromorphone) (3cc), amphetamines (1cc or 3cc), crystal methamphetamin (1cc), benzodiazepine (1cc) (Benedtti & Mary, 2018; Government du Quebec, 2017). Noel et al. (2015) determined that between 2012 and 2013, PWID in Quebec were more likely to use 1ml syringes compared to 3ml syringes. Often, PWID preferred needles that were 27 G X 1/2" in size.

Coverage

According to the World Health Organization (WHO et al., 2009), coverage refers to the "number of syringes distributed per IDU [person who injects drugs] per year" (p. 13). There are ways to define coverage and estimate the number of needles/syringes to distribute per PWID per year. The WHO defines high national coverage when 60% of the estimated population of people who inject drugs being regularly reached by services and more than 200 needles and syringes are distributed per PWID per year (WHO, 2012). As a part of the strategy to eliminate global HCV, in 2016 the WHO recommended increasing the distribution target to more than 300 needles and syringes per person per annum, acknowledging that even this number might be insufficient for many people who inject drugs. O'Keefe et al (2019) proposed individual-level measurement as a complement, not a replacement, to current recommended population-level measures to enhance existing monitoring efforts and service-planning using practices based on context-specific evidence. In 2019, The Blueprint to Inform Hepatitis C Elimination Efforts in Canada was developed to help Canada achieve the WHO's goal to eliminate Hepatitis C as a public health threat by 2030. The Blueprint proposes that needle and syringe distribution targets in Canada should be higher than the WHO guidelines, increasing the target from 300 to 750 needles and syringes distributed for every person who injects drugs each year (The Canadian Network on Hepatitis C Blueprint Writing Committee and Working Groups, 2019).

High coverage with needles and syringes in Europe was associated with a 76% reduction in HCV infection risk but was not associated with risk reduction in North America (Platt et al, 2020). In their systematic review and meta-analysis, Platt et al (2017) reported that both high coverage of needles and syringes and opioid substitution treatment can reduce the risk of HCV transmission alone, but the impact is greater when they are combined. They found that PWID who reported combined coverage of needle and syringe with opioid substitution treatment had a 74% reduction in HCV infection risk compared to 50% reduction for PWID who reported only opioid substitution treatment coverage. Similarly, Minoyan et al (2020) found that both HCV-naive and previously infected PWID in Montreal, Quebec who reported both full needle and syringe coverage and opioid agonist treatment coverage had lowered rates of HCV acquisition.

In 2015, Larney et al (2017) reported that 45 million needles and syringes were distributed to PWID in Canada. With an average of 148 needles and syringes distributed per PWID, according to their estimates (Larney et al, 2017). This falls below the WHO guidelines for high coverage, which is defined as at least 200 needles and syringes per PWID per year (Larney et al, 2017).

PWID population size estimates in Canada are relatively scarce. Most estimates are limited to large cities: Montreal, Toronto, and Vancouver (Roy et al, 2016). Using a multiplier method, Jacka et al (2020) estimated that the population of PWID in Canada increased from 130,000 in 2011 to 171,000 in 2016. But the authors also found that needle and syringe coverage improved over time, increasing from 193 needles and syringes per PWID in 2011 to 291 in 2016 (https://www.catie.ca/en/practical-guides/hepc-in-depth/prevention-harm-reduction/safer-injection). According to the Jacka et al (2020), almost 50 million needles and syringes were distributed in 2016, nationally. However, significant differences in the level of coverage exist on subnational level between the provinces (Jacka et al, 2020). In 2016, 8 of 11 provinces and territories in Canada met WHO guidelines for high needle-and-syringe provision. The highest needle and syringe coverage were found in Saskatchewan and Alberta where over 700 needles and syringes were distributed per PWID in 2016. New Brunswick, Quebec, and Yukon were below the WHO threshold both in 2011 and 2016. (Jacka et al, 2020). The greatest increase in needle and syringe coverage was observed in Manitoba. The number of needles and syringes distributed in Manitoba per PWID increased more than 2.5 times, from 78 needles and syringes in 2011 to 207 in 2016 (Jacka et al, 2020). Ontario and British Columbia distributed the highest volume of needles and syringes at 18,100,000 and 14,991,900 respectively. This information about the distribution of needles and syringes in Canada is made possible by having central distribution programs and tracking systems. A breakdown of the total number of needles and syringes distributed in each province in 2016 is provided in table 1.1 (Jacka et al, 2020).

Table 1.1—Estimated number of Opioid Agonist Treatment (OAT) recipients per 100 People Who Inject Drugs (PWID) and number of needles and syringes distributed per PWID for PWID: Canada, 2016

	Estimated No. of PWID (Range)	No. of OAT Recipients	Estimated No. of OAT Recipients per 100 PWID (Range)	No. of Needles and Syringes Distributed	Estimated No. of Needles and Syringes per PWID (Range)
Canada	171,900 (152,200-191,400)	113,381	66 (59-75)	49,958,381	291 (261-328)
Alberta	4,700 (4,100-5,200)	7,636	163 (147-185)	4,122,866	883 (793-997)
British Columbia	47,600 (42,100-53,000)	23,506	49 (44-56)	14,991,900	315 (283-356)
Manitoba	8,500 (7,500-9,400)	2,490	29 (26-33)	1,754,597	207 (186-234)
New Brunswick	5,000 (4,400-5,500)	2,554	51 (46-58)	664,047	220 (198-249)
Newfoundland & Labrador	2,900 (2,600-3,200)	2,136	73 (66-83)	642,181	134 (120-151)
Nova Scotia	3,600 (3,200-4,100)	3,299	99 (89-112)	1,660,642	456 (409-515)
Ontario	76,700 (67,900-85,400)	58,706	77 (69-86)	18,100,000	236 (212-267)
Prince Edward Island	500 (460-570)	786	152 (136-172)	215,078	416 (373-470)
Quebec	14,900 (13,200-16,600)	6,401	43 (39-49)	2,503,574	168 (151-190)
Saskatchewan	7,300 (6,500-8,200)	5,435	74 (67-84)	5,276,496	719 (646-812)
Yukon	170 (150-190)	105	61 (54-69)	27,000	156 (140-176)

Source: Jacka et al. (2020)

Changing drug use trends can have an impact on the coverage and effectiveness of NSPs (Scheim et al, 2018). For example, in 2015, NSPs in London, Ontario distributed an estimated 2.5 million needles in comparison to 1.9 million in Toronto (Scheim et al, 2018). Despite the large volume of distributed needles and syringes, 22% of participants in a London study reported syringe sharing in the past 6 months and large number of participants reported having difficulties accessing sterile needles. The authors attributed this discrepancy to the increase in crystal methamphetamine injection in London, Ontario (Scheim et al, 2018). Injecting crystal methamphetamine is associated with higher number of daily injections and higher rates of syringe sharing (Tyndall et al, 2003).

Being available when and where people need needles

NSPs can facilitate access to sterile needles with varied modes of program delivery including fixed sites with extended open hours, mobile needle distribution, pharmacy distribution, peer distributors, home delivery, and vending machines. Vending machines can offer increased access to sterile syringes during times when NSPs and other harm reduction services are closed (Islam et al., 2007, 2008; McDonald, 2009). Evidence from a Toronto study (Strike et al., 2005) showed that clients engage in different needle acquisition patterns. Some stockpile large numbers, others make sure they have enough for a week or two while others acquire needles daily. Of these, daily access is the most problematic because this group is more likely to reuse, share or borrow needles.

A study from Vancouver (Bozinoff et al, 2017) found that access to sterile needles and syringes for youth may be suboptimal. In this study, 37.8% of street-involved youth reported some type of syringe sharing, despite a well-established large NSP operating in Vancouver. The authors suggested that current programs might be less effective for youth than for adults (Bozinoff et al, 2017). As mobile vans and vending machines were found to attract younger and higher risk PWID (Jones et al, 2010) the authors believe that scale-up of these services may increase access to needles and syringes for street-involved youth (Bozinoff et al, 2017

Studies from Switzerland indicate that only 47.5% of pharmacies reported distributing or selling sterile injection material (Stadelmann, Samitca, Henry, & Bize, 2017). This study identified a 54% reduction in the use of pharmacies for sterile injection equipment among PWID between the years of 2005 and 2016. In the study, 14% of pharmacies limited the number of sterile injection equipment distributed, 7% provided new syringes only to people who returned used syringes and 24% reported deciding whether to provide sterile equipment to individuals based on their state and attitude at the time of retrieval (Stadelmann, Samitca, Henry, & Bize, 2017). In France, Beauviller et al. (2017) reported that among 317 PWIDs, 42% utilized pharmacies to get new syringes. This same study found that sharing needles and syringes and other injection equipment was almost non-existent among participants, but they were likely to re-use their own injection equipment (Beauviller, Bonnet, & Cornibert, 2017).

Implementing NSPs where they are needed matters too. In a study of 456 people who inject drugs in Montreal, it was found that distance from NSP services was associated with high-risk injecting behaviour and the authors suggested that this finding confirms that NSPs need to be established where they are needed (Bruneau et al., 2008).

Other issues specific to needles

Dead-space syringes

All syringes contain some fluid or "dead-space" when the plunger is depressed (Strauss et al., 2006), but the amount of fluid depends on whether the needle is permanently attached or detachable. Syringes that have detachable needles are generally high dead-space syringes (HDSS) as they retain fluid in the needle, needle hub, and syringe tip (Zule et al., 2009). Syringes with permanently attached needles are typically low dead-space syringes (LDSS) as fluid is only contained in the needle when the plunger is depressed (Zule et al., 2009; Benedetti & Mary, 2018). Zule et al (2009) found that 77% of the variance in dead space volume depended on the needle and syringe design. In their study, barrel capacity accounted for 26% of the variance in dead space volume in HDS syringes with HDS needles (Zule et al, 2018). LDSS may also clog more easily than syringes with fixed needles. Abadala et al., (2016) reported that syringes with fixed needles were were less likely to get clogged by blood and yielded fewer HIV-positive syringes than LDSS syringes attached to needles of equivalent diameter.

The dead-space in a syringe has important implications for the risk of HIV and HCV transmission if fluid in the dead space is contaminated with HIV, HCV and/or HBV and the syringe is reused by someone who is not infected. Binka et al (2015) measured the presence of hepatitis C virus in the residues in different needles-syringe combinations before and after storing them for one week and rinsing them once or twice with water. In all three experimental conditions, insulin syringes with fixed needles had lower proportion of HCV-positive syringes than syringes with detachable needles (Binka et al, 2015). Heimer et al. (2018) performed a set of experiments to determine if HCV transmission occurs mainly through re-used drug equipment (i.e., cookers and filters) or through sharing of drug solutions. They also explored if drugs shared through re-used detachable syringes is more likely than fixed needle syringes to contaminate drug solutions. The experiments showed HCV transmission is more likely through shared drug solutions and when these are prepared with detachable syringes.

After rinsing, HDSS can retain 1000 times more blood compared to LDSS (Zule et al., 2009). Studies have shown links between sharing HDSS and HIV and HCV prevalence (Zule et al., 2002, 2009). A mathematical modelling study suggests that even a small percentage of syringe-sharing involving HDSS can substantially increase the spread of HIV, especially in high-risk populations (Bobashev & Zule, 2010). HCV has been observed to survive in HDSS for up to 63 days (Paintsil et al., 2010), thus these types of syringes may be much more likely to transmit the virus. Zule et al. (2013) suggest that switching from HDSS to LDSS would be a simple and low-cost intervention that may help reduce HIV transmission "in countries with injection-driven epidemics" (p. 6) and recommend additional research. A study from Bristol estimated that replacing HDSS syringes with LDSS syringes in needle and syringe programmes would be a cost-effective intervention to reduce HCV transmission resulting in a 30% reduction in HCV infections during the 10-year intervention (Hancock et al, 2020). Another study (Kesten et al, 2017) found that detachable LDSS syringes, when introduced, are likely to be accepted by the clients of two NSPs in Bristol and Bath, UK. The authors suggest that detachable LDSS should be offered to PWID who use detachable HDSS and/or fixed 1ml LDSS to inject into deeper femoral veins (Kesten et al, 2017).

Safety-engineered syringes

Safety-engineered syringes – also known as difficult to re-use syringes, single-use syringes, and one-use syringes – are designed to be used only once (e.g., the plunger cannot be retracted once it has been depressed or the needle retracts into the syringe). These devices can be "passive" whereby the user does not need to perform extra steps to engage the safety feature, or "active" whereby the user actively engages the safety feature. Potential benefits of safety-engineered syringes may include the prevention of needle reuse and sharing (and thereby less transmission of pathogens) and prevention of needlestick injury, including potential injury from publicly discarded needles. Empirical literature does not contain much information regarding the use of safety-engineered syringes among people who use drugs attending harm reduction programs; most of the literature focuses on their use to prevent needlestick injuries among healthcare workers in other health settings (e.g., Tosini et al., 2010; Whitby et al., 2008).

Research on the use of safety-engineered syringes among people who inject drugs has highlighted several concerns. Des Jarlais (1998, 2000) reviewed the existing literature on difficult to reuse syringe use among people who inject drugs and raised the following points:

- Any needle, regardless of design, can be reused.
- Difficult to reuse syringes are difficult to disinfect.
- A faulty mechanism may misfire, resulting in the loss of drugs.
- The mechanism prevents people who inject drugs from aspirating or "registering", i.e., drawing blood into the syringe to check whether they have found a usable vein and then continuing with injection.
- Difficult to reuse syringes prevent "booting" or "flagging" – a process of injecting part of the drug solution, then retracting the plunger to draw blood into the drug mixture and injecting again. It has been anecdotally reported that booting, flagging, and registering may be associated with risk for embolism. However, booting and flagging serve to extend the pleasurable effects of drug injection and people who inject drugs may want to repeat this process several times.
- A person cannot recover the drug if something goes wrong with an injection, e.g., if a vein collapses.

Use of bleach to disinfect injection equipment

In 2004, the WHO reviewed the scientific evidence concerning the effectiveness of bleach to disinfect used injection equipment and stated that bleach and other methods of disinfection are not supported with good evidence for reducing HIV transmission. As well, the WHO (2004) states that studies in the field cast doubt that disinfection procedures could ever be effective. PHAC (2004) reviewed the evidence regarding the use of bleach to prevent the transmission of HCV, HBV, and HIV. PHAC (2004) concluded that although there is partial effectiveness, bleach disinfection offers little benefit to prevent HCV transmission among people who inject drugs. This report states, "Bleach distribution and education programs for people who use injection drugs must be careful not to impart a false sense of security regarding bleach's protective efficacy" (p. 16). Since the publication of these two reports, there have been no new studies evaluating the impact of bleach to disinfect equipment.

Binka et al (2015) assessed the effectiveness of household products, including bleach, in disinfecting HCV-contaminated syringes. This study found that diluted bleach, when used properly, was the best disinfectant in a laboratory setting for decontaminating used syringes both with fixed and detachable needles, to prevent HCV transmission. Diluted bleach was able to eliminate residual HCV infectivity with only one rinse in syringes contaminated with fresh blood after injection. It is not known if the bleach would be as effective in killing hepatitis C virus in dried or clotted blood. However, the authors recommend using bleach to disinfect needles and syringes only when new syringes are unavailable (Binka et al, 2015). In cases where the use of bleach is the only way to disinfect needles and syringes, proper procedures have to be followed to maximize the effectiveness of bleach (Arkell & Anderson, 2016).

Needle and syringe distribution evidence summary

The evidence that informs this chapter and its recommendations came from a variety of studies. Laboratory studies involving virologic testing have contributed much knowledge regarding the transmissibility of HIV, HCV, and other blood-borne pathogens via needles. Cross-sectional studies and prospective cohort studies were the main types of studies to contribute evidence on injection risk behaviours, while some qualitative interview studies have deepened our understanding of such risky practices. A few articles relied on randomized controlled trial (RCT) designs to provide data on injection risk behaviours. While RCTs are generally considered to provide the highest quality evidence for interventions, it is not always feasible or ethical to conduct this type of research within populations or with harm reduction programs. This is recognised by several public health experts and authorities, for example:

> *[T]he difficulty of conducting a strictly randomized controlled trial to evaluate a public health intervention such as a NSP should not be underestimated. Potential sources of bias and confounding are impossible to control because of insurmountable ethical and logistical impediments. (WHO, 2004, p. 5)*

> *[I]n some cases it is impossible for researchers to conduct RCTs since to do so would be unethical. Further, given the complexity of causal chains in public health, the external validity of RCT findings often has to be enhanced by observational studies. (NICE, 2009, p. 17)*

Review papers – including a few systematic and meta-analytic reviews – have covered a variety of topics including HIV and HCV seroconversion, infections and other health-related harms among people who inject drugs, and program coverage. Other study designs (e.g., case-control, cost-effectiveness, modelling) and other materials (e.g., manuals) also provided some information. Much of the evidence that was reviewed for this chapter came from observational and other studies.

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Chapter 2: Needle and syringe distribution for anabolic steroid injection, hormone injection, piercing and/or tattooing

Recommended best practice policies to facilitate use of sterile equipment for injecting anabolic steroids and/or hormones, and for piercing and/or tattooing the skin:

DISTRIBUTION

- Distribute needles and syringes based on the quantity requested by clients with no limits
- Distribute needles and syringes without requiring exchange of used. One-for-one is never a recommended practice
- Offer a variety of needle and syringe types suitable for intramuscular injection of anabolic steroids and/or hormones

EDUCATION

- Educate about the correct, single person use of needles and syringes
- Educate about the risks of using non-sterile needles/syringes for injecting, piercing and/or tattooing
- Educate about the risks of sharing multi-dose vials or ampoules of anabolic steroids
- Educate about the potential risks associated with sharing tattooing supplies (e.g., ink and ink pots)

DISPOSAL

- Dispose of used needles and syringes in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

In this chapter, we encourage programs to distribute needles of varied gauges for the injection of anabolic steroids (Section I), the injection of hormones among transgender people (Section II) and related risks associated with each, and we include a short discussion about piercing and tattooing (Section III).

Section I: Needle distribution for anabolic steroid injection

Description of anabolic steroid use

Anabolic-androgenic steroids (commonly called "anabolic-steroids") are synthetic derivatives of testosterone that promote skeletal muscle growth and the appearance of male sex characteristics; some steroidal supplements also promote higher testosterone levels in the body (Goldman, Harrison, Pope & Bhasin, 2019; Harvey, Keen, Parrish, van Teijlingen, 2019; Beel et al., 1998; NIDA, 2006). Anabolic steroids can be taken in different ways including intramuscular injection, oral administration, and application to the skin in gel or cream form (NIDA, 2006; Goldman et al., 2019; Harvey et al., 2019; Van de Ven, Zahnow, McVeigh & Winstock, 2020). People may use anabolic steroids for a variety of reasons, including increasing muscle size, improving appearance, enhancing strength and/or improving sporting performance, competing in bodybuilding, for medical reasons, and for other occupation-related reasons (Harvey et al., 2019; Glass et al., 2019; Brennan, Wells & Van Hout, 2017; Aitken et al., 2002; Beel et al., 1998; Bolding et al., 2002; NIDA, 2006). Anabolic steroids are often taken according to a pattern/schedule or in cycles ("cycling"; Grace et al., 2001; NIDA, 2006). Some people combine the use of different steroids or performance-enhancing substances ("stacking") and/or escalate the number of steroids or dosages up to a peak in a cycle ("pyramiding"; Grace et al., 2001; NIDA, 2006). Anabolic steroids are commonly injected into large muscle groups such as the buttocks, thighs, and shoulders (Aitken et al., 2002; Larance et al., 2008). In a cross-sectional survey conducted by Rowe et al. (2017), needles used for intramuscular injection of steroids were typically larger than those for inravenous injection of psychoactive drugs. Little is known about the injection of human growth hormone as part of a performance-enhancing regimen (Evans-Brown & McVeigh, 2009) and as such we will not address this substance further.

People who inject anabolic steroids may attend harm reduction services such as needle and syringe programs (NSPs) in Canada and in the United Kingdom to obtain injection supplies (Mandryk & McDougall, 2013; Sirko, 2014; Harvey et al., 2019). However, the literature about this topic is sparse, and thus our knowledge is limited about how often people who inject anabolic steroids attend NSPs, the equipment they request, and other issues that are important for providing service to this population. An environmental scan of the 36 core NSPs in Ontario revealed that most programs desire more research evidence, local statistics, and guidance regarding how to provide safer steroid use services (Ontario Harm Reduction Distribution Program, 2013). A study conducted by Harvey et al. (2019) with individuals using non-prescriptive anabolic androgenic steroids, demonstrated that often these groups obtain supplies and information such as needles and syringes through the following locations: NSPs, pharmacies, primary care offices or from peers.

A cohort study conducted by Glass et al. (2019) in the United Kingdom with 537 individuals who injected image and performance enhancing drugs, showed that 87% engaged with NSP. This study additionally found that 34% of participants often gathered injecting based equipment for peers (Glass et al., 2019). Similar findings were reported in an Australian cohort study (van Beek & Chronister, 2015). Among 103 participants who injected image and performance enhancing drugs, 57% attended and gathered supplies from NSP (van Beek & Chronister, 2015) and 53% of participants had used alternative locations such as pharmacies or peers to gather supplies and information (van Beek & Chronister, 2015).

Evidence of needles and syringes used for anabolic steroid injection as vectors of HIV, HCV, and HBV transmission

Little is known about the injection risk behaviours and needs of people who inject anabolic steroids, as there are fewer studies for this population than for those who inject psychoactive drugs. Injecting anabolic steroids can carry risks of transmitting blood-borne infections such as HIV (e.g., see a documented case in Scott & Scott, 1989) and HCV from the use of contaminated needles, syringes, and other injection equipment. Needles of various gauges, including the gauges more suitable for intramuscular injection, are typically ordered as separate or detachable needles which have more dead space than fixed or attached needles/syringes. Although more research is needed, the amount of fluid retained in a needle/syringe has implications for transmission risk if the needle/syringe is reused.

Incidence and prevalence of HIV, HCV, and HBV among people who inject anabolic steroids in Canada

Canadian and international estimates of the incidence and prevalence of HIV, HCV, and HBV are currently lacking for people who inject anabolic steroids.

In England and Wales, HIV and viral hepatitis among people who inject drugs is monitored through an annual unlinked-anonymous survey (Hope et al., 2013). In response to increasing concerns about people who use performance- and image-enhancing drugs (PIEDs) –anabolic steroids being the most common substance – a targeted survey was conducted as part of the ongoing survey (Hope et al., 2013). Between May 2010 and May 2011, 395 men who inject PIEDs were recruited through 19 NSPs for oral-fluid samples and a questionnaire. Overall, 12% (n=47) tested positive for one or more of anti-HIV (only 1.5%), anti-HCV, and anti-HBc (a marker for HBV infection); 43 had just one of these markers and four had two or more. Hope et al. (2013) noted that while there are standard methods used for recruiting people who inject drugs, the reliability of these approaches for people who inject PIEDs is unclear given limited knowledge about the size and nature of this population. Only 4.8% of participants in the study had ever injected psychoactive drugs including heroin and cocaine.

Evidence of injection-related risk behaviours associated with anabolic steroid injection

This subsection summarizes the available evidence about risk behaviours associated with injecting anabolic steroids. While there is some evidence of needle/syringe sharing, the sharing of other equipment (particularly vials or ampoules that contain anabolic steroids) and personal needle reuse may deserve special attention from service providers and researchers. In their review on anabolic steroid use and related issues, Beel et al. (1998) noted that needle sharing among people who inject anabolic steroids is likely underreported, complicating efforts to determine the magnitude of this issue. Nevertheless, older data from US and Canadian studies about high school students who inject anabolic steroids have shown rates of needle sharing varying from 9.1% to 29.1% (Beel et al., 1998). A UK study (Morrison, 1994) that sampled 21 males who injected anabolic steroids reported no needle sharing, though some reported having seen others share needles and syringes. Crampin et al. (1998) examined data from the national (England and Wales) Unlinked Anonymous HIV Prevalence Monitoring Survey of people who inject drugs. In 1991, none of the 719 participants who currently injected drugs were injecting anabolic steroids. By the end of the study period in 1996, 149 participants had injected anabolic steroids. It is not clear from the article if all of those who reported injecting steroids had ever injected, or were also injecting, other drugs. Saliva specimens were also tested; none of those who injected anabolic steroids had antibodies to HIV while three had antibodies to HBV (prevalence of 2%). None of the latter three had reported sharing of injection equipment. Eight out of 134 current steroid users reported "ever having received" used needles or syringes, though it is not clear from the study if those who had received these needles/syringes had used them. Crampin et al. (1998) suggested that people who inject anabolic steroids need to be distinguished from other people who inject drugs because they are a different group in terms of their injecting practices and other characteristics.

A cross-sectional study of 605 men who injected image and performance enhancing drugs found that 54.5% of individuals had injected in arm muscles and 6.3% had injected in their calves or thighs (Rowe et al., 2017). Sharing injection related material among study participants was rare (Rowe, Berger, Yaseen & Copeland, 2017). Similar findings were reported by Ip et al. (2016), who found that among individuals who injected anabolic steroids and performance enhancing drugs, they had a decreased likelihood of sharing injection related material compared to those who injected non-anabolic steroids or performance enhancing drugs (n=3100). This review documented that when comparing the two groups, the former was found to spend increased time preparing for injections, including measuring doses and ensuring high drug quality (Ip, Yadao, Shah & Lau, 2016).

Kimergard and McVeigh (2014) conducted semi-structured interviews with NSP service providers in the United Kingdom, to better understand the role these services play in assisting those who inject anabolic steroids. These service providers expressed concern for anabolic steroid users due to their limited available information on proper injecting practices (Kimergard & McVeigh, 2014). Many service providers explained that anabolic steroid users gathered information from peers, which impacts the quality of injection strategies implemented (Kimergard & McVeigh, 2014). Concerns regarding the validity of injection-related information was also documented in a cohort study conducted in Australia by Dunn et al. (2014).

A case-control study of HIV and HCV risk behaviours among anabolic steroid users from the North-East of England found low rates of injection-related risk behaviours among a sample of male weight trainers (Midgley et al., 2000). The study had 90 participants who were given a semi-structured interview and questionnaire; 50 used anabolic steroids and 40 were controls. Of those who used steroids, 47 were currently injecting steroids, two had used oral steroids only but had injected at some point in the past, and one never injected. The mean number of anabolic steroid injections per week was 2.93 (range 0-18) and 15% injected steroids at least once per day. The most reported injection-related risk behaviours among the sample were sharing multi-dose vials (23.4%) and dividing substances using syringes (17%). One person reported sharing injecting equipment (his training partner used a needle and syringe after he had used) and two reported seeing other people who use anabolic steroids share injecting equipment in the past. This study also examined sexual risk behaviours and found that people who use anabolic steroids engaged in more risky sex practices compared to controls.

In another UK study, Grace et al. (2001) recruited 106 gym users from three non-commercial gyms that carry a wide array of heavy weight training equipment in South Wales. Fifty-three percent (all males) reported using anabolic steroids in the last year. Among this group, 69% combined oral and injection steroid administration, while 20% reported injection only and 11% oral administration only. Twenty percent of participants who had injected anabolic steroids reported sharing syringes with others at times when syringes were unavailable. A cross-sectional study that recruited 772 gay and bisexual men from six gyms in central London, UK, found that 15.2% (n=117) had used anabolic steroids and 11.7% (n=90) had injected steroids in the last 12 months (Bolding et al., 2002). Among 85 who injected anabolic steroids and provided information about their injecting behaviour, 94.1% reported always using sterile, disposable needles, and 8.2% reported having sometimes reused their own needle on themselves. None reported sharing needles or syringes, but two (2.4%) people had split a multi-dose container with at least one other person. Bolding et al. (2002) also reported that the prevalence of anabolic steroid use was significantly higher among gay or bisexual, HIV-positive men (31.7%) compared to those who were HIV-negative (14.5%) or never tested (4.7%); this same pattern held for those who inject anabolic steroids (24.6%, 10.9%, and 4.1%, respectively).

These findings are mirrored in a cross-sectional study conducted in San Francisco by Ip et al (2017). This study found that among 293 participants, individuals who identified as homosexual and injected anabolic steroids were more likely to test positive for HIV, when compared to heterosexual anabolic steroid users.

In a seroprevalence study from Victoria, Australia, that used a convenience sample of people who inject illicit anabolic steroids, Aitken et al. (2002) reported that HCV was much lower among the steroid users compared to what was typically found among people who inject other drugs. Out of 63 blood samples tested, six (9.5%) had HCV antibodies, while out of 50 specimens tested for HBV, six (12.0%) tested positive for the HBV core antibody; none contained HIV antibodies. Among the 58 participants who completed a questionnaire, only half had injected anabolic steroids in the month prior to the interview. The mean number of steroid injections in the last month was 10 (range 2-50). None reported injecting steroids with a needle that had been previously used by someone else, but four (6.9%) had shared a needle to inject other drugs and only one had given his needle to someone else in the 12 months prior to the interview. A comparison of injecting behaviours between those who tested positive for the HCV antibody versus those who had not showed no difference in steroid-injecting behaviours. In an earlier analysis of Australian data, among 127 clients of a Steroid Peer Education Project – a program that provided people who inject steroids with specialised needle distribution and collection services – 6% had used someone else's used needle to inject steroids or other drugs, 14% reused their own needle, and 15% had injected steroids or drugs from a shared container (Delalande et al., 1998).

Larance et al. (2008) collected data in the Sydney, Australia, region between January and August 2005 from 60 males who used anabolic steroids, human growth hormone, or insulin-like growth factors for non-medical reasons in the previous six months. Ninety-three percent of participants had intramuscularly injected PIEDs at some point in their lifetime and 68% reported injecting in the last month. Only 5%reported ever sharing needles; one had shared needles in the past month to inject other illicit drugs. Personal needle reuse was more common

(13%). Seventy-seven percent reported illicit drug use in the last six months (most commonly stimulants and cannabis) and 27% reported ever having injected illicit drugs.

Glass et al. (2019) reported that among 537 individuals who inject IPEDs , 8% reported injecting heroin and cocaine while 7% reported injecting speed. Similar results were documented by Rowe et al. (2017), who found that among 605 men who injected image and performance enhancing drugs, 5.1% injected non-image and performance enhancing drugs such as meth or heroin.

Overall, people who inject anabolic steroids exhibit low rates of needle/syringe sharing. However, a potentially unique transmission risk among this population is that they may be likely to share vials or ampoules that contain anabolic steroids. In the study noted earlier by Hope et al. (2013), 8.9% of participants reported having ever shared a needle/ syringe or drug vial, 6.8% (n=27) had shared only a vial, while 1.5% (n=6) shared a needle/ syringe and 0.51% (n=2) shared both. Larance et al. (2008) found that 29% of their sample had injected from a shared vial or container. When discussing injection-related risks with people who inject steroids, harm reduction program staff should highlight that sharing any piece of injection equipment carries the risk of pathogen transmission.

Injecting anabolic steroids can lead to bruising and damage around injecting sites, particularly if a needle is reused. Wounds are vulnerable to bacterial infection, and the risk of abscesses is also a concern when needles are reused. Some evidence shows that people who inject anabolic steroids may reuse their own needles, causing the needle tip to become duller after each use. Aitken et al. (2002) noted that because some force is needed to inject into parts of the body like the buttocks and shoulders, and because these can be awkward or imprecise spots to reach, such injecting can lead to puncture wounds that bleed. Pain around injecting sites may also occur (Bolding et al., 2002). Larance et al. (2008) noted that the combination of a thicker needle and greater force may damage skin and surrounding tissue.

Policies for distributing needles for anabolic steroid injection

Studies document that people who inject anabolic steroids access NSPs (Beel et al., 1998; Crampin et al., 1998; Dunn et al., 2014; Hope et al., 2013; Iversen et al., 2013; Kimergård & McVeigh, 2014; Larance et al., 2008; Morrison, 1994), but there is little evidence about the frequency of attendance. Cross-sectional survey data from Australian NSPs have supported anecdotal reports that this is an increasing population of NSP attendees in New South Wales and Queensland (Iversen et al., 2013). There are also indications that people who inject anabolic steroids are a hard-to-reach group for harm reduction programs (Aitken & Delalande, 2002; Larance et al., 2008). In a qualitative interview study of 24 people who use anabolic steroids and nine service providers from England and Wales, Kimergård and McVeigh (2014) reported that people who inject anabolic steroids perceived themselves as different from other people who inject drugs. The authors stated that people who inject anabolic steroids “tended to ignore or at least make their risky behaviours seem less hazardous than they actually were” (p. 5), even though some participants reported risk behaviours such as needle reuse. This distancing from other types of people who use drugs, and the stigma associated with injection drug use, may impede NSP attendance or service uptake among people who inject anabolic steroids. In England, interventions such as mobile needle distribution programmes in gyms and steroid clinics, were specifically designed to increase access to sterile needles and syringes for users of anabolic steroids (Kimergård & McVeigh, 2014).

As noted earlier, people who inject anabolic steroids may share injection equipment when sufficient equipment is not available (Grace et al., 2001), though rates of needle sharing seem to be lower in comparison to people who intravenously inject psychoactive drugs. In the study by Midgley et al. (2000), some participants explained in interviews that injection risk behaviours were not as common among people who use anabolic steroids because sterile injecting equipment is readily accessible to them. The majority of study participants who injected anabolic steroids obtained their needles from NSPs. Larance et al. (2008) also found that a majority (71%) of their participants reported obtaining needles from NSPs (versus 14% from a chemist/ pharmacy, 11% from a doctor, 2% from friends, and 2% from others). Although many obtained injecting equipment from NSPs, only 7% reported seeking information about PIEDs from NSP services (Larance et al., 2008). More often, participants relied on the Internet, friends, doctors, and gym contacts for information.

There is little empirical data concerning the best types of needles for anabolic steroid injection; however, the UK manufacturer Exchange Supplies (www.exchangesupplies.org) recommends varying gauges between 21 and 23. Needles of 22 to 23 gauge are typically used for injecting in the buttocks (Sirko, 2014).

In addition to needles/syringes, harm reduction programs may want to consider distributing other pieces of equipment to people who inject anabolic steroids, including small-volume vials of sterile water. Although there is no specific literature about this issue, it has been suggested by service providers that since some people obtain steroids in a powder form that needs to be mixed with water, distributing sterile water to these clients may help prevent any sharing of mixing-water sources. Alcohol swabs should be distributed for cleaning the injection site and clients should also have access to biohazard containers for safer sharps disposal (Sirko, 2014).

To reach clients who inject anabolic steroids, outreach may need to be conducted in locations these clients are likely to frequent, such as gyms and sports centres, and include appropriate and knowledgeable peers, such as bodybuilders or trainers, to make contact (Aitken & Delalande, 2002). People who inject anabolic steroids and who may not attend NSPs may already have a relationship with these knowledgeable peers and are likely to trust them.

In the study by Kimergård and McVeigh (2014), all participants who use anabolic steroids reported that they had easy access to needles and syringes from harm reduction services, but outreach distribution to gyms and secondary distribution (i.e., distribution between people who inject anabolic steroids) were also accepted practices. Although these practices may extend the reach of harm reduction services, service providers may be concerned about missing opportunities to engage with vulnerable groups such as young people who start using anabolic steroids (Kimergård & McVeigh, 2014). Specialized services such as steroid clinics can offer additional opportunities to distribute sterile injecting equipment alongside conventional NSPs. People who use anabolic steroids may find specialized clinics attractive, especially if they are staffed by non-judgemental workers who are highly knowledgeable about anabolic steroids (Kimergård & McVeigh, 2014).

Because some people purchase anabolic steroids and related substances – as well as obtain information (e.g., in bodybuilding forums) – online, there may be opportunity to develop online peer outreach or interventions. Larance et al. (2008) suggested that people who inject PIEDs need information on blood-borne and other infections, hepatitis vaccinations, injection techniques, hygiene procedures (e.g., hand washing), and the range of negative physical effects linked to PIED use. These authors also suggested that harm reduction advice should consider factors such as dose, frequency of use, diet and training, other illicit drug use, safer sex, and monitoring of mental and physical health. Given the available evidence on risk behaviours, people who inject anabolic steroids appear to need targeted injection-related education concerning the risks of reusing one's own needle and the risks of blood-borne virus transmission when any pieces of injection equipment are shared (including use of multi-dose vials or ampoules containing steroids or other substances). Many harm reduction program staff may also need specific training and education about anabolic steroid use and related issues before and when working with clients who inject steroids. Dunn et al. (2014) interviewed 13 NSP workers from New South Wales, Victoria, and Queensland, Australia about their contact with people who use anabolic steroids. Workers expressed concern about their own level of knowledge regarding anabolic steroids and the equipment that clients need, in addition to concern about lack of knowledge among clients. Dunn et al. (2014) suggested that there is a need for workforce training and better engagement of people who use anabolic steroids in harm reduction strategies. Kimergård and McVeigh (2014) learned in their study that service providers can have conflicting views about the "boundaries of harm reduction" for people who inject anabolic steroids. While service providers in their sample agreed that needle and syringe distribution is essential, they disagreed on how much information workers should give to clients about anabolic steroids and their use, in part due to the unknown effects of taking high doses of anabolic steroids over a long period of time.

Other health-related harms associated with anabolic steroids

Use of anabolic steroids has been associated with several serious health-related side effects including increased risk of coronary heart disease, blood clots, and liver damage (Goldman et al, 2019; Beel et al., 1998; Morrison, 1994; NIDA, 2006). Goldman et al. (2019) documented the risk long term users of anabolic androgenic steroid have in developing illnesses such as cardiomyopathy, coronary atherosclerosis, myocardial infarction and mortality. Therefore, regular medical follow-up is important for this population. However, much of what we know about the long-term effects from steroid use comes from case reports rather than large, epidemiological studies (NIDA, 2006). Steroid use can produce reversible and irreversible effects due to changes in hormone production, including reduced sperm production and testicular atrophy in men (NIDA, 2006). Psychological effects associated with steroid use include aggression and symptoms of dependence and withdrawal after stopping use (Beel et al., 1998; NIDA, 2006). In the study by Bolding et al. (2002), those who used anabolic steroids were more likely than non-users to report having suicidal thoughts or to have felt depressed.

In addition, people who use anabolic steroids may acquire black-market steroids and other substances that are thought to be steroids from online or street-based sources (Aitken et al., 2002) and injection of these substances may carry (unknown) risks of other side effects and harms. As there is no assured quality control when purchasing anabolic steroids from online and street sources, people who do so should be reminded to ensure that the packaging is unopened, look at labels and expiry dates, check for any floating debris in liquid in vials (Mandryk & McDougall, 2013; Sirko, 2014) and consider sending a sample to getyourdrugstested.com for analysis with an FT-IR spectrometer.

Section II: Needle distribution for hormone injection

Description of hormone use among transgender people

The term "transgender" refers to a highly diverse group of people "who cross or transcend culturally defined categories of gender" (Bockting et al., 1998). Transgender and gender-diverse people typically identify with a gender(s) that differs from the sex they were assigned at birth. There are many different terms and identities included under the transgender umbrella, including but not limited to trans men, trans women, male-to-female, female-to-male, trans-sexual, genderqueer, gender-neutral, and Two-spirit. Transgender people can present in a variety of ways.

They may or may not choose to undergo hormone therapy or gender-affirming surgeries or may choose only some of the medical options or interventions available in the transition process.

To modify external appearance, hormones are taken (orally, injected, or transdermally) by some transgender people to suppress undesired secondary sex characteristics and/or to induce and maintain the desired secondary sex characteristics (De Santis, 2009; Khobzi Rotondi et al., 2013). Hormones for "feminizing" the body include estrogen and progesterone, while testosterone is a "masculinizing" hormone. Anti-androgen drugs may also be taken to block the effects of testosterone. According to the World Health Organization (2011), "Hormone injection is the most common gender enhancement practice among transgender people" (p. 55). Hormonal interventions should be medically supervised, although some transgender people obtain hormones from non-medical sources (WHO, 2011). People who inject hormones typically administer the injections intramuscularly (e.g., into the thighs and buttocks). Some may believe that injection produces better effects compared to oral administration (Bockting et al., 1998; Edwards et al., 2007). However, decisions to inject hormones may also be based on costs (i.e., testosterone preparations that can be injected are usually less expensive) and availability. Other substances such as silicone may also be injected as gender enhancements (i.e., for added curves to the body; Bockting et al., 1998; De Santis, 2009); such practices may be relatively uncommon at this time in Canada but they are important to note as they may carry additional risks (e.g., inflammation, infection).

Evidence of needles and syringes used for hormone injection as vectors of HIV, HCV, and HBV transmission

Injection of hormones with previously used needles and syringes can put people at risk of transmitting or acquiring HIV, HCV, HBV, or other pathogens. Although limited, there is evidence to substantiate this injection-related risk among transgender people. The WHO (2011) recommends that, "Transgender people who inject substances for gender enhancement should use sterile injecting equipment and practise safe injecting behaviours to reduce the risk of infection with bloodborne pathogens such as HIV, hepatitis B and hepatitis C" (p. 14). Further, the WHO (2011) notes that although "conclusive evidence" is missing regarding an association between hormone injection and HIV transmission, there is potential for needle sharing in the context of "frequent self-administration of these substances" (p. 56). Please see Chapter 1: Needle and syringe distribution for a review of studies pertaining to injection drug use and evidence of HIV, HCV, and HBV in used needles, including evidence about dead-space syringes. Needles of various gauges, including the gauges more suitable for intramuscular injection, are typically ordered as separate or detachable needles which have more dead space than fixed or attached needles/syringes. Although more research is needed, the amount of fluid retained in a needle/syringe has implications for transmission risk if the needle/syringe is reused.

Incidence and prevalence of HIV, HCV, and HBV among transgender and people who inject hormones

Canadian estimates of the incidence and prevalence of HIV, HCV, and HBV are lacking for transgender people (Anderson, 2014). Chen et al. (2011) noted that transgender status has not been collected in US national HIV/AIDS surveillance activities and, when data on transgender status have been collected, the accuracy of such data depends on how someone presents to their medical provider. Nonetheless, studies have shown that transgender people are among those at high risk for HIV through sexual behaviours, rather than non-sexual or injection-related behaviours (e.g., Baral et al., 2013; Bauer et al., 2012; Clements-Nolle et al., 2001; Edwards et al., 2007; Nemoto et al., 1999; WHO, 2011). For example, Baral et al. (2013) performed a meta-analysis comparing HIV infection in trans women populations to adults of reproductive age in 15 countries. Pooled HIV prevalence in 11,066 trans women worldwide was 19.1%. Results from a systematic review showed that transgender people self reported higher rates of HIV infection (16.1%) than are found in studies using laboratory confirmed (9.2%) testing. Laboratory-confirmed HIV infection was significantly higher in transwomen (assigned male at birth, identify as female: 14.1%) than transmen (assigned female at birth, identify as male: 3.2%). Black transwomen had a significantly higher prevalence estimate (44.2%) compared with White (6.7%) and other race/ethnicity (9.8%) transwomen. Transwomen self-reported 21% HIV infection and transmen self-reported 1.2% (Becasen et al, 2018). According to the WHO (2011), "The few existing epidemiological studies among transgender people have shown disproportionately high HIV prevalence ranging from 8% to 68%, and HIV incidence from 3.4 to 7.8 per 100 person-years" (p. 10). Currently, the relative contribution of hormone injection versus injection drug use versus sexual risk behaviours to the incidence of HIV among transgender people is not known and further research is needed.

Evidence of injection-related risk behaviours associated with hormone injection

Evidence is limited from Canadian contexts regarding hormone injection and related risks among transgender people. Using survey data from the Trans PULSE Project, a large Ontario study of transgender people conducted from 2009 to 2010, Bauer et al. (2011) reported that 36.4% of trans men and 6.0% of trans women injected hormones, 0.8% of the sample injected drugs in the past year, and three participants ever injected silicone. Two reported re-use of another person's needle. Also using Trans PULSE data, Khobzi Rotondi et al. (2013) examined "do-it-yourself" (DIY) hormone use. Among the 402 of 433 participants who provided information pertaining to hormones, 43% reported hormone use. Among these, four reported DIY hormone injection and three reported obtaining needles or syringes from NSPs or from doctors' offices. Anecdotally, Canadian transgender people sometimes share vials containing hormones (e.g., vials of testosterone); once a contaminated needle is introduced into a shared vial, this presents a risk of blood-borne pathogen transmission (Young, personal communication, 2013).

Bockting et al. (1998; 1999) developed an HIV prevention education program for transgender people in Minneapolis and St. Paul, Minnesota. The first phase of this project involved gathering data from 19 transgender individuals who participated in focus groups. Sharing needles used to inject hormones was one of the risk factors discussed by participants. Both trans women and trans men may acquire hormones through street or underground sources and administer them without medical supervision. Bockting et al. (1998) noted that people acquiring hormones and silicone from underground sources sometimes do not consider themselves as people who use drugs and as such may not perceive needle-sharing behaviour as risky.

Garofalo et al. (2006) surveyed a convenience sample of 51 ethnic-minority trans women (aged 16 to 25) in Chicago. While 61% reported using "feminizing hormones" like estrogen – and 44% reported injection hormones – only 29% received hormones from a medical provider. Only 8% (n=4) of the sample reported shared needle use for injection of hormones or silicone. Injection of illicit drugs (e.g., heroin) was uncommon among this sample, though 29% reported lifetime use of injecting silicone.

Edwards et al. (2007) examined data from an annual risk assessment survey conducted in 2004 by the Los Angeles County Department of Health Services, Office of AIDS Programs and Policy. Out of 2,126 survey completers, 96 (4.5%) identified as male-to-female transgender and 11 (0.5%) as male-to-female transsexual. Factors associated with identifying as transgender included, among other factors: using a needle to inject steroids or hormones in the last six months, using a needle after someone else in the last six months, having ever been paid for sex, being marginally housed, and having ever received HIV testing or counselling. However, heroin use in the last six months was inversely related to identifying as transgender. When compared to non-trans-gender participants, those who identified as transgender were significantly more likely to have injected with a used needle compared to other clients; used hormones more often, but they were not more likely to inject illicit drugs than other clients. Among transgender participants, 52% reported that they were HIV-positive compared to 22% of the non-transgender participants. Edwards et al. (2007) noted that the study questionnaire allowed differentiation between hormone injections and other substances, and that research should continue to include this distinction.

Compared to trans women, much less is known about trans men and their risk behaviours (De Santis, 2009). Chen et al. (2011) studied data from 59 trans men in San Francisco to describe their HIV risk factors. Among this population, sexual risk behaviours may be of greater concern than non-sexual risk behaviours (e.g., 63% of this sample reported unprotected receptive vaginal or anal sex in the past year). Eight percent of the trans men reported injection drug use in the past 12 months and 5% shared needles during the same time period. The study did not report on hormone use.

Policies for distributing needles for hormone injection

NSP distribution of a variety of needles and syringes appropriate for hormone injection alongside other harm reduction equipment and materials on safer sex and safer drug use education will promote accessibility of programs for transgender people. In their study of DIY hormone use, Khobzi Rotondi et al. (2013) noted the need for NSPs and doctors "to be flexible in providing gauges of needles that are suitable for intramuscular injections" (p. 1835). As well, there is a pressing need for trans-positive or trans-inclusive HIV prevention educational materials and inclusive or friendly attitudes among medical professionals and other service providers (see Garofalo et al., 2006; Lyons et al., 2015; Namaste, 1999; Underwood, 2008). Cost and lack of needle availability can place transgender people at risk for HIV and other infections through sharing and reuse of needles for hormone injection (Namaste, 1999). We know from studies of NSPs that policies that limit the number of needles distributed also limit the effectiveness of strategies to prevent HIV and HCV transmission (please see again studies reviewed in Chapter 1: Needle and syringe distribution). Providing access to needles suitable for hormone injection without placing limits on the number distributed (i.e., so that clients always have a new sterile needle for each injection) may help prevent HIV and HCV transmission, and other injection-related harms, among transgender people who inject hormones. There is a lack of evidence on the types of needles that are best for injecting hormones, but community-based sources recommend that needles of different gauge sizes be used for drawing up hormones and for injecting hormones due to the viscous nature of most hormones. A wider gauge needle of 18 can be used for drawing up hormones, while gauge sizes of 22 to 23 can be used for intramuscular injection. Needle length is also a consideration; depending on body build some people may need, for example, needles that are 1 to 1.5 inches in length to reach muscle.

Studies report that transgender people experience high levels of social isolation and stigma, which can be accompanied by psychological distress, including struggling with gender identity (e.g., De Santis, 2009; Garofalo et al., 2006; Lyons et al., 2015; Underwood, 2008). Evidence suggests that multiple life stressors among transgender people may increase the risk of substance use, including injection drug use (De Santis, 2009). However, the prevalence of psychoactive drug injection, as noted above, appears low. Research has found that transgender people are also likely to engage in sexual risk behaviours, including engaging in sex work (Bauer et al., 2012; De Santis 2009). Some transgender people may reach out to harm reduction programs due to these needs and risk behaviours. Programs may better attract and serve the needs of diverse transgender clients by offering tailored educational materials on safer sex and safer drug use alongside needles appropriate for hormone injection.

Section III: Needle distribution for piercing and tattooing

As with other types of needles, those used for piercing and tattooing can be vectors of HIV, HCV, HBV, and other pathogens when they are reused or shared (e.g., Armstrong et al., 2007; D'Souza & Foster, 2003; Holbrook et al., 2012; Jafari et al., 2010). However, the CDC noted that there are no known cases of transmission of HIV from piercing and tattooing and the risk of transmission maybe more likely in unlicensed settings (https://www.cdc.gov/hiv/basics/hiv-transmission/ways-people-get-hiv.html). Older evidence shows that HIV, HCV, and HBV risks among people who receive piercings and tattoos in prison (e.g., Serup, 2017; Crofts et al., 1996; Dolan et al., 1999; Hellard & Aitken, 2004; Hunt & Saab, 2009; Kinner et al., 2012; Samuel et al., 2001; WHO, 2007). The exact magnitude of transmission risk among people who pierce and tattoo is unclear. Some harm reduction programs have developed kits specifically for piercing containing supplies such as needles, gloves, swabs, gauze, piercing aftercare solution, and containers for safer disposal.

Within the context of clients accessing community-based harm reduction programs, there is a lack of studies that focus on behaviours related to and programs that encourage safer piercing and tattooing. Programs may recommend universal precautions/routine practices (https://www.ccohs.ca/oshanswers/prevention/universa.html) and encourage clients to clean the injection site, never reuse injection equipment, and never share needles or injection equipment. Further, tattoo ink and ink pots should not be reused or shared as ink can also become contaminated with bacteria and other pathogens, including those that can lead to skin infections (Centers for Disease Control and Prevention, 2012; LeBlanc et al., 2012).

Needle distribution for anabolic steroid injection, hormone injection, piercing and/or tattooing evidence summary

The evidence that informs the three main sections in this chapter and the overall recommendations came from a limited number of studies. Cross-sectional studies and a mix of other study designs have contributed information about risk behaviours among people who inject anabolic steroids. Cross-sectional studies and a few qualitative studies have contributed information about risk behaviours among transgender people.

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Chapter 3: Cooker distribution

Recommended best practice policies to facilitate use of a sterile cooker for each injection:

DISTRIBUTION

- Distribute individually pre-packaged, sterile cookers with flat bottoms and heat-resistant handles
- Distribute based on the quantity requested by clients with no limits
- Offer a variety of cookers that meet the needs of clients
- Offer a needle, sterile water, filter and alcohol swab with each cooker provided

EDUCATION

- Educate about the correct single person use of cookers
- Educate about the risks associated with sharing and reuse of cookers
- Educate about the benefits and risks of heating all drug solutions before injecting

DISPOSAL

- Dispose of used cookers in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how cookers are used

Prior to injection, drugs in powder form (e.g., cocaine, white heroin), solid form (e.g., crack cocaine, black tar heroin), and tablet form (e.g., Dilaudid, OxyContin; Fentanyl) need to be mixed with water to make a solution that can be injected. A container is needed for this mixing process. These containers are often called ‘cookers’ as the solution may be heated to further dissolve the drug so that the solution is of the right consistency for injection. People who inject drugs will often use items such as spoons and bottle caps as cookers which are not sterile and can lead to infections. Pouring water into ascorbic acid packages instead of a cooker is not recommended, due to increase risk of infection (Government du Quebec, 2017). A person may use their needle/syringe to draw up water from a new, sterile water vial and then squirt it into the cooker for mixing with the drug of choice. It is common for drugs to be collectively purchased and then shared. Distribution of a ‘share’ is often accomplished when the drug is mixed into a solution and amounts can be measured out. There is a risk of disease transmission when cookers or any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens. To reduce the risk of transmission from contaminated cookers, clients need to use a new cooker each time. Also, to ensure that the cooker and its contents are not contaminated, all other pieces of equipment (i.e., needle, filter, water, etc.) must be unused and sterile.

Evidence of cookers as vectors of HIV, HCV, and HBV transmission

Laboratory studies have detected HIV and HCV on cookers. There is evidence of elevated risk of HIV and HCV transmission related to the sharing of cookers/other injection equipment and to the methods used to prepare drug solutions but Heimer et al., (2018) caution that drug preparation methods may be more implicated in transmission than equipment sharing. In a 1996 study, Shah et al. examined previously used injecting equipment from shooting galleries in Miami, Florida, for the presence of HIV-1. Antibodies to HIV-1 were detected in three (14%) of 21 rinses from cookers. Components of HIV-1 were detected in six (46%) and seven (54%) of the 13 cookers examined (Shah et al., 1996). Epidemiologic studies also document increased HIV risk through sharing previously used cookers. Significant differences in cooker-sharing behaviour related to HIV-positive status were observed among 355 people who inject drugs and who completed both a baseline and a two-week follow-up interview as participants in the evaluation of Baltimore’s needle and syringe program (NSP) between August 1994 and August 1995 (Vlahov et al., 1997). People who inject drugs who tested HIV-positive at their baseline interview were more likely to report sharing cookers (71%) than those testing HIV-negative at their baseline interview (56%; Vlahov et al., 1997).

Crofts et al. (2000) examined previously used injecting equipment from 10 Australian injecting settings for HCV RNA and detected it on 25% of the spoons tested. In addition to this virologic study, epidemiologic studies have also documented increased HCV risk through sharing and reusing cookers. In a cohort study of 353 HCV-negative people aged 18 to 30 years who inject drugs recruited from the greater Chicago area, Illinois, Thorpe et al. (2002) found the sharing of cookers to be a statistically significant predictor of HCV seroconversion. Sharing a cooker in the six months prior to the follow-up interview elevated the risk of HCV seroconversion among this group of younger people who inject drugs fourfold (adjusted relative hazard (ARH)=4.1; 95%CI: 1.4-11.8). After adjustment for syringe sharing, sharing cookers remained the strongest predictor of HCV seroconversion, elevating the risk of seroconversion threefold (ARH=3.5; 95%CI 1.3-9.9; Thorpe et al., 2002). Similarly, Hagan et al. (2001) measured HCV seroconversion among a cohort of 317 Seattle people who inject drugs and who tested negative for HCV antibody at recruitment into their study. Among the 123 people who inject drugs and who did not share syringes, sharing cookers and cotton (combined) elevated the risk of HCV seroconversion sixfold (adjusted relative risk (ARR)=5.9; 95%CI: 1.1-31.7; Hagan et al., 2001). A meta-analysis reported an association between HCV seroconversion and sharing drug preparation containers (PRR = 2.42, 95% CI 1.89, 3.10; Pouget et al., 2011).

The methods used to prepare drug solutions has been shown to influence the survival of HCV and HIV in solutions and on injection equipment. Doerrbecker et al. (2011) showed that HCV on a spoon, simulating the heating of a drug solution, can survive temperatures up to 65 degrees Celsius, and HCV could be eliminated between 65 and 70 degrees Celsius. Similarly, Ball et al. (2019) and Kasper et al. (2019) emphasized the importance of "cooking your wash". Ball et al. (2019) found that after two rounds of heating a drug solution containing hydromorphone in a cooker with cigarette lighter until it boils rendered any HIV present undetectable. This study also found that "cooking your wash" when using hydromorphone does not increase the amount or potency of hydromorphone and thus does not increase the risk of overdose. Kasper et al. (2019) showed that the amount of bacteria, specifically staphylococcus aeurus that causes many infections among PWID, can be significantly reduced by 'cooking' drug solutions of hydromorphone until bubbling. However, this study also showed that using a wash that was cooked 24 hours or more in the past was less effective than immediate "cooking" (Kasper et al. 2019). In addition, heating solutions may counter the HIV preserving effects of some excipients within controlled-release hydromorphone and reduce the likelihood of HIV transmission when cookers and other equipment is shared (Ball et al. 2019). Mateu-Gelabert et al. (2020) and Broz et al. (2018) note that preparing prescription opiates may require a greater number of steps, including heating, to dissolve pill formulations. This may involve heating the cooker, heating the pill, or heating both in a process referred to as 'browning' (Mateu-Gelabert et al. 2020; Broz et al. 2018). Mateu-Gelabert and colleagues caution that given the evidence of the benefits of heating a drug solution in a cooker to eliminate viruses and bacteria, heating pills is to be discouraged as an alternative to heating drug solutions (Mateu-Gelabert et al. 2020). All solutions that are heated must be cooled down and filtered prior to injection (Benedetti & Mary, 2018; Noel et al., 2015).

Heimer and colleagues (2018), caution that interventions need to focus on drug preparation methods. They found that it may not be the sharing of injection equipment such as cookers that leads to transmission but rather the common practice of sharing and dividing drugs (Heimer et al. 2018). Given that sharing drugs is common among PWIDs, it may be that sharing drugs between HCV-discordant injectors leads to an increased opportunity for transmission (e.g., using contaminated syringes to divide contents or add water – which would leave contents in cookers and filters). A review of research on the link between drug preparation equipment sharing and HCV reports that there are few studies that have been designed "to allow an adequate assessment of the individual contributions of containers, filters and water to HCV incidence" (De et al., 2008, p. 279). While studies included in this review showed positive associations between HCV seroconversion and equipment sharing, methodological flaws such as small sample sizes, confounders, short follow-up times, and how people who inject drugs were defined lead to questions about the veracity of findings (De et al., 2008). According to Corson et al. (2013), some studies do not specify the numbers of injection equipment sharing events leading to flaws in models assessing the link between drug preparation equipment sharing and HCV. In Corson et al.'s (2013) study, a mathematical model accounting for drug preparation equipment sharing events, HCV transmission associated with sharing cookers, filters or water was 13 times lower than HCV transmission associated with needle/syringe sharing (Corson et al. 2013). Given the discrepancy between Corson et al. (2013) findings and other study's findings, Corson et al. (2013) underline the possibility that PWID under-report the frequency at which they share syringes/needles – contributing to inaccurate numbers of sharing events included in mathematical models (Corson et al. 2013). In other words, it is difficult to measure the magnitude of the risk of HCV transmission from equipment sharing and this consideration should be kept in mind when examining the evidence regarding other pieces of injection-related equipment.

A case-control study on risk factors for HBV infection among people who inject methamphetamine in Wyoming found that sharing 'spoons' was not significantly associated with acute HBV infection (Vogt et al., 2006). However, there is little research on injection-related equipment sharing and risk of HBV.

Evidence of risk behaviours

Data from Canadian and international studies document that cooker sharing is common among people who inject drugs. In Ottawa, Leonard et al. (2005) examined cooker sharing among 418 men and 85 women who inject drugs participating in the POINT Project between October 2002 and January 2003. The majority of men (59%) and women (68%) had injected with previously used equipment at some point in their injection drug use history. The majority of men (82%) and women (76%) who had injected with previously used equipment in the six months prior to their baseline interview had shared another person's cooker or spoon (Leonard et al., 2005). A study conducted in Indiana showed that prior to a large HIV-outbreak, PWID reported sharing cookers and other injection equipment with up to 15 people (Broz et al. 2018). A cross-sectional study of 145 people who inject drugs in London, Ontario found that more participants gave cookers (45%) to someone else than used needles (36%) or other types of equipment (water 36%, filters 29%, and swabs 8%; Strike et al., 2010). Thirty-seven percent also reported that they had reused someone's cooker.

In a longitudinal study conducted in Denver, sharing a used cooker in the last 30 days decreased from 59.8% of PWID between 1996-2000 to 49.8% of PWID between 2006-2011 (Davis et al. 2017). This overall decrease was also observed in a study conducted in San Francisco where the percentage of PWID reporting ever having shared a cooker decreased from 46.5% to 37.9% and the percentage sharing a cooker with 2-5 people in the past 12 months decreased from 27.2% to 19.3% between 2005-2012 (Kim et al. 2015). A study conducted in San Diego among PWID reported 55.8% of participants had ever shared a cooker in the last 3 months, 26.1% reported sharing a cooker less than fifty percent of the time and 29.7% reported sharing a cooker more than fifty percent of the time (Asher et al., 2019). In another study conducted in Indiana in the US, 64% of people who inject drugs reported receptive cooker sharing. In this group, 81% of people living with HIV reported receptive cooker sharing in comparison with 54% of people who were HIV-negative (Dasgupta et al. 2019). Interestingly, in a study focused on injection equipment sharing during one's first injection, 17% of those who recalled using a cooker reported using a cooker that had been used by someone else (Guichard et al. 2015). One of the highest rates of sharing cookers, in the literature summarized here, was found in Morris et al.'s (2014) study of intimate injection partnerships and sharing behaviors. In this study, 67% of participants reported sharing a cooker with an injection partner (Morris et al. 2014). In a later study by Morris et al. (2018), focusing on women who inject drugs and who report having a main or primary male sex partner who they inject with, 56% of women reported sharing cookers with their partner. It was significantly more common to report cooker sharing than needle or syringe sharing (Morris et al. 2018). In a study conducted across Germany, Wenz et al. (2016) found that 33% of PWID in Hamburg and Hannover reported sharing cookers, filters or water in the last 30 days, and a higher percentage (43.8%) of PWID in Frankfurt reported sharing cookers, filters or water in the last 30 days. Upon closer examination of the data, the authors noted that Frankfurt has a larger population of people who use crack, requiring more frequent injection, which may contribute to a higher likelihood of equipment sharing (Wenz et al. 2016).

In a study examining the multiperson use of injection drug equipment among 794 street-recruited people who inject drugs in Chicago, Huo et al. (2005) found that 65% of participants shared cookers with others at the time of their baseline interview. At follow-up, participation in an NSP was associated with the reduction of needle sharing but not associated with the reduction of sharing cookers. This suggests that despite awareness efforts, the risks of indirect sharing among people who inject drugs remains underrecognized or difficult to avoid (Huo et al., 2005). It has been noted elsewhere that cooker sharing is more common than syringe sharing (Latkin et al., 2010).

Several studies have found that people share cookers more frequently than other items of drug preparation equipment (Beardsley et al., 1999; Gossop et al., 1997; Koester et al., 1990, 1996; Scottish Drugs Forum and Glasgow Involvement Group, 2004; Thorpe et al., 2002; Strike et al., 2012, Smith et al., 2015 and Davis et al., 2017). Clatts et al. (1999) reported from their direct observations of injecting episodes that people who inject drugs tend to retain and reuse cookers longer than either filters or rinse water. Seventy-eight percent of cookers examined showed evidence of previous use, and 90% of the cookers were retained for future use (Clatts et al., 1999). People who use their own sterile needles for injection may share cookers during drug preparation. For example, Hunter et al. (1995) studied the injection-related risk behaviours of 2,062 people who inject drugs in Greater London, United Kingdom, from 1990 to 1993. In 1992 and 1993, over 50% of the respondents reported sharing cookers and/or filters in the six months prior to the interview. More than 33% of those who reported that they had not shared needles during the previous six months had shared cookers and filters during that time period (Hunter et al., 1995). In a study of 321 people who inject drugs in Montreal (86% of whom were recruited from NSPs), many considered containers (i.e., cookers; 85%), filters (82%), and water (82%) as potentially high-risk modes of infection transmission (Cox et al., 2008). Maisa et al. (2019) reported 58% of PWID reported sharing cookers compared to 53% who reported sharing filters, 47% sharing water, 39% sharing foil, and 29% sharing syringes. However, other studies report that sharing syringes is more common than sharing cookers (Handanagic et al., 2016; Heimer et al., 2014).

In one study among people who primarily use prescription opioids, 31% were not aware that HIV could be transmitted from one person to another when sharing equipment such as cookers (Dunn et al. 2013). Another study conducted to develop and test PWID knowledge of injection risk-behaviors associated with Hepatitis C infection found that 74.6% of PWID understood that sharing cookers can increase one's risk of acquiring hepatitis C but only 13.8% understood that cleaning a syringe with water does not eliminate Hepatitis C. The effectiveness of brief educational sessions by Dunn et al. (2013) showed that after a 1- hour information session, 94% of participants correctly identified that HIV could be transmitted through the sharing of cookers and other injection related supplies comparison to 69% pre-intervention.

Evidence suggests that psychosocial group interventions may reduce high-risk injection practices such as sharing injection equipment and/or re-using equipment. In a study examining the effectiveness of a three-session psychosocial group intervention with 36 women who reported sharing or re-using injection equipment, the proportion of women who had used a previously used spoon or container or had used equipment (filter, spoon, cooker, water) with someone they knew to be HCV positive, was significantly lower after participating in the intervention (Gilchrist et al. 2017).

Correlates of risk behaviours

Studies show that the re-use of cookers is linked with correlates such as age, gender, race, time since initation of injection drug use, HCV infection status, mental health, homelessness, methadone treatment status, migration status, injection drug use networks, peer norms and access to NSPs. Aspinall et al. (2012) reported that in their survey of 2,037 people who inject drugs, a multivariate model showed that spoon sharing was significantly associated with age greater than 30 years, homelessness in the last 6 months, having not injected in the last 4 weeks, exclusive heroin injecting, and injecting more than once a day.

Data from 275 people who inject drugs in Montreal indicates that use of sterile containers is low compared to use of sterile syringes and water; however, this was predominantly a cocaine-injecting group and they may use other types of containers (Morissette et al., 2007). In this study, factors associated with sterile container use were having at least high school education, injecting heroin, injecting alone, older age, and being HCV-negative.

In contrast, Broz et al. (2014) found that being between the ages of 18-29 years old was associated with sharing injection equipment. This study also found that being arrested in the past year and frequent heroin or cocaine injection (separately or as a speedball) was associated with sharing syringes, cookers, filters and water. On the other hand, being Black was associated with reporting fewer instances of sharing syringes, cookers, filters and water (Broz et al. 2014). Guichard et al. (2015) examined injection behaviors and initiation to injection drug use and found that being female, injecting for the first time before the age of 18, injecting for the first time at a party, not having planned to inject, being injected by another person, and being injected with drugs given by another person were factors associated with sharing cookers and other injection equipment during one's first injection. A similar positive association between having another person prepare one's drugs and injection and sharing cookers and other equipment was found in a study conducted with 30 women who inject drugs (Wagner et al., 2013).

Davis et al.'s (2017) examined factors associated with mortality among PWID. They found that sharing cookers was a risk factor for mortality in multiple cohorts (Davis et al. 2017). A study focused on the association between HIV, HCV and equipment sharing, points to an association between positive HIV or HCV test results and reporting sharing injection equipment (Broz et al. 2014). These findings from Broz et al. (2014) are contrasted in Strike et al.'s (2012) study with 144 PWID, that found that being HCV positive was associated with a decrease in risk behaviors, including sharing cookers (Strike et al. 2012).

People with a history of mental health problems who inject drugs appear to be more likely to inject using previously used cookers. Morse et al. (2001) found that among a cohort of 2,198 people who inject drugs aged 18 to 30 from five U.S. cities, people with a history of mental health hospitalization (OR=1.5; 95%CI: 1.2-1.8) or with suicidal ideation (OR=1. 6; 95%CI: 1.3-1.9) were more likely to report sharing cookers. Reyes et al. (2007) found that in a sample of 557 people who inject drugs in Puerto Rico, those with severe anxiety symptoms were almost four times more likely to share filters/cookers compared to those with minimal anxiety symptoms. Heimer et al. (2014) found a significant association between high levels of depression and risky injection practices, including sharing cookers as well as associations between younger age, injecting outside of one's home, low social support and larger injection networks and risky injection practices. Strike et al. (2010) found that factors associated with distributing used cookers included a score on the Addiction Severity Index (ASI) indicative of a mental health problem. A study, conducted in Montreal found no association between psychological distress and sharing ancillary equipment but found a significant association between psychological distress and the risk of sharing needles (Levesque et al. 2013).

A study focused on intimate injection relationships and risky injection behaviors found recent sexual relations with an injection partner, living with an injection partner, recently injecting a partner's drug residue and recently backloading drugs into their syringe were associated with receptive cooker sharing (Morris et al. 2014). A later study by Morris, found that higher levels of trust, intimacy and cooperation in a partnership was positively associated with sharing injection equipment, including cookers whereas power and risk dynamics in a partnership were negatively associated with injection equipment sharing (Morris et al., 2017). In Broz et al.'s (2014) study, participants who reported unprotected vaginal sex or anal sex or multiple opposite-sex partners in the past years were more likely to report receptive cooker sharing in addition to receptive syringe, filter and water sharing (Broz et al. 2014).

Another factor that has been associated with sharing cookers is migrant status. Gelpi-Acosta et al (2016) examined differences in injection equipment sharing between US-born PWUDs, US-born Puerto Ricans, long-term, medium-term and recent Puerto Rican immigrants and found that medium-term and recent immigrants had higher rates of cooker and other injection equipment sharing.

Woody et al. (2014) explored the relationship between HIV-risk reduction and opioid antagonist treatment, namely buprenorphine-naloxone and methadone. Findings suggest that there was a significant decrease in sharing cookers among PWID assigned to buprenorphine-naloxone (17.1% at baseline, 2.5% at 12-week follow-up, 3% at 24-week follow-up) and among PWID assigned to methadone (18.9% at baseline, 4.8% at 12-week follow-up, 4.5% at 24-week follow-up; Woody et al. 2014).

Evidence also suggests that one's ability to plan for withdrawal and next injection may reduce the likelihood of sharing cookers and other injection equipment (Scheidell et al. 2015; Sirikantraporn et al. 2012). However, Scheidell et al. (2015) suggest that the association may exist exclusively among men, as sharing injection equipment was found to be high among women, despite planning abilities.

Risk perception and peer norms among people who inject drugs have been associated with sharing cookers. Latkin et al. (2010) found that people who inject drugs in 'cooker-sharing networks' perceived sexual and injection-related risks differently than people in multiple needle-sharing networks. Some groups of people would share cookers, but not share or endorse sharing needles. A later study by Latkin et al. (2013) examining the relationship between social norms and injection behavior found a significant association between having friends who share cookers and filters at baseline and reporting sharing cookers and filters six months later. PWID who shared cookers were more likely to believe that it was the norm in their social circle (Latkin et al., 2013).

Dasgupta et al. (2019) found that receptive sharing of cookers decreased from 65% to 45% after the implementation of an NSP, and distributive sharing of cookers, filters, and water decreased from 74% to 42% after the implementation of an NSP (Dasgupta et al. 2019). The reduction in sharing injection equipment behavior was found to be more significant among people living with HIV (Dasgupta et al. 2019). Patel et al. (2018) findings also demonstrate an association between NSP attendance and a reduction in risky injection behaviors, including sharing cookers and inserting a used needle into a cooker that was being shared. Patel et al., (2018) reported that those who continued to engage in risky injection behaviors despite visiting an NSP cited the following as reason for continuing to share: not re-supplying at NSPs and missing a mobile NSP visit. Fatseas et al. (2012) found that cooker, filter, water and needle/syringe sharing significantly decreased after the implementation of a harm reduction policy in France in which there was increased access to injection equipment. However, the decrease in sharing was pronounced for cookers in contrast to other injection equipment (Fatseas et al., 2012). Broz et al. (2018) reported that following the implementation of an NSP, the reduction in cooker and other ancillary equipment sharing and reuse was less significant than the reduction of syringe sharing and reuse.

People who engage in secondary syringe exchange (SSE) may be more likely to share cookers. In a study of SSE practices and risk behaviours among people who attended 23 NSPs in California, it was found that SSE participants were more likely than non-participants to share cookers and needles in the previous six months (Lorvick et al., 2006). The authors suggest that NSPs should inform SSE participants about the importance of not sharing injection equipment.

Other health-related harms

Abscesses are a common health risk associated with injection drug use. Asher et al. (2019) sought to uncover if there was a relationship between a history of abscesses and sharing injection equipment. They found that there was indeed a significant association between a history of abscesses and sharing cookers, filters and rinse water in the previous 3 months (Asher et al.2019).

Cooker distribution policies

The Ontario Harm Reduction Distribution Program has suggested provision of 1000 cookers per person per year to match the coverage suggestion regarding needles (www.ohrdp.ca).

Cooker distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were less common. Cross-sectional studies were the main type of study to contribute evidence on risk behaviours such as sharing injection equipment. Prospective cohort studies were also fairly common. Laboratory studies – particularly virologic testing of cookers, filters, water, tourniquets, and/or swabs collected from community and clinical settings – have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Review papers, including a few systematic reviews, have explored a variety of related topics and some clinical case reports/studies have provided information on infections among people who inject drugs. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs. Although the evidence base has grown in recent years, there are notable gaps in the research on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other bloodborne pathogen transmission from sharing each item of injecting equipment are needed. There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 4: Filter distribution

Recommended best practice policies to facilitate use of a sterile filter for each injection:

DISTRIBUTION

- Distribute pre-packaged, sterile filters that filter out most impurities from the drug solution
- Distribute based on the quantity requested by clients with no limits
- Offer a sterile filter with each needle, cooker, sterile water, and alcohol swab provided

EDUCATION

- Educate about the correct single person use of filters
- Educate clients about the risks of:
  - not using filters
  - using makeshift filters
  - re-using and sharing filters
  - making 'washes' from filters

DISPOSAL

- Dispose of used filters in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how filters are used

Prior to injection, drugs in powder, solid, or tablet form are mixed with water to make a solution that can be injected. Once a drug solution is mixed, a needle is placed in the mixing container and the solution is then drawn up into the syringe. Filters are used on the tips of the needles to prevent any undissolved particles of the drug, other debris (e.g., cornstarch and wax from crushed pharmaceutical tablets), and/or bacteria from being drawn into the syringe, potentially injected into a vein and causing negative health effects. While heating of drug solution does kill many bacteria and viruses, filtering solutions remains important because some larger particles, bacteria and fungi may remain after heating (Alhusein et al., 2016) and not all drug solutions are heated prior to injection. Household items made of cotton or cotton wool are often used as filters. Cigarette filters are also commonly used for this purpose but may contain glass fibres and are to be avoided for such purposes (Benedittti and Mary, 2018). In addition, there are anecdotal reports of the use of tampon fibres, cigarette rolling paper and/or cotton swabs as filters. Although these filters may prevent large particles from getting into the syringe, these items are not sterile, may not be clean, and will not prevent the entry of smaller particles and small organisms such as bacteria. There is a risk of disease transmission when filters or any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens. To reduce the risk of transmission from contaminated filters, clients need to use a sterile filter each time.

There are significant differences between filters pertaining to the effectiveness of removing particles, bacteria and fungi; time of filtration, and recovery of substance (Jauffret Routside et al., 2018). Benedetti & Mary (2018) recommend double filtration of solutions made with prescription drug tablets. Some PWID do not filter their drugs as they are concerned that doing so will filter out some or all of the 'active' ingredients thereby lessening the effect, perceived lack of time to do so and/or lack of knowledge of the health effects of injecting unfiltered substances (Benedetti & Mary, 2018). Ministère des Solidarités et de la Santé (2020) recommends that PWID begin with a 0.22-micron filter prior to moving up to larger sizes.

An evaluation of the EXPER kits among 52 PWUD in France determined that the use of wheel filters had specific advantages, namely that they aid in rapid filtration, are efficient and easy to use and reduced filter-related health complications (Milhet, 2016). Despite these advantages, participants also noted that wheel filters cannot recuperate drug remnants and often become blocked or full quickly (Milhet, 2016).

Comparison of various filters

Type of filter	Characteristics
Cigarette filters	• Block particles larger than 50 μm • Less efficient at recovering drugs as liquid cannot be pushed through with air • Not sterile and may not be clean • When manipulated with the hands or even with the mouth, it can become contaminated with bacteria or funghi • Do not filter out viruses
Polypropylene membrane filters (10 μm)	• Filters out the majority of large particles • Less likely to become blocked by large particles unlike wheel filters • Retains considerably less active drug than other filters • Sterile in package • Do not filter out viruses
Wheel filters (0.45 μm or 0.22 μm)	• The most effective filter at removing smaller particles • Can become blocked by large particles • Sterile in package • Do not filter out viruses
Dual membrane filters (either 5.0/0.22 μm or 0.8/0.2 μm)	• Remove 99% of 10 μm particles • Do not cause a significant loss of product • Require less filtration time compared to other filters • More expensive than other filters and less accessible • Sterile in package • Do not filter out viruses

Evidence of filters as vectors of HIV, HCV, and HBV transmission

When a filter is shared among people who inject drugs, the syringe of the second person – even if it is a sterile syringe – may become contaminated with blood or other biological material left in the filter (Ball et al., 2019 (2)). Even filters with a small pore width available do not filter out viruses (McLean et al., 2009). HIV may be transmitted between people who inject drugs by the shared use of filters. In a 1996 study, Shah et al. examined used injection equipment from shooting galleries in Miami, Florida, for the presence of HIV-1. Antibodies to HIV-1 were detected in three (18%) of 17 rinses made from filters (cottons). Components of HIV-1 were detected in three (27%) and four (36%) of the 11 filters examined respectively (Shah et al., 1996). Epidemiologic studies also document increased HIV risk through injecting with previously used filters. Among 355 people who inject drugs who completed both a baseline and a two-week follow-up interview for the evaluation of Baltimore's Needle Exchange Program (August 1994 to August 1995), significant differences in cotton-sharing behaviour related to HIV-positive status were observed (Vlahov et al., 1997). People who inject drugs who tested HIV-positive at their baseline interview were more likely to report sharing cotton (52%) than those who tested HIV-negative at their baseline interview (43%; Vlahov et al., 1997). It is also possible that HCV may be transmitted between people who inject drugs via the shared use of filters. One study examined used injection equipment from 10 Australian injection settings for the presence of HCV RNA. HCV RNA was detected on 40% (2/5) of the filters tested (Crofts et al., 2000). However, in another study from France, HCV RNA was not detected on 10 used filters collected from multiple sites (Thibault et al., 2011).

Epidemiologic studies have documented increased HCV risk through the sharing of filters. Lucidarme et al. (2004), in a study conducted between March 1999 and July 2000, examined the factors associated with HCV seroconversion among 165 HCV-negative people who inject drugs attending care centres in Northern and Eastern France. In this study, injection with a used cotton filter was a significant independent predictor of HCV seroconversion. Injection with a used cotton filter increased the risk of acquiring HCV infection more than 16-fold (adjusted relative risk (ARR)=16.4; 95%CI: 1.4- 190.6; Lucidarme et al., 2004). Sharing cotton filters was also a significant independent predictor of HCV seroconversion in a study among 353 HCV-negative people, aged 18 to 30 years, who inject drugs that were recruited from the greater Chicago area, Illinois from 1997 to 1999 (Thorpe et al., 2002). Sharing a cotton filter in the six months prior to the follow-up interview doubled the risk of HCV seroconversion among this group of young adults who inject drugs (adjusted relative hazard (ARH)=2.4; 95%CI: 1.1-5.0; Thorpe et al., 2002). Similarly, Hagan et al. (2001) measured HCV seroconversion among a cohort of 317 people who inject drugs in Seattle, Washington who tested negative for the HCV antibody at recruitment into their study. Among the 123 people who inject drugs who did not share syringes, sharing cookers and cotton elevated the risk of HCV seroconversion six-fold (ARR=5.9; 95%CI: 1.1-31.7; Hagan et al., 2001). In a study of people who inject drugs in New South Wales, Australia, independent predictors of HCV seroconversion included, among other factors, shared use of filters (Maher et al., 2006).

A review of research on the link between drug preparation equipment sharing and HCV reports that there are few studies that have been designed "to allow an adequate assessment of the individual contributions of containers, filters and water to HCV incidence" (De et al., 2008, p. 279). This review found that risk estimates from studies indicate a positive association between HCV seroconversion and equipment sharing. However, these findings should be treated with caution because the studies had small sample sizes, confounding variables and short follow-up times (De et al., 2008). In other words, it is difficult to measure the magnitude of the risk of HCV transmission from equipment sharing and this consideration should be kept in mind when examining the evidence regarding other pieces of injection-related equipment. A meta-analysis conducted as part of the HCV Synthesis Project reported an association between HCV seroconversion and shared use of filters (PRR = 2.61, 95% CI 1.91, 3.56; Pouget et al., 2011). Doerrbecker et al. (2013) performed an experimental analysis to examine HCV transmission risk and the practice of storing filters in foil wrap. They reported that up to 10% of initial viral infectivity was associated with filters and this association increased if contaminated filters were wrapped in foil. A study on risk factors for HBV infection among people who inject methamphetamine in Wyoming found that sharing cotton filters was statistically associated with HBV infection (89% of case-patients versus 52% of controls; Vogt et al., 2006). After use, filters can retain a residue of the drug solution. Making a 'wash' involves add water to one or more used filters to obtain any remaining drug solution in the filter(s). Saving and re-using filters is not recommended because they may be contaminated with particles and bacteria (especially if stored in a damp place) leading to infection.

Hot and cold extraction methods and filters

When dissolving tablet drugs for injection, there are PWUD who use a hot extraction method and others who use a cold extraction method. A hot extraction method implies that hot water is mixed to dissolve the drug, whereas a cold extraction method relies on cold water to dissolve the tablet. Patel et al. (2012) as well as White et al. (2015) found that among PWUD, 60% reported using a hot extraction method and 40% reported using a cold extraction method (Patel et al., 2012; White et al., 2015). In conjunction with using a filter, hot and cold extraction methods may have a significant impact on the entry of large particles into the body during injection drug use. The findings of Patel et al. (2012) suggest that hot extraction methods may reduce the number of particles before injection by roughly half in comparison to the cold extraction method. This could be the result of the ability of elevated temperatures to combine large particles into even larger particles, preventing them from being taken up during injection and causing potential health consequences (Patel et al., 2012). Moreover, hot extraction methods were shown to be key for pushing solution through 0.45 μm filters which may have been difficult to filter through otherwise (McLean et al., 2012). On the other hand, there is evidence that in some cases hot extraction methods dissolve larger particles in the waxy layer of tablets and re-form when injected into the body (McLean et al., 2009 in Patel et al., 2012; McLean et al., 2017). The heat may also affect the solubility of certain formulations and cause adverse reactions over a sustained time period(Yeo et al., 2006 and Scott et al., 1992 from Patel et al., 2012)(Patel et al., 2012)(McLean et al., 2017). Given these potential issues associated with preparing injection solutions with hot water, Lafferty et al. (2017) recommend PWUD use cold water and wheel filters to reduce the particulate matter and the associated health consequences (Lafferty et al., 2017). Among PWUD in this study, 48% report using a hot extraction method with cotton or other filters and only 12% report using a cold extraction method with a wheel filter (Lafferty et al., 2017). Of those who are reluctant to adopt a cold extraction method, there are expressed concerns about cold extraction reducing the effect of the injected drug. However, among PWUD who report using the cold extraction method – there is a perception that the cold extraction method, in fact, increases the effect of the drug (Lafferty et al., 2017).

Evidence of risk behaviours

Data from international studies document the high frequency of reuse or sharing of filters; studies also document the frequency of injecting washes obtained from previously used filters. There is evidence of filter sharing among people who inject drugs in Canada. In a study examining risk behaviors such as sharing injection equipment and injecting residue, 14.5% of a group of PWUD reported sharing a cotton or filter in the past 6 months and 7.2% had injected residue (Roy et al., 2012). Among PWUD experiencing homelessness, 53% reported sharing filters (Maisa et al., 2019). Similarly, among a group of youth who inject prescription opioids, 40.8% reported sharing filters (Zibbell et al., 2014). Leonard et al. (2005) examined filter or cotton sharing among 418 men and 85 women who inject drugs who participated in the POINT Project in Ottawa between October

2002 and January 2003. The majority of men (59%) and women (68%) had injected with previously used equipment at some point in their injection drug use history. Among this group, the majority of men (68%) and women (72%) who had injected with previously used equipment in the six months prior to their baseline interview had shared another person's filter or cotton (Leonard et al., 2005).

A cross-sectional study of 145 people who inject drugs in London, Ontario found that 29% distributed used filters in the past six months (Strike et al., 2010). Reuse of filters was also reported by 18% of the study's participants (Strike et al., 2010). More recent data from Ontario, collected between 2010 and 2012 as part of the I-Track Study, found that 13.3% of the 953 people who participated and who inject drugs had borrowed filters (average of data from Toronto, Kingston, Sudbury, Thunder Bay, and London, Ontario; unpublished data). Among a group of PWUD recruited from three urban areas in England, Hope et al. (2015) found that 35% had re-used a filter and 32% had saved a filter with the intention of re-using it in the following month (Hope et al., 2015). In a study conducted with American Indians residing on an Indian Reservation in Montana, 53% of PWUD reported using a filter that had been used by someone else (Anastario et al., 2017). Engaging in these high-risk injection practices did not appear to be associated with a lack of knowledge about the risks as 85% of PWUD correctly linked HCV transmission to sharing injection equipment, including filters (Anastario et al., 2017). In an ethnographic study that examined drug acquisition and the sharing of injection equipment in 54 "networks" of people who inject drugs selected from six American cities and Puerto Rico, cotton filters were shared 77% of the time (Needle et al., 1998). Moreover, when drugs were purchased by a higher-risk group (defined in the study as having at least one group member who engaged in behaviours such as reusing a previously used syringe), cotton filters were always shared (Needle et al., 1998). Similarly, Hunter et al. (1995) studied the injection-related risk behaviours of 2062 people who inject drugs in Greater London, United Kingdom. In 1992 and 1993, over 50% of people reported sharing filters and/or spoons in the six months prior to the interview. More than 33% of those who reported that they had not shared needles during the previous six months had shared filters and spoons during that time (Hunter et al., 1995).

Filters, particularly cigarette filters, can absorb some of the drug solution. People who inject drugs sometimes give these drug solution-soaked filters to others who may have collected several such filters from different sources. These filters are mixed with water and the resultant "wash" is injected. Some studies report PWUD performing as many as seven washes from one preparation of hydromorphone (Roy et al., 2011; Roy et al., 2016). Roy et al. (2016) examined the prevalence of injecting drug residue from a filter or a container among PWUD and found 41.8% reported injecting residue. One study revealed, that to some PWUD, washes may not be understood as risky sharing practices (Roy et al., 2012). Research demonstrates that different substances, mainly prescription opioids, may result in higher retention in injection equipment and subsequently more performed washes (Ball, Venner, Tirona et al., 2019; Ball, Klajdi, Speechley et al., 2019; Mateu Gelabert et al., 2015; Roy et al., 2012). Ball, Venner and Tirona et al. (2019) found that 45% of hydromorphone-controlled release (HMC) tablets are left behind in injection equipment after the first use whereas only 16% remains when hydromorphone immediate release tablets are used – pointing to a higher potential for conducting multiple washes with HMC saturated injection equipment. This practice was observed by Bourgois and Pearson (1998) in an observational study of HIV injection-related risk behaviours among a network of 46 people who use heroin in San Francisco. In this group, people considered to be 'lower' in the network hierarchy would ask for "cotton shots" referring to the use of a cotton remnant from a previous injection episode (potentially containing blood and residual heroin) to prepare a solution for injection (Bourgois & Pearson, 1998). Power et al. (1994) observed that it was common practice for people who inject drugs to leave used filters as payment in kind for being permitted to inject in another person's home. Thus, there are different ways that people may obtain used filters. The HIV and HCV status of people who previously used the filters may be unknown, presenting potential for transmission.

Correlates of risk behaviours

Dasgupta et al. (2019) and Iversen et al. (2017) found that people injecting prescription opioids are more likely to engage in sharing injection equipment and as a result are at higher risk of HCV because more residue is left in filters (Dasgupta et al., 2019). People with a history of mental health problems who inject drugs appear to be more likely to inject using previously used cotton filters. Roy et al. (2016) findings reveal a significant association between injecting drug residue from filters or containers and psychological distress. They reported that the odds of residue injection increased 7% per unit on a psychological distress score (Roy et al., 2016). Morse et al. (2001) found that among a cohort of 2,198 people who inject drugs aged 18 to 30 from five U.S. cities, those with a history of mental health hospitalization (OR=1.38; 95%CI:1.12-1.68) or with suicidal ideation (OR=1.62; 95%CI:1.36-1.94) were more likely to report sharing cotton. A study of 557 people who inject drugs in Puerto Rico, found that, compared to those with minimal anxiety symptoms, people with severe anxiety symptoms were almost four times more likely to share filters/cookers (Reyes et al., 2007). This correlation could be explained by the distress that PWUD feel during withdrawal, which can lead to 'last resort' residue injections, or alternatively this association could demonstrate the psychological distress resulting from insufficient doses of drugs obtained by doing washes (Roy et al., 2016).

In a study observing potential differences in risk behaviors between HIV-positive and HIV-negative PWUD, Dasgupta et al. (2019) found that people living with HIV (PLHIV) were more likely to report distributive sharing of cookers, filters and water for injection compared to people who were HIV-negative (88% vs. 64%; Dasgupta et al., 2019). In this study that explored risk behaviors before and after the implementation of a syringe service program, PWUD reported reducing sharing injection equipment, and with a more pronounced reduction in risk behaviors among PLHIV (Dasgupta et al., 2019). HCV positivity was also associated with sharing drug equipment (Zibbell et al., 2014; Pouget et al., 2012). Strike et al. (2010) found that factors associated with distributing used filters included having injected cocaine/crack or having stayed on the street or in some other public place overnight. In multivariate analysis in a cross-sectional study of people who inject drugs in Scotland, Aspinall et al. (2012) found that filter sharing was significantly associated with being female, older than 30 years, homelessness in the last 6 months, having not injected in the last 4 weeks, exclusive heroin injecting, and injecting more than once a day. Contrary to Aspinall et al. (2012) findings, another study found that being younger than 25 years was associated with risky injection practices including injecting drug residues from filters and containers (Roy et al., 2016). Roy et al. (2016) found injecting drug residue from filter or containers was significantly associated with illegal or marginal income sources, experiencing a recent overdose and pre-dominantly using opiates (Roy et al., 2016). Examining risk behaviors at first injection, Guichard et al. (2015) study's findings corroborate Aspinall et al., (2012) as being a female was associated with sharing injection equipment. This study also found that sharing injection equipment (including filters) at injection initiation was associated with the following: injecting for the first time, being younger than 18, during a party, occurring spontaneously (not previously planned), with the injection being done by someone else and with the substance being provided by someone else (Guichard et al., 2015). Hope et al., 2015 found a significant association between re-using or saving filters and PWUD injecting into their groin (Hope et al., 2015). Specific to the context of Germany, Derks et al. (2018) findings suggest that former Soviet Union migrants were more likely to report sharing filters in comparison to their native German counterparts (Derks et al., 2018).

Fischer et al. (2013) found that secondary distributors were more likely to tell other about where they can procure filters or alcohol swabs in comparison to PWUD who do not identify as secondary distributors (41.2% vs. 25.9%). This finding highlights an important network and an opportunity to increase access to sterile filters (Fischer et al., 2013). Given the limited availability of wheel filters and dual membrane filters at NSPs and other harm reduction services as well as the higher cost associated with these filters, PWUD may face barriers in using filters with the recommended pore width (Geddes et al., 2018; Alhusein et al., 2016). A study of 275 people who inject drugs in Montreal found that sterile filters were reportedly used for at least half of all injecting episodes by 23% of participants (Morissette et al., 2007). In this study, factors associated with sterile filter use were having at least high school education, injecting heroin, and injecting alone. Another study, undertaken in France, used qualitative (241 questionnaires from people who inject drugs and focus groups with a total of 23 people who inject drugs) and quantitative analyses to examine filter preferences (Keijzer & Imbert, 2011). They found that 72% of participants reported using a Sterifilt filter "always" or "frequently" with at least one of the substances they injected in the last month. The filter was used more often by people who inject at least 2 to 7 days a week. Most people who inject buprenorphine (64%) reported using the filter. Keijzer and Imbert (2011) found that reasons for not using the Sterifilt included filter membrane clogging, filtration preparation time, beliefs that cocaine and heroin filtration were not as important as buprenorphine filtration, and the availability of the filters (which were not accessible from vending machines or pharmacies). The main reasons for using the Sterifilt were quality of the filter and beliefs that using it would help prevent health-related harms (Keijzer & Imbert, 2011). There are programs in South Australia that offer a range of filters, where 0.22 μm filters are considered bacterial filters and 5.0 μm filters are intended to get rid of chalk from certain tablet preparations (Anex Bulletin, 2011).

Other health-related harms

'Cotton fever'

People who inject drugs are prone to a condition called 'cotton fever'. The exact cause of cotton fever is not known, however, the condition has been documented in association with injection drug use and the use of cotton filters (Harrison & Walls, 1990; Kaushik et al., 2011; Jauffret Routside et al., 2018; Mezaache et al., 2020). Bacteria such as Staphyloccus aureus and Candida albicans have been associated with cotton fever (Jauffret Routside et al., 2018). A prominent theory suggests that the cotton plant contains bacteria which release endotoxins. These endotoxins are water-soluble and their toxicity is increased with heating – leading to the cascade of symptoms associated with cotton fever and injection drug use (Zerr et al., 2016; Torka & Gill, 2013). Cotton has been known to provoke an inflammatory and pyrogenic (inducing fever) response, creating symptoms such as headache, chills and rigors, dyspnea, palpitations, nausea, emesis, abdominal pain, vomiting, muscle pain and other fever symptoms that can even mimic sepsis (Mezaache et al., 2020; Zerr et al., 2016; Harrison & Walls, 1990). This number and range of symptoms as well as diagnosis of exclusion (a diagnosis made by excluding all other known diseases) associated with cotton fever can cause the condition to be difficult to diagnose (Mezaache et al., 2020; Xie et al., 2016).

Cotton fever typically occurs immediately or soon after injection and, in some cases, can last for as long as twelve hours (Mezaache et al., 2020; Zerr et al., 2016). In a recent study conducted by Mezaache et al. (2020), 54% of a group of PWUD reported experiencing cotton fever at least once (Mezaache et al., 2020). Cotton fever was experienced by two thirds of PWUD who reported not using a filter or using a cotton filter and 50% of PWUD who reported using membrane filters (Mezaache et al., 2020). In addition to these differences between cotton and membrane filters, injecting crack cocaine was associated with a higher risk of acquiring cotton fever. As the study indicates, this could be due to the requirement to use an acid agent when preparing crack cocaine and the common practice of using lemon juice – which may increase bacterial and fungi contamination leading to cotton fever (Mezaache et al., 2020). Shragg (1978) studied two heroin users with febrile symptoms after they had boiled a previously used cotton filter to retrieve and inject residual drugs. No cause of fever could be determined other than that perhaps by the filter itself (Shragg, 1978).

Ferguson and colleagues reported a case of cotton fever in a person who injects drugs who had used cotton to filter heroin and concluded that the bacterial organism Enterobacter agglomerans was likely the causal agent of the cotton fever (Ferguson et al., 1993). The concern is that people who use drugs and who experience these symptoms may be suffering from a more serious illness such as pneumonia, endocarditis, or hepatitis and therefore it is recommended that all febrile cases be hospitalized as a measure of precaution, which presents a significant burden to the healthcare system (Harrison & Walls, 1990). Although the research on cotton fever is quite limited, it is important to advise clients not to use household items like cotton balls and Q-tips as filters. These items are not sold in sterile packaging and therefore may contain bacteria even when not reused. Of course, once sterile cotton is removed from packaging it too becomes exposed to potential bacterial contamination from the surrounding area. Depending on the type of filters provided and the assembly of safer injection kits, NSP staff may want to consider handling filters as little as possible and to wear gloves while doing so.

Bacterial infection

Microbiological studies that have examined the injection equipment of people who use heroin have found bacteria in their needles, most notably variations of the Streptococcus and Staphylococcus bacterium. These are the two bacteria responsible for the formation of abscesses (Caflisch et al., 1999). Wet filters that have been stored for re-use create a productive environment for bacteria proliferation (Alhusein et al., 2016). In addition, filters can be colonized with bacteria when handled and/or when they contact bacteria on the surface of the skin (McLean et al., 2017). There are reports of drugs in tablet form being crushed by teeth in the mouth contributing to the spread of oral bacteria to drugs and subsequently filters (McLean et al., 2017). In Kasper et al. (2019) study, 14% of filters and cookers used for injecting hydromorphone controlled release contained the bacteria S.Aureus (Kasper et al., 2019). In a study carried out in 1997, Caflisch and colleagues measured bacterial growth, more generally, in sterile syringes after they had been used for injection with three different types of filters. Bacterial contamination was found in 23 of 24 syringes used with a cigarette filter; in 20 of 24 syringes used with a filter with a pore width of 20 μm; and in only 6 of 24 syringes when a filter with a pore width of 0.22 μm was used. The authors concluded that a filter with a pore width of 0.22 μm was significantly more effective in preventing bacterial contamination of syringes than both cigarette and larger pore width filters (relative risk (RR)=18.0) and the 20-μm filter (RR=4.5; Caflisch et al., 1999). In addition to bacterial contamination differences between filters, some material may encourage bacterial survival in injection equipment due to excipients often included in controlled-release tablets (Kasper et al., 2019). Upon examining HMC tablets, HMI tablets and controlled-release oxycodone, Kasper et al. (2019) found that HMC tablets uniquely promote the survival of S. Aureus in vitro (Kasper et al., 2019). This is thought to be the result of excipients as well as more handling involved in the preparation of HMC.

Particles entering the body

Foreign particles entering the body through injection drug use can lead to deep vein thrombosis (DVT) and other health complications. Injection drug use was observed as a risk factor for DVT in a study that examined the cause of venous thromboembolism among 322 women aged 16 to 70 years accessing hospital care in Glasgow, Scotland for vein thrombosis (McColl et al., 2001). Injection drug use was associated with 21% of all cases of DVT observed among this group. Among women under 40 years of age, the DVT-related risk attributed to injection drug use was even more pronounced. Among this younger group of women, injection drug use was associated with 52% of cases of DVT, leading the study authors to conclude that injection drug use may be the most common risk factor for DVT in their region (McColl et al., 2001). When some types of drugs are prepared for injection (especially drugs that are not intended for injection, but were formulated for swallowing), there may be increased risk of large particles entering the body. Pharmaceutical tablets contain fillers like talc or cornstarch that can enter the bloodstream and may cause pulmonary emboli and other complications (McLean et al., 2017; Roux et al., 2011). A study in France compared the effectiveness of the use of a filter with a pore size of 10 μm versus no filter at reducing particles in solutions containing dissolved generic buprenorphine and Ritalin® (Roux et al., 2011). The authors found that filtering both drug solutions was effective at significantly reducing the number of large particles. McLean et al. (2009) examined filtration of solutions made from slow-release morphine tablets. They found that cigarette filters removed most large particles, but not smaller particles. Commercially available syringe filters (0.45 and 0.22 μm) substantially reduced the number of particles, though would sometimes block. Another complication may arise when heating drug solutions made from pharmaceutical tablets. Waxy components of some tablets can be melted down and will pass through filters, but upon cooling these waxy components may re-solidify and potentially cause harms (Anex

Bulletin, 2011; McLean et al., 2009). It's important to note that substances may have specific qualities that, together with a filter, may result in different amounts of insoluble particles. Bouquie et al., (2014) examined the mechanism behind cutaneous lesions, observed almost exclusively among people who inject generic buprenorphine (Wainstein et al., 2014 from Bouquie et al., 2014). After filtering both generic buprenorphine and Subutex with a cotton filter, the study found a higher number of particles and smaller particle size in the generic buprenorphine solution (Bouquie et al., 2014).

Intravascular talcosis ('chalk lung') and talc retinopathy

Failure to properly filter out impurities and filler materials such as talc can lead to a condition known as intravascular talcosis (talcum powder deposited into the blood vessels of the lungs (McLean et al., 2017; Griffith et al., 2012). An unfiltered drug solution prepared from oral medications may deposit talc in the lungs, liver, and/or heart valves; from the lungs, the talc may eventually access and lodge within the eyes (Drenser et al., 2006). As a result, intravascular talcosis is linked to dyspnea, pulmonary fibrosis, hypertension and heart failure (McLean et al., 2017).

Filter distribution policies

The distribution of filters is an important way for NSPs to reduce the risks associated with sharing or reusing filters. Filters with small pore widths help prevent particles and, if small enough, bacteria, from entering the body which can lead to health-related harms like abscesses and DVT. A systematic review by Gillies et al. (2010) suggested that more research is needed regarding evidence that demonstrates that providing sterile injection-related equipment reduces HCV transmission. Aspinall et al. (2012) found a dose-response relationship between filter uptake and filter sharing. Among a sample of 2,037 people who inject drugs in Scotland, those who had obtained more than 30 filters in a typical week during the last 6 months had significantly lower odds of filter sharing in that time compared to those who did not obtain filters (Aspinall et al., 2012). In another multivariate model, participants who experienced a shortfall of more than 10 filters in a typical week had increased odds of sharing filters. These findings suggest a connection between filter provision, uptake, and risk behaviours.

Filter distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were less common. Cross-sectional studies were the main type of study to contribute evidence on risk behaviours such as sharing injection equipment. Prospective cohort studies were also fairly common in this research. Laboratory studies – particularly virologic testing of cookers, filters, water, tourniquets, and/or swabs collected from community and clinical settings – have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Review papers, including a few systematic reviews, have covered a variety of related topics and some clinical case reports/studies have provided information on infections among people who inject drugs. We did not find any reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs. Although the evidence base has grown in recent years, there are notable gaps in the research on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other bloodborne pathogen transmission from sharing each item of injecting equipment are needed (Corson et al., 2013). There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 5: Ascorbic acid distribution

Recommended best practice policies to facilitate use of ascorbic acid to dissolve drugs (e.g., crack cocaine, some forms of heroin):

DISTRIBUTION

- Ask clients if ascorbic acid is required to dissolve the drug(s) to be injected
- If needed, distribute single-use sachets of ascorbic acid
- If needed, distribute based on the quantity requested by clients with no limits
- If needed, offer ascorbic acid with each needle, sterile water, cooker, sterile filter and alcohol swab provided

EDUCATION

- Educate about the correct single person use of ascorbic acid
- Educate about the potential HIV- and HCV-related risks associated with sharing ascorbic acid
- Educate about the risks of fungal infections associated with using spore-contaminated lemon juice and other acids
- Educate about how to determine the smallest amount of acid needed to dissolve the drug of choice

Description of how acidifiers are used

To inject drugs such as crack cocaine and some forms of heroin, the drug must first be converted into a water-soluble form by adding an acid. The acidifier is added to the drug and water solution in the container or "cooker" to dissolve the drug before injection. Common acidifiers include ascorbic, citric, and acetic acids. The amount of acidifier utilized will vary depending on the substance individuals are using (Beneditti & Mary, 2018).

Pure ascorbic (vitamin C) or citric acids are not always available. When these acids are not available, people who inject drugs may use lemon juice – fresh and from plastic bottles – which can introduce risks of bacterial infection (Gallo et al., 1985; Shankland & Richardson, 1988; Beneditti & Mary, 2018; Ministère des solidarités et santé, 2020). There is no evidence in the research literature that using vinegar as an acidifier to dissolve some drugs is harmful. There is a risk of disease transmission when acidifiers or any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens. To reduce the risk of transmission from contaminated acidifier sources, clients need to use uncontaminated acidifiers each time.

Evidence of acidifiers as vectors of HIV and HCV transmission

HCV and HIV can be transmitted through the sharing of contaminated injection-related equipment (Hagan et al., 2001; Shah et al., 1996; Thorpe et al., 2000, 2002; Vlahov et al., 1997). If several people who inject drugs were to use the same acidifier source for their injections, the acidifiers could be possible reservoirs for pathogens. If a person living with HIV or HCV loaded their previously used syringe from a communal acidifier source, the other members of the injection group would thus be exposed to the blood-borne pathogen upon drawing up the contaminated acid.

The sachets of acidifiers distributed by some programs are designed to provide an individual with enough acid for only one injection (www.exchangesupplies.org), thus discouraging multi-person use of acidifiers and reducing the possibility of HIV or HCV infection.

Evidence of risk behaviours

Data from two studies identify lemon juice as a commonly used acidifier (Garden et al., 2003; Harris et al., 2019). Garden et al. (2004) evaluated the provision of single-use citric acid sachets among a group of 360 people who inject drugs (280 men and 80 women between the ages of 17 and 52) in Glasgow, Scotland and found that 94% reported using an acidifier to dissolve their drug prior to injection. All participants had at one point used single-use citric acid sachets. Two thirds of the sample had tried using lemon juice as an acidifier. The quantity of acidifier that is used in drug preparation has also been identified to be dependent on a variety of factors. Harris et al. (2019) conducted a study in the UK with 455 people who use drugs and identified that poor-quality heroin and limited knowledge on appropriate acidifier quantities were related to increased use of acidifier. Some participants engaged in the risky practice of using tea bags to filter lemon juice during drug preparation believing that this process would purify lemon juice (Harris et al., 2019).

In 2004, the Scottish Drugs Forum and the Glasgow Involvement Group surveyed 76 people who inject drugs to gain feedback on existing needle exchange provisions. Ninety-one percent of respondents shared spoons and acidifiers (combined) most frequently, indicating a potential risk of infection with HIV or HCV through indirect sharing. The authors also found that 41% of respondents included acidifiers as one of their top five provision requests (Scottish Drugs Forum and Glasgow Involvement Group, 2004).

Correlates of risk behaviours

In the study mentioned above by Garden et al. (2004), men were significantly more likely to use lemon juice compared to women ($p<0.05$). People who injected more frequently ($p<0.05$) and those with longer injecting careers ($p<0.001$) were also significantly more likely to inject using other acidifiers.

Other health-related harms

Bacterial and fungal infection

Some common household acids like lemon juice have the properties of a growth medium for certain bacteria and fungi (Gallo et al., 1985). These organisms can infect the heart in the form of endocarditis and the eyes in the form of candidal endophthalmitis, which can lead to blindness (Gallo et al., 1985; Garden et al., 2004).

Shankland and Richardson (1988) examined the epidemiology of an outbreak of candidal endophthalmitis among people who use heroin in the United Kingdom. Isolates of the organism Candida albicans were found in the lemon juice used by the affected people who inject drugs. Similarly, Garden et al. (2004) in the study described previously found that 38% of people who inject drugs and who reported using an acidifier had experienced some sort of eye problem, and those who injected more frequently were significantly more likely to experience eye problems than those who injected less frequently ($p<0.001$).

McGuigan et al. (2002) examined the presence of Clostridium novyi type A and other spore-forming organisms among a group of 60 Scottish people who inject drugs during an outbreak between April and August 2000. Clostridium novyi is a bacterial strain that can lead to necrotizing fasciitis (flesh-eating disease), a potentially fatal condition. In this study, 31 cases involved women, the majority of whom had injected heroin and citric acid extravascularly. The predominant symptoms included soft tissue infection, necrotizing fasciitis, and multiple organ failure leading to death. Twenty-three people died, likely due to a toxin-producing organism. The authors hypothesised that this was an opportunistic infection involving the extravascular injection of heroin and citric acid contaminated with C. novyi type A spores. The acidic solution damaged the soft tissue and the associated toxin led to severe local inflammation (McGuigan et al., 2002).

Vein damage

Any acid injected into the bloodstream is likely to cause vessel irritation and possible local vein damage. A study conducted by Harris et al. (2019) revealed that among a sample of 455 people who inject drugs in London England, 84% of participants used citric acid during drug preparation, which was associated with painful injections and peripheral vein damage. This study also demonstrated that deep vein thrombosis was associated with acidifier overuse, which occurred among 36% of participants (Harris et al., 2019). Using the smallest amount of acid possible to dissolve a drug may help to avoid vascular harm (Scott et al., 2000). For this reason and other hygienic reasons, citric and ascorbic acids are sometimes packaged into single-use, airtight, and water-resistant sachets of 100 mg and 300 mg, respectively. Anecdotal accounts have suggested that ascorbic acid is perceived as less irritating for veins (Scott, 2010) and is often recommended over citric acid for this reason. It also has a large margin of safety allowing more room for “error” as a small amount of extra ascorbic acid will be unlikely to cause vessel damage (e.g., www.ohrdp.ca; www.towardtheheart.com). However, citric acid can be distributed in a pure form that is readily available (i.e., not in tablet form) and of consistent strength, therefore making it relatively easy to use (Garden et al., 2004). It is important that people who inject drugs are aware that ascorbic acid sachets are three times the volume of citric acid sachets since it is a weaker acid. Thus, if people who inject drugs were to switch from using vitamin C to using citric acid, they should be made aware of the difference in strength and reduce the amount of acid used for injection to avoid experiencing pain and vein damage. Exchange Supplies has an instructional video available from their website that shows a lab experiment designed to help people who inject drugs know how much acidifier to add (www.exchangesupplies.org). BC Harm Reduction Strategies and Services recommends that for crack cocaine the amount of vitamin C needed is about one quarter the size of the rock; although they also note that the amount of vitamin C needed to fully dissolve drugs like crack cocaine and brown or black tar heroin will vary with drug purity (BC HRSS, 2010)

Other concerns

A study conducted by McGowan et al. (2020) among 400 people who inject drugs, documented that albuminuria (albumin, a blood protein excreted in urine) a known biomarker for various illnesses such as cardiovascular disease, was significantly associated with the overuse of acidifier. This association was particularly apparent among participants who overused acidifiers, which the authors defined as using more than half a package of citric acid or vitamin C per £10 of heroin. (McGowan et al., 2020, p4). These authors also note the potential connection between overuse of acidifier and the development of local or systemic inflammation- an additional factor associated with albuminuria (McGowan et al., 2020, p5). An additional concern for people who use ascorbic acid is evident from hospital data which document that large infusions of vitamin C have been linked to the formation of kidney stones. However, this is not usually a concern for people who inject drugs since the amount of acid used per injection is relatively small (Garden et al., 2004).

Due to the potential risk of all acidifier-related problems, once a sachet has been opened, any leftover acid should be disposed of so that it does not become contaminated and potentially lead to infection. Some NSP clients may ask about ingesting vitamin C with water. Clients should be made aware that all types of acidifiers distributed by NSPs are meant for dissolving specific types of drugs for injection (crack cocaine and certain types of heroin).

Other issues specific to acidifiers

The OHRDP advises programs to rotate their acidifier inventories to ensure that products have not expired prior to distribution (www.ohrdp.ca). The OHRDP also recommends that programs consider their injection kit content as not all types of drugs require an acidifier – thus, including sachets in every kit may be wasteful and not cost-effective. In this regard, clients should also be asked if ascorbic acid is required to dissolve the drug(s) to be injected.

Ascorbic acid distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were employed less frequently. Cross-sectional studies were the main type of study to contribute evidence on risk behaviours. Laboratory studies have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Clinical case reports/studies have provided information on infections among people who inject drugs. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs.

Although the evidence base has grown in recent years, there are notable gaps in the literature on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other blood-borne pathogen transmission from sharing each item of injecting equipment are needed. There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 6: Sterile water distribution

Recommended best practice policies to facilitate use of sterile water for each injection:

DISTRIBUTION

- Distribute single-use, smallest size sterile water vials
- Distribute based on the quantity requested by clients with no limits
- Offer a sterile water vial with each needle, cooker, sterile filter and alcohol swab provided

EDUCATION

- Educate about the correct single person use of mixing and rinse water
- Educate about the HIV- and HCV-related risks associated with sharing mixing and rinse waters
- Educate about the risks of using non-sterile water (such as tap, bottled, rain, puddle, and urinal water) and other fluids (such as saliva and urine)

DISPOSAL

- Dispose of used water in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how sterile water for injection is used

Prior to injection, drugs in powder, solid, or tablet form need to be mixed with water to make a solution that can be injected into the bloodstream. Dissolving substances in sterile water not only aids in minimizing the risk of developing an infection but also aids in reducing vein damage (BC DOAP, 2014). A needle is often placed into a water source and water is drawn up into the syringe. The water is then squirted into a container – usually a spoon or 'cooker' – for mixing with and dissolving the drug. However, inserting a needle into a water vial may dull or 'barb' the needle which can lead to skin and vein damage, so water vials should be designed to be opened in a manner (e.g., easy twist-off cap) that allows a person to drip the water directly into the cooker.

While a new, sterile needle for each injection is recommended, some people who inject drugs may rinse their needles between injections by flushing the needle with water to remove any blood from the previous injection. Other injection equipment, such as cookers, may also be rinsed between uses. Needles from different users may be placed into the same water source for drawing up water for either mixing or rinsing purposes. There is a risk of disease transmission when water or any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens. Once opened, water ampoules should not be kept for future use (Government du Quebec, 2017; Ministère de solidarités et santé, 2020). To reduce the risk of transmission from contaminated water, clients need to use a new, sterile water source each time. Using needles as a method to open water ampoules should also be avoided, as it can damage the needle and risk vein or tissue damage (Beneditti & Mary, 2018).

Evidence of water as a vector of HIV, HCV, and HBV transmission

When a water source is shared or used by more than one person, there is a chance that small amounts of blood from any piece of equipment that maybe deposited into the water and create risks for HIV, HCV, HBV, or bacterial transmission (Bridgeman, Fish, & Mackinnon, 2017).

Water for mixing and rinsing can potentially become contaminated with HIV if a person who injects drugs and who is HIV-positive places a previously used needle into a communal water source. Shah et al. (1996) examined previously used injection equipment from shooting galleries in Miami, Florida for the presence of HIV-1. Antibodies to HIV-1 were detected in one (6%) of 17 rinse waters. Components of HIV-1 were detected in 38% (5/13) and 67% (10/15), respectively, of the rinse waters examined (Shah et al., 1996).

Small amounts of blood in rinse water can potentially be enough to transmit HCV between people who inject drugs. Crofts et al. (1999) examined previously used injection equipment from 10 Australian injection settings for the presence of HCV RNA and they detected HCV in 33% (1/3) of the water samples tested. In a study from France, HCV RNA was not detected on used water vials (70 vials in total) collected from multiple sites (Thibault et al., 2011). Doerrbecker et al. (2013) performed an experimental analysis to examine HCV stability in water and viral association with different types of water container materials (i.e., plastic, aluminum, and glass). These authors found that, depending on the dose of the virus, HCV can survive in water for up to 3 weeks and longer. No residual virus was detected in the glass container; HCV was most strongly associated with the aluminum container followed by the plastic container. Thus, even water container material may present a risk of HCV transmission in instances where previously used containers are emptied and/or washed out and refilled with water. Such findings underscore the need for people who inject drugs to have their own, single-use sources of water.

Epidemiologic studies have documented increased HCV risk through injecting with previously used water. Evidence from cohort studies documents an elevated risk of HCV seroconversion attributed to sharing rinse water. Hagan et al. (2001) measured HCV seroconversion among a cohort of 317 people who inject drugs in Seattle who tested negative for HCV antibody at recruitment. The risk of HCV seroconversion was elevated for those who shared rinse water, although it was not statistically significant (Hagan et al., 2001). Similarly, Thorpe et al. (2000) measured HCV incidence among a cohort of 700 people who inject drugs aged 18 to 30 in Chicago between 1997 and 1999. Sharing rinse water doubled the risk of HCV seroconversion among study participants. The adjusted relative hazard (ARH) of HCV seroconversion was highest for sharing cookers (ARH=3.48; 95%CI: 1.43-8.48), immediately followed by sharing rinse water (ARH=2.21; 95%CI: 1.06-4.63; Thorpe et al., 2000). Finally, a review of studies reporting HCV seroincidence found an association between HCV seroconversion and sharing of rinse water (PRR = 1.98, 95% CI 1.54, 2.56; Pouget et al., 2011).

A study on risk factors for HBV infection among people who inject methamphetamine in Wyoming found that sharing water used for mixing or rinsing was statistically associated with HBV infection (94% of case-patients versus 44% of controls; Vogt et al., 2006). In hypothesis-generating interviews, people who inject drugs noted that often rinse water was not changed between injecting episodes "and was sometimes contaminated visibly with blood" (Vogt et al., 2006, p. 729).

Evidence of risk behaviours

The sharing of mixing and rinse water is a frequent practice among people who inject drugs. A study conducted by Harris et al. (2020) aimed to uncover how environmental factors influenced injection practices through urinalysis (n=455) and qualitative-based interviews (n=32) among people who inject drugs in the United Kingdom. The majority of the study participants described experiencing housing precarity and those in the qualitative portion of the study described using drugs in parks, public toilets, garbage sheds and stairwells (Harris, Scott, Hope, Wright, McGowan & Ciccarone, 2020). Drug use in these public locations was often accompanied by a sense of urgency resulting in risky preparation procedures such as using puddle water to prepare their substances (Harris et al., 2020). Other liquids such as whisky, saliva, toilet cistern water and soda beverages were used in the absence of sterile water to prepare substances and/or rinse equipment (Harris et al., 2020). Many participants attempted to mitigate risks associated with using non-sterile water and liquids by filtering solutions through alcohol swabs or carrying bottled water (Harris et al., 2020). Similar findings were reported by Scheim et al. (2017), who surveyed 196 individuals in Ontario, Canada and found that 46.4% of individuals injected outside and 43.3% used 'outdoor water sources' when preparing drugs or rinsing injection sites.

A study conducted by Deren et al. (2018) among 201 people who inject drugs, found that approximately 30% of participants shared injection paraphernalia including water. Other studies have reported that individuals who share injection material such as water had 22 times the likelihood of acquiring HIV (Lawson Health Research Institute, 2019). Scheidell et al. (2015) used the NEURO-HIV Epidemiologic Study to determine if associations exist among the ability to plan prior to using and risky behaviours among 456 (n=59% male) people who inject drugs in Baltimore City, Maryland. For male participants, it was determined that the inability to plan in advance for making shots was associated with an increased likelihood of sharing rinse water among other risky behaviours (Scheidell, Khan, Clifford, Dunne, Keen II, & Latimer, 2015). Similarly, Wang et al. (1998) analyzed the results from two 1997 studies among people who use opiates in Zurich, Switzerland. Fifty percent of people who inject drugs had shared water from a communal container, and participants measured the water using their own syringes which had been used more than once 83% of the time (Wang et al., 1998).

Correlates of risk behaviours

Rinse water was shared 77% of the time in an ethnographic study that examined drug acquisition and the sharing of injection drug equipment in 54 "networks" of people who inject drugs selected from six American cities and Puerto Rico (Needle et al., 1998). Sharing rinse water was found to be a more frequent practice among the lower-risk networks which were defined as groups that did not share drug solutions or needles but had at least one member who injected with previously used injection drug equipment. When drugs were purchased by a lower-risk group, rinse water was shared five times out of six episodes (Needle et al., 1998). Additional factors that have been documented to be related to water sharing practices included housing stability and injection preparation ability (Harris et al., 2020; Scheidell et al., 2015; Scheim et al., 2017).

People who inject drugs and have a history of mental health problems appear to be more likely to share rinse water. In examining the relationship between a history of mental health problems and HIV- and HCV-related risk behaviours among a cohort of 2,198 people who inject drugs aged 18 to 30 from five U.S. cities, Morse et al. (2001) found that those with a history of mental health hospitalization (OR=1.48; 95%CI: 1.21-1.81) or suicidal ideation (OR=1.72; 95%CI: 1.44-2.05) were more likely to report sharing rinse water. Other factors may be associated with sharing water too. Strike et al. (2010) found that factors associated with giving away used water included being male, having injected methadone, injected other stimulants, and moved three or more times in the past 6 months. In a study of unsafe practices among people who inject drugs in Vancouver, Rachlis et al. (2010) found that frequent reporting of using a used water capsule was associated with requiring help injecting, being HIV-positive, and daily heroin injection. In a cross-sectional survey of 2,037 people who inject drugs in Scotland, sharing water was significantly associated with being female, homelessness in the last 6 months, having not injected in the last 4 weeks, exclusive heroin injecting, and injecting more than once a day (Aspinall et al., 2012).

Other health-related harms

To avoid the risks associated with sharing water, some people may purchase their own sterile water from a local pharmacy or try to prepare it at home by boiling tap water and storing it in a sealed container (Sorge & Kershnar, 1998; Canadian Institute for Substance Use Research, 2017). If sterile water is not available, Beneditti and Mary (2018) recommend using tap water instead of bottled water, as it contains less bacteria.

Pseudomonas aeruginosa is an organism found in non-sterile water sources such as toilets and was found to be the organism responsible for 10% of 180 cases of sternoclavicular septic arthritis (inflammation caused by infection in the joints of the clavicle and sternum) reviewed by Ross and Shamsuddin (2004). The authors found that injection drug use was the most common risk factor for this condition.

Other studies have found a relatively high prevalence of organisms normally found in the mouth in drug-related, soft-tissue abscesses due to using saliva to prepare a drug solution (Calder & Severyn, 2003; Gonzalez et al., 1993; Henriksen et al., 1994; Murphy et al., 2001). For example, Gonzalez et al. (1993) conducted a four-year retrospective review of 59 people who inject drugs with drug-related abscesses and reported that most of the organisms cultured were oral or skin flora.

Sterile water distribution policies

Provision of single-use vials of sterile water for injection is the best method to eliminate the risk of HIV and HCV transmission through sharing mixing and rinse water and to prevent bacterial infections caused by using non-sterile water. Sterile water for injection vials should contain enough water to mix drugs into an injectable form. The sterile water vials are only effective if provided in sufficient quantity to ensure that each injection is prepared with a vial of sterile water. Gillies et al. (2010) suggested in a systematic review that more research is needed to demonstrate that providing sterile injection-related equipment reduces risk of HCV transmission. Aspinall et al. (2012) conducted a cross-sectional survey of people who inject drugs in Scotland and found that those who had obtained sterile water in a typical week during the last 6 months had significantly lower odds of sharing water compared to those who did not obtain any sterile water. In another multivariate model, these authors found that participants who had a shortfall of sterile water in a typical week during the last 6 months had increased odds of sharing water. The Scottish Drugs Forum and the Glasgow Involvement Group surveyed 76 people who inject drugs in Glasgow in 2004 to gain feedback on existing needle exchange provisions. The authors reported that 26% of respondents included water as one of their top five provision requests.

Both sterile water for injection and sterile water for inhalation can be distributed. Sterile water for injection contains no added substances or microbial agents. Sterile water for inhalation is not manufactured for injection purposes and is non-pyrogenic (i.e., has no bacteriostatic agents and is preservative free) and is often distributed by harm reduction programs because it often comes in small volume formats and maybe better to promote single use (Ontario Harm Reduction Program, 2020). Plastic sterile water vials need to be checked to ensure that they have not been punctured, frozen or expired.

Coverage

A total of 13,354,000 sterile water ampoules were distributed from January to December 2020 in Ontario. In British Columbia, a total of 9,423,000 sterile water ampoules were distributed in 2019.

Sterile water distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were employed less frequently. Cross-sectional studies were the main type of study to contribute evidence on risk behaviours such as sharing injection equipment. Prospective cohort studies were also common in this literature. Laboratory studies – particularly virologic testing of cookers, filters, water, tourniquets, and/or swabs collected from community and clinical settings – have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Review papers, including a few systematic reviews, have covered a variety of related topics and some clinical case reports/studies have provided information on infections among people who inject drugs. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs.

Although the evidence base has grown in recent years, there are notable gaps in the literature on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other blood-borne pathogen transmission from sharing each item of injecting equipment are needed. There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 7: Alcohol swab distribution

Recommended best practice policies to facilitate use of sterile alcohol swabs for each injection:

DISTRIBUTION

- Distribute single-use, individually pre-packaged, and sterile alcohol swabs
- Distribute based on the quantity requested by clients with no limits
- Offer sterile alcohol swabs with each needle, sterile water, cooker and sterile filter provided

EDUCATION

- Educate about the correct single person use of alcohol swabs
- Educate about the HIV- and HCV-related risks associated with sharing swabs
- Educate about the risks of bacterial infection if the injection site is not cleaned with an alcohol swab prior to injection
- Educate about the risks of consumption of the non-beverage alcohol in the swabs
- Educate about using a dry swab or tissue post-injection instead of an alcohol swab

DISPOSAL

- Dispose of used swabs in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how alcohol swabs are used

Alcohol swabs are used by people who use drugs to clean an injection site before injection. Additionally, people may want to use a swab to clean their fingers and thumb before an injection and to remove any blood resulting from the injection on their fingers and other surfaces. There is a risk of disease transmission when alcohol swabs or any of the pieces of equipment used to prepare, share, or inject the drug solution are contaminated with HIV, HCV, HBV, or other pathogens. To reduce the risk of transmission from contaminated swabs, clients need to use new swabs every time (Beneditti & Mary, 2018).

Evidence of alcohol swabs as vectors of pathogen transmission

Swabs can be contaminated with microbial pathogens and as such HCV may be transmitted between people who inject drugs when alcohol swabs are shared. Crofts et al. (1999) examined previously used injection equipment from 10 Australian injection settings for the presence of HCV RNA. HCV RNA was detected on 67% (6/9) of the alcohol swabs tested (Crofts et al., 1999). In a more recent study from France that examined the presence of HCV on injection equipment collected from multiple sites, HCV was detected at a high rate in pools of swabs (82%), especially when compared to the rate of contaminated syringes (32%; Thibault et al., 2011). Further, the levels of contamination on swabs were often 10 times higher (median, 412 IU/mL; range, 12–4932) than those on the syringes (median, 12 IU/mL; range, 12–890). Residual blood tended to be visible on both swabs and syringes (Thibault et al., 2011). The authors suggested that the amount of residual blood on some swabs may have been greater than that in syringes; although they also noted that people tend to rinse syringes between uses. Because swabs may be a source for HCV contamination, the authors recommended that programs have strong messages about preventing the sharing of swabs.

Evidence of risk behaviours

Alcohol swabs are sometimes shared among people who inject drugs, but not as frequently as other equipment. For example, Scottish Drugs Forum and the Glasgow Involvement Group surveyed 76 people in Glasgow who inject drugs to gain feedback on existing needle exchange provisions. Twenty-three percent of study participants had shared alcohol swabs (Scottish Drugs Forum and Glasgow Involvement Group, 2004). In a study of 145 people who inject drugs in London, Ontario, distributive sharing of swabs in the past six months was reported by only 8% of participants and reuse of swabs was reported by 6% (Strike et al., 2010).

Despite evidence describing limited sharing of alcohol swabs among people who inject drugs, there has also been research that has explored the complete lack of swab use. Gibbs et al. (2019) identified that 48% of their sample (n=835) did not use an alcohol swab prior to injecting. Some participants indicated not using an alcohol swab due to disliking them or not having access to them (Gibbs et al., 2019). It was documented that not using an alcohol swab while injecting was linked to an increased probability of participants sharing other injecting equipment (Gibbs et al., 2020).

A study that reported on data collected from 208 people who inject drugs from three US cities found that most study participants (92.5%) reported using alcohol pads to clean their injection site prior to injection (Grau et al., 2009). Similarly, a study conducted by Gibbs et al. (2019) in Australia among 853 respondents demonstrated that only 26% of participants did not use an alcohol swab prior to their last injection. This same study established that over half of the participants used an alcohol swab every time they engaged in injection drug use (Gibbs et al., 2019). Schechter et al. (1999) examined the association between NSP attendance and the spread of HIV among 694 Vancouver people who inject drugs and they found that 50% reported receiving alcohol swabs from the NSP. In the Scottish study described above, 21% of the study participants included alcohol swabs as one of their top five provision requests from the NSP (Scottish Drugs Forum and Glasgow Involvement Group, 2004). Iyengar et al. (2019) indicate how different NSP locations (fixed vs mobile) can impact participant's alcohol swab use. They showed that participants who used a fixed site had a greater likelihood of using alcohol swabs prior to injection compared with the mobile site (29.6% vs 14.8%) (Iyengar, Kravietz, Bartholomew, Forrest, & Tookes, 2019, p 3). It was demonstrated that among participants who used the mobile site, 70.5% of them reported never using an alcohol swab before injecting (Iyengar et al., 2019, p3).

Correlates of risk behaviours

NSP attendance is an important factor when it comes to encouraging people to use their own swabs and clean their skin before injection. Longshore et al. (2001) investigated frequency of attendance at a Rhode Island NSP and its association with injection-related risk practices among 248 people who inject drugs. Those who visited the NSP less frequently were less likely to always clean their skin before injecting (AOR=0.33; 95%CI: 0.1-1.1, $p<0.07$). Although, as the authors note, the significance level falls just short of the conventional cut-off for statistical significance, likely due to small sample numbers (Longshore et al., 2001). Similar findings were documented by Gibbs et al. (2019), who identified that 91% of their sample (n=853) obtained an alcohol swab along with a sterile needle from a NSP. Knittel et al. (2010), in an evaluation of a small NSP outside an urban area in Michigan, found that NSP follow-up participants were statistically more likely to clean their skin with alcohol before and after injecting compared to baseline.

Documented barriers surrounding the use of alcohol swabs prior to injection include whether an individual is experiencing withdrawal, has prepared drugs prior to injection or carries alcohol swabs while experiencing strong cravings (Phillips, 2016). Phillips et al. (2016) additionally explain how fear of interacting with the criminal justice system and limited awareness while intoxicated were also barriers to using alcohol swabs prior to injection.

Other health-related harms

Using a sterile alcohol swab to clean the skin prior to injection can help reduce the occurrence of bacterial infections associated with injection drug use. Hope et al. (2014) documented that among a sample of 855 individuals, those who consistently used an alcohol swab prior to injection were less likely to have an abscess at the injection site compared to participants who did not use an alcohol swab. Vlahov et al. (1992) surveyed 1,057 people who inject drugs in Baltimore, Maryland, and found that the occurrence of subcutaneous abscesses and endocarditis was less common among those who reported skin cleaning all the time. Although it should be noted that skin cleaning in this study also included methods other than use of alcohol swabs, such as use of soap and water.

Murphy et al. (2001) examined the risk factors for skin and soft-tissue abscesses among 418 people who inject drugs in San Francisco and reported that skin cleaning with alcohol was the only independent variable found to have a significantly protective effect against abscess formation (OR=0.48; 95%CI: 0.3-0.74, $p<0.05$). Dunleavy et al. (2019) also determined that knowledge and social awareness of skin and soft-tissue infections aided in the uptake of harm reduction practices such as using alcohol swabs among a sample of 22 people who injected drugs in Glasgow and Edinburgh.

A literature review that examined evidence on skin disinfection prior to intradermal, subcutaneous, and intramuscular (but not intravenous) injection found that there appeared to be little clear evidence to support the need for skin disinfection (Infection Control Team, 2006). It was recommended that soiled skin be cleaned with soap and water. Further, if disinfection is to be performed it can be done with a pre-medicated 70% alcohol swab and the injection site should be rubbed with the swab for 30 seconds and allowed to dry for another 30 seconds to render bacteria inactive (Infection Control Team, 2006). However, the evidence reviewed was often from clinical settings. People who inject drugs in community settings may not have access to soap and clean water and may inject in environments where there is a much greater presence of bacteria and debris compared to clinical settings. Therefore, people who inject drugs are advised to clean their skin prior to injection with alcohol swabs, especially if basic cleaning agents (i.e., soap and water) are unavailable.

Alcohol swabs should be used to clean the skin prior to injection but should not be used to stop blood flow after injection because alcohol hinders blood coagulation which could leave injection sites susceptible to infection (Grau et al., 2009; Treloar et al., 2008). Thibault et al. (2012), in a reply about a study they conducted, noted that they observed blood-tainted swabs, indicating improper use by people who inject drugs (i.e., post-injection use). Clients should be reminded that alcohol swabs are for skin cleaning prior to injection. To stop blood flow after injection, dry and absorbent pads may also be considered for distribution. The One-Use and Stericup cooker packages that are distributed by OHRDP to core harm reduction programs in Ontario, contain post injection swabs (www.ohrdp.ca)

There are reports in the medical literature of alcohol poisoning through consumption of surrogate alcohols such as hand sanitizers and rubbing alcohol (Blanchet et al., 2007; Bookstaver et al., 2008; Doyon & Welsh, 2007; Emadi & Coberly, 2007; Engel & Spiller, 2010; Francois et al., 2012; Gormley et al., 2012; Rich et al., 1990; Weiner, 2007). The term "surrogate alcohol" refers to substances "that contain ethanol or other potentially intoxicating liquids but are not intended for drinking, such as medicinal compounds, industrial spirits, automobile products, and cosmetics" (ICAP, 2010, p. 4).

Alcohol swab distribution policies

The distribution of sterile alcohol swabs to clients is the best way for NSPs to reduce the HCV-related (and potential HIV-related) risks associated with either the reuse or sharing of alcohol swabs among people who inject drugs. Skin cleaning with alcohol prior to injection may also have a protective effect against the formation of abscesses and other bacterial infections.

The Government of Quebec (2017) recommends distributing multiple alcohol swabs to PWID to prevent risk of infections. Chlorhexidine wipes have been documented to be an effective means of disinfection and are recommended for use prior to injection to clean hands or injection sites (Ministère des Solidarités et de la Santé, 2020). An evaluation of EXPER kits showed that chlorhexidine wipes were more effective in removing viruses, bacteria and fungi from injection sites and surfaces when compared to alcohol swabs (Milhet, 2016).

Coverage

We can employ numbers from Ontario and British Columbia to provide examples of alcohol swab distribution volume. A total of 34,420,000 alcohol swabs were distributed from January to December 2020 in Ontario. British Columbia distributed over 24,000,000 alcohol swabs in 2019.

Alcohol swab distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were employed less frequently. Cross-sectional studies were the main type of study to contribute evidence on risk behaviours such as sharing injection equipment. Laboratory studies – particularly virologic testing of cookers, filters, water, tourniquets, and/or swabs collected from community and clinical settings – have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Review papers, including a few systematic reviews, have covered a variety of related topics and some clinical case reports/studies have provided information on infections among people who inject drugs. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs.

Although the evidence base has grown in recent years, there are notable gaps in the literature on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other blood-borne pathogen transmission from sharing each item of injecting equipment are needed. There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 8: Tourniquet distribution

Recommended best practice policies to facilitate use of a clean tourniquet for each injection:

DISTRIBUTION

- Distribute thin, pliable, easy-to-release, non-latex tourniquets with non-porous surfaces
- Distribute based on the quantity requested by clients with no limits
- Offer a tourniquet with each needle provided

EDUCATION

- Educate about the correct single person use of tourniquets
- Educate about the risks of bacterial contamination and HIV and HCV associated with the reuse and sharing of tourniquets
- Educate about the risks of tissue and vein damage and impairment of blood circulation caused by improper use of tourniquets
- Educate about the importance of replacing a tourniquet when:
  - There is visible blood and/or dirt on it
  - It has ever been used by someone else
  - There is a loss of elasticity

DISPOSAL

- Dispose of used tourniquets in accordance with local regulations for biomedical waste
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how tourniquets are used

Tourniquets or “ties” are used by people who inject drugs to “tie off” the vein; that is, to provide pressure to increase the blood flow into the preferred vein and facilitate injection. Not all people who inject drugs need to use tourniquets to help make their veins more evident, including people who are relatively new to injecting drugs.

In the absence of a thin, pliable, stretchy tourniquet with a non-porous surface that is easy to release, people who use drugs may substitute pieces of rope, shoelaces, wire, condoms, leather or terry cloth belts, or bandanas. The major disadvantage of these items is that they are not elastic enough for quick, easy release and may therefore cause trauma to the skin and veins (including vein rupture due to increased pressure) and may cause infiltration of blood and fluids into surrounding tissues. In addition, these items are hard to clean if they become splattered with blood. Tourniquets should not be applied too tightly and should be loosened after a vein is located to avoid disrupting the blood flow (Beneditti & Mary, 2018). A tourniquet can be re-used if it does not have blood on it, no one else has used it or it has not lost its elasticity (Gouvernement du Québec, 2017; Ministère des solidarités et santé, 2020).

Evidence of tourniquets as vectors of HIV, HCV, and HBV transmission

It is possible that HCV and HIV could be transmitted between people who inject drugs by the shared use of tourniquets, although the magnitude of risk has not been determined and may not be as high as it is for other types of injection-related equipment. In a microbiological study by Rourke et al. (2001), 36% (75/200) of tourniquets sampled had visible bloodstains.

Participant observation studies of people who inject drugs in Australia (Crofts et al., 1999) and Scotland (Taylor et al., 2004) have shown that tourniquets may be a potential source of exposure to blood-borne pathogens. For example, a person who injects drugs may use the tourniquet to stem the flow of blood after an injection. This person may then apply the tourniquet to an injecting partner’s arm, deposit-ing a smear of blood on the skin which is subsequently punctured by a needle. Passing the tourniquet over the injection site creates the opportunity for the blood of someone living with HCV or HIV to enter the bloodstream of another person. Any activity that introduces new pathogens to a person’s skin, especially where there is an injection site, may plausibly elevate risk of infection.

The Australian National Council on AIDS, Hepatitis C and Related Diseases (2000) advised the Australian Federal Government that tourniquets, as well as other injecting equipment, clothing, and surfaces used while injecting may potentially spread HCV among people who inject drugs: *'Even though a drug user may only get a small trace of blood on the tourniquet as they pass it over their injection site when removing it, we believe that this may be a sufficient amount of blood to transmit the hep C virus if the same tourniquet is then used by another drug user'.*

Evidence of risk behaviours

Research has shown that people who inject drugs share tourniquets. The Scottish Drugs Forum and the Glasgow Involvement Group (2004) surveyed 76 people who inject drugs to gain feedback on existing needle exchange provisions. Sixty percent of respondents had shared tourniquets, indicating the potential risk of infection with HIV or HCV by means of indirect sharing (Scottish Drugs Forum and Glasgow Involvement Group, 2004). More recent survey data from Ontario, collected between 2010 and 2012 as part of the I-Track Study, found that 25% of the 953 people who inject drugs sampled had borrowed tourniquets (average of data from Toronto, Kingston, Sudbury, Thunder Bay, and London, Ontario; unpublished data).

Other health-related harms

Rourke et al. (2001) examined bacterial contamination of 200 tourniquets obtained over a two-week period in June 2000 from a cross section of healthcare professionals working in a 1,200-bed teaching hospital in Sheffield, United Kingdom. They found that 10 (5%) of the tourniquets sampled were contaminated with Staphylococcus bacteria, the organism responsible for the formation of abscesses (Rourke et al., 2001).

Similarly, Golder et al. (2000) examined 77 tourniquets from a London, United Kingdom teaching hospital to determine if previously used tourniquets could pose a cross-infection risk to patients. Fifty tourniquets were examined for bloodstains and culture growth. Twenty-five tourniquets had visible bloodstains, all 50 grew heavy skin flora, and of these, 17 had cultured bacterial organisms. It was determined that tourniquets are a potential reservoir of pathogenic bacteria and are thus a cross-infection risk to patients (Golder et al., 2000).

Conroy (2004) supported this argument in a letter to the British Medical Journal, indicating that methicillin-resistant Staphylococcus aureus (MRSA) is likely transmitted from patient to patient by means of tourniquet reuse. Disposable tourniquets were advised to eliminate this risk of cross-infection (Conroy, 2004). Studies have found that used tourniquets in clinical settings can become contaminated with MRSA and thus pose a risk to patients (Elhassan & Dixon, 2012; Leitch et al., 2006).

Tourniquet distribution policies

Distributing thin, pliable, easy-to-release tourniquets with non-porous surfaces to clients in the quantities that they request is the best way for NSPs to reduce the HIV and HCV-related risks associated with tourniquet sharing. It would also reduce the potential for contamination of tourniquets by bacteria that can cause abscesses and other health harms such as trauma to veins and risk of blood circulation impairment.

Coverage

National data on NSP tourniquet distribution in Canada is lacking. We can employ numbers from Ontario and British Columbia as examples of tourniquet distribution volume. A total of 2,521,700 tourniquets were distributed from January to December 2020 in Ontario. British Columbia distributed a total of 2,020,500 tourniquets in 2019.

Tourniquet distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were employed less frequently. Cross-sectional studies were the main type of study to contribute to evidence on risk behaviours such as sharing injection equipment. Laboratory studies, particularly virologic testing of cookers, filters, water, tourniquets, and/or swabs collected from community and clinical settings – have contributed knowledge regarding the potential transmissibility of HIV, HCV, and other pathogens via injecting equipment. Clinical case reports/studies have provided information on infections among people who inject drugs. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs. Although the evidence base has grown in recent years, there are notable gaps in the literature on other injecting equipment. Studies that are well designed to measure the magnitude of risk of HIV, HCV, and other blood-borne pathogen transmission from sharing each item of injecting equipment are needed. There are also few empirical studies that address injecting equipment distribution policies and coverage.

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Chapter 9: Safer crack cocaine smoking equipment distribution

Recommended best practice policies to facilitate safer crack cocaine smoking with a pipe - stem, mouthpiece, and screen:

DISTRIBUTION

- Distribute crack cocaine safer smoking supplies - stems, mouthpieces, screens, and push sticks
- Distribute safer sex supplies, such as condoms and lubricant
- Distribute safer crack cocaine smoking supplies without requiring exchange of used ones
- Distribute based on the quantity requested by clients with no limits
- Offer mouthpieces with each stem provided

EDUCATION

- Educate about:
  - safer use of equipment
  - proper disposal of used safer smoking equipment
  - safer smoking practices
  - risks of sharing smoking supplies
  - safer sex and
  - overdose prevention practices
- Educate about the importance of replacing a pipe when:
  - The pipe and/or the mouthpiece have been used by anyone else
  - The pipe is scratched, chipped or cracked
  - The mouthpiece is burnt
  - The screen shrinks and is loose in the stem

DISPOSAL

- Dispose of used smoking supplies in accordance with local regulations for biomedical waste
- Encourage clients to return and/or properly dispose of used or broken stems
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of safer smoking equipment and how it is used

Crack cocaine is a stimulant and is produced by converting powder cocaine to a cocaine base (Delas et al., 2010). The term 'crack' refers to the crackling sound that is made when the drug is heated (Cruz et al., 2006). When heated to high temperatures, crack cocaine first liquefies (or melts) and then vapourizes. The vapour is then inhaled through a pipe into the lungs. A screen is placed at one end of the pipe or stem to hold the melted crack cocaine in place and away from the mouth. Pipes can be crudely constructed from glass bottles, soft drink cans, plastic bottles, car aerials, metal pipes, and other materials in the absence of safer alternatives (Benjamin, 2011). When using a pipe, four main factors must be considered to minimize risk of infection: 1) the stem should have a sufficient length to allow the smoke to cool down, 2) additional mouth pieces should be used to minimize the risk of burning lips, 3) any pipes that have chips or broken pieces should not be used and 4) avoid scratching the inside of the pipe to recuperate oil as this may cause glass particles to be inhaled (Ministère des solidarités et santé, 2020).

Self-made pipes increase the risk of injuries and burns. Mouth and lip burns can occur from the use of metal "straight shooters" made from metal pipes and car antennas (Porter & Bonilla, 1993). Plastic bottles release toxic vapours when heated, which can be inhaled while smoking crack cocaine (Hopkins et al, 2012). Beverage cans are lined with plastic which can melt and release toxic vapours. Additionally, low quality glass eyedroppers and stemmed glass tubes, commonly sold in convenience stores, can shatter when heated causing injury to the eyes and entire face (Jozaghi et al., 2016). Lastly, the use of metal wool (such as Brillo.) to hold the rock in place can result in small pieces of metal being inhaled, and can cause damage to the oral cavity, throat and lungs (Meleca et al., 1997; Mayo-Smith & Spinale, 1997).

Evidence for the role of crack cocaine smoking in disease transmission

Smoking crack cocaine can increase the risk of acquiring diseases such as HIV, HCV, hepatitis B (HBV), other sexually transmitted infections (STIs) and respiratory infections such as tuberculosis and pneumonia. The risks of smoking crack cocaine can be divided into two categories. The first category relates to the physical injuries, inflammation and immunosuppression caused by smoking crack cocaine. The second category concerns practices that are associated with increased risk of infection for individuals who smoke crack cocaine. It is hypothesized that transmission may occur if a pipe with bodily fluids (mucous, saliva and/or blood) contaminated with HBV, HCV, pneumonia, or tuberculosis bacteria is used by more than one person.

Glass and metal pipes conduct heat, resulting in burns to hands and lips while smoking crack cocaine. The hot vapours and metal wool particles (eg. Brillo particles) can also cause burns to the mouth and throat (Mayo-Smith & Spinale, 1997; Meleca et al., 1997; Osborne et al., 2003; de Lima, 2007; Zacharias et al., 2011; Jozaghi et al., 2016; Valdez et al., 2016). The anaesthetizing effects of cocaine on the surface of the oral cavity can diminish the sense of pain, therefore increasing the risk of injury and burns (Meleca et al., 1997). These injuries can act as an entry point for pathogens into the bloodstream.

People who smoke crack cocaine have heightened risks for disease transmission and infection compared to the general population due to effects of the smoke and heat on the oral cavity. Faruque and colleagues (1996) reported a higher prevalence of oral sores among individuals who smoked crack cocaine more than 3 times per week, for at least one month prior to the study, compared to those who had never smoked crack cocaine. Such sores have also been reported in Campbell River, Nanaimo and Prince George, BC, Edmonton, Alberta and Ottawa, Ontario (Fischer et al., 2010; Leonard et al., 2006; 2010; Hyshka et al., 2016). Hot crack cocaine vapours along with metal particles can lead to inflammation in the oral cavity (Restrepo et al., 2007). Prolonged inflammation has been shown to increase the risk of infection. Inflamed tissue contains large numbers of white blood cells that can act as hosts for HIV (Mayer & Venkatesh, 2011). Therefore, inflammation caused by smoking crack cocaine may present a risk of disease transmission similar to that of STIs and other blood-borne diseases.

Risk and prevalence of HIV transmission among people who smoke crack cocaine

The Safer Inhalation Program Final Evaluation from Ottawa reported that 46 to 75% of laboratory-confirmed HIV-positive clients shared crack cocaine pipes (Leonard, 2010); and it is hypothesized that this is a means through which infectious bodily fluids such as blood can be transferred between people who smoke crack cocaine. Inflammation, cuts, burns and oral sores increase the likelihood of transmission of bloodborne infections. Prevalence rates of HIV among people who smoke crack cocaine in Canadian settings last reported range from 19% in Vancouver to 6% in Toronto and 10.6% in Ottawa (Bayoumi et al., 2012; Leonard, 2010; Shannon et al., 2008). The Toronto group included some people who used to inject drugs, although no one had injected in the previous 6 months. A study by Hagan and colleagues in New York City (2011) identified smoking crack cocaine as an independent predictor of HIV infection; participants who inhaled or smoked drugs were 4.2 times more likely to be HIV positive than those who had ever injected (95% confidence interval = 1.5–12.5) (Hagan et al., 2011). In a study from Washington D.C., HIV prevalence among people who smoke crack cocaine was 11.1% versus 9.5% in people who inject drugs (Kuo, et al., 2011). In these two studies, the authors suggested that the high rates of HIV among people who smoke crack cocaine were related to risky sexual behaviours. A study from New York City focused on a cohort of non-injection drug users observed a decrease in HIV prevalence from 16% in 2005 to 8% in 2014 (Des Jarlais et al., 2016). This finding was observed alongside a significant decrease in reported crack use, decrease in having multiple sex partners, and an increase in Anti-Retroviral Therapy (ART) utilization among participants (Des Jarlais et al., 2016). Since the risk of transmission of HIV is highest for sharing of injection equipment, it can be difficult to attribute infection to crack cocaine smoking and/or sexual risk in people who used to inject drugs and it is important to separately study people who smoke crack cocaine and who have never injected.

Smoking crack cocaine and HIV transmission have been linked through high-risk sexual behaviours (e.g., multiple sex partners, sex work and exchanging sex for drugs or shelter, and inconsistent condom use) and the intensity and frequency of smoking crack cocaine (Hoffman et al., 2000; Kuo et al., 2011; Schonnesson, et al., 2008). Intensity of use refers to how much crack cocaine is smoked in a single setting, while frequency refers to the number of smoking episodes in a defined time period. Daily smoking of crack cocaine increased the risk of HIV seroconversion in a study of Vancouver area people who smoke crack cocaine (DeBeck et al., 2009). Continued smoking of crack cocaine has been associated with the progression of HIV infection to AIDS-related disease due to immune system compromise and higher viral loads (Cook et al., 2008; Kipp et al., 2011). Crack cocaine may also accelerate the progression of HIV/AIDS even while a person is on ART (Baum et al., 2009; Kipp et al., 2011; Rasbach et al., 2013). Ladak and colleagues (2019) reported that daily non-injection crack use was associated with a greater risk of HIV-1 viral load rebound in ART-exposed participants (AHR = 1.45, 95% CI: 1.08, 1.92). Higher viral loads present a greater risk for HIV transmission if others are exposed to the affected individual's blood (CATIE, 2009). Therefore, individuals who smoke crack cocaine may be at an elevated risk for acquiring or transmitting HIV.

Risk and prevalence of HBV transmission in people who smoke crack cocaine

It is hypothesized that HBV may be transmitted through sharing crack cocaine pipes because HBV can be spread through exposure of mucous membranes (e.g., mouth, genital area, rectum) and broken skin to infectious body fluids (blood, saliva, semen, vaginal fluids) and contaminated drug equipment (PHAC, 2010). Shared pipes may contain the blood or saliva of another person and therefore present a risk for HBV transmission, particularly since the virus can also survive for more than a week on inanimate surfaces (Kramer et al., 2006).

Hepatitis B can cause damage to the liver and it is present in high proportions among individuals who are highly sexually active and individuals who inject drugs (PHAC, 2009; PHAC, 2019). In Canada, the primary mode of transmission of the Hepatitis

B is through sexual contact and in 2017 the total number of reported HBV acute and chronic cases was 0.5 and 11.4 per 100,000, respectively (PHAC, 2019). Neaigus and colleagues (2007) reported that risk of HBV seroconversion was related to multiple sex partners and decreased safer sex practices. As noted previously, because smoking crack cocaine is associated with increased sexual activity, inconsistent condom use, and other riskier sexual behaviours, there is an increased risk of sexual exposure to HBV among people who smoke crack cocaine.

Risk and prevalence of HCV among people who smoke crack cocaine

Pipe sharing has been positively associated with the transmission of HCV (Macias et al., 2008; Neaigus et al., 2007). In a laboratory study by Fischer and colleagues (2008), HCVRNA was isolated on a used crack cocaine pipe. It has been hypothesized that HCV particles can be transferred to a pipe in blood or saliva, thus presenting a risk for transmission if pipes are shared (Fischer et al, 2008). HCV particles were detected on inanimate surfaces after 7 days (Doerrboecker et al., 2011). Ciesek and colleagues concluded that due to the stability and infectivity of HCV at room temperature on various surfaces, it presented a substantial risk for transmission (2010). In this study HCV particles were detected 28 days after inoculation of plastic and metal surfaces and rubber gloves (Ciesek et al., 2010). Several studies have reported the presence of HCV particles in saliva (Hermeida et al., 2002; Lins et al., 2005; Suzuki et al., 2005; Wang et al., 2006); and in nasal secretions (Aaron et al., 2008; McMahon et al., 2004). Therefore, there is also the potential for devices used to smoke or snort drugs (such as pipes and straws) to transfer pathogens among individuals. This is particularly important if skin or mucous tissue integrity is compromised (smoking crack cocaine can damage the lips and tissues lining the oral cavity and throat).

The risk of acquiring HCV through sexual activity is low; however, damaged mucous membranes such as those in the mouth, vagina or rectum have been implicated in the transmission of the virus (Alter, 2011). Therefore, riskier sexual behaviours among people who smoke crack cocaine may create an elevated risk for HCV infection.

The prevalence of reported HCV cases in Canada as of 2017 is 31.7 per 100,000 population (PHAC, 2019). In Ottawa, the prevalence among people who smoked crack cocaine during Phase 1 of the Safer Inhalation Program was 36.5% and non-significant declines in prevalence of HCV were noted 11 months after implementation of the program (Leonard, 2010). Fifty-two to 62% of participants in the study with a positive HCV test reported lending their used pipes. This is a troubling finding, given the association between pipe sharing and HCV infection. A 2018 study conducted in Vancouver used phylogenetic clustering of HCV infection and latent class analysis to identify the increased risk of HCV transmission among different drug user sub-groups. They suggest that the likelihood of HCV transmission is higher within the cocaine injecting and the cocaine and opioid injecting groups than within the crack-smoking group (Jacka et al., 2018). Shannon and colleagues reported that among people who smoke crack cocaine and inject drugs in Vancouver, the prevalence of HCV was 79%; for people who smoke crack cocaine only it was 43% (2008). Toronto I-Track results indicate that the prevalence of HCV among people who smoke cocaine was 29% (Bayoumi et al., 2012). In a study of sex workers in Miami, Florida, a significant predictor of being HCV-positive was daily crack cocaine use (OR=2.197, (1.28-3.76), $p<0.004$) (Inciardi, 2006). Finally, a study of poly-drug users in Montreal observed that HCV seroconversion was associated with smoking crack cocaine (cHR 1.23, 95% CI: 0.74-2.06). Importantly, the same study found that individuals who injected prescription opioids and smoked crack cocaine had a super-additive risk of HCV infection (cHR 4.14, 95% CI: 2.55-6.74, RER1HR: 1.27). This highlights that poly-drug users constitute a population of concern (Puzhko et al., 2017).

Risk and prevalence of other STIs in people who smoke crack cocaine

In a report about Toronto area people who smoke crack cocaine, Goodman noted that many respondents reported STIs as among their largest concerns (2005). Crack cocaine smoking has been associated with screening positive for concurrent STIs (Dehovitz et al., 1994; Miller et al., 2008). Crack cocaine has also been associated with detection of prevalent and incident infections of Human papilloma virus (HPV) (Minkoff et al., 2008); Herpes Simplex Virus -2 (HSV-2; Des Jarlais et al., 2010); HIV and HSV coinfections (Des Jarlais et al., 2010); Lymphogranuloma Venereum (Bauwens et al., 2002); Trichomoniasis (Sorvillo et al., 1998; Cu-Uvin et al., 2001; Gollub et al., 2010); and lastly, syphilis (Ross et al., 2006; Se.a et al., 2007). A nation-wide longitudinal survey from the United States observed that non-injection crack cocaine use was significantly associated with having a biologically-confirmed STI (APR: 1.63, 95% CI: 1.10–2.42) and having sex with an STI-infected partner (crack-cocaine APR: 1.65, 95% CI: 1.31–2.08; Khan et al., 2013). As noted previously, smoking crack cocaine can lead to inflammation in the oral cavity and increase the risk for acquiring an infection. Many STIs, including syphilis, herpes simplex-2 virus (HSV-2), chlamydia, and gonorrhea, can also lead to ulcers and inflammation in the oral cavity (Venes, 2009). In a comprehensive review of HIV and STI transmission, Mayer & Venkatesh concluded that inflammation in mucous tissues can facilitate the transmission of HIV (2011).

Risk and prevalence of pneumonia and tuberculosis in people who smoke crack cocaine

It is hypothesized that pneumonia and tuberculosis (TB) may be transmitted through sharing or reusing crack pipes. Mycobacterium tuberculosis (the bacterium that causes tuberculosis in humans) can survive for up to 4 months on inanimate surfaces (Kramer et al., 2006). Phlegm or saliva can carry bacteria, and infectious saliva on shared pipes was posited as the cause of an outbreak of pneumonia in Vancouver among people who smoke crack cocaine (Romney, et al, 2008). In this study, crack cocaine smoking was the single most important risk factor for developing severe pneumonia (OR=12.4, CI – 2.22-69.5); and it was proposed that transmission might have been accelerated by the depressed social conditions and marginalization of many people who smoke crack cocaine (Romney, et al, 2008).

Between 2006 and 2008, a tuberculosis outbreak occurred in British Columbia. Forty-one confirmed cases of tuberculosis were discovered, and genetic analysis of the tuberculosis strain revealed that it had been present in the region 5 years prior to the outbreak (Gardy et al., 2011). The investigators noted that the epidemic curve also matched the number of cocaine-related police investigations, and the number of crack cocaine smoking spaces in the region. The outbreak was subsequently attributed to crack cocaine smoking (Gardy et al., 2011). It is unclear from the study if infection was a result of pipe sharing or being exposed to sputum or phlegm (through coughing or sneezing). Shotgunning, the practice of blowing inhaled vapours directly into the mouth of another person (Haydon & Fischer, 2005), had previously been implicated in a TB outbreak among a group of people who smoked crack cocaine in South Dakota (McElroy, et al., 2003).

A review of TB outbreak investigations in the United States noted that the transmission of TB is perpetuated through impaired immune responses in the lungs due to crack cocaine smoking, prolonged infectious periods due to delays in seeking medical care, and drug equipment sharing in poorly ventilated spaces such as "crack houses" (Mitruka et al., 2012). The authors of this review also reported that poverty, unstable housing and overcrowding perpetuated transmission (Mitruka, et al., 2012). In a pilot study involving people who smoke crack cocaine in Toronto, 95% (19/20) of the participants reported at least one respiratory complaint in the week prior to the study, 60% (12/20) had a diagnosis of chronic obstructive pulmonary disease (COPD), and 20% (4/20) had both asthma and COPD (Leece et al., 2012). While this was a small pilot study, asthma and COPD are associated with the acquisition of respiratory infections (Soriano et al., 2005). Therefore, it is important to consider the multiple risks associated with respiratory infections for people who smoke crack cocaine.

The immune system, levamisole, fentanyl and crack cocaine

In 2008, five cases of severe neutropenia (low white blood cell count) linked to levamisole in cocaine were reported in Alberta (Knowles et al., 2009). A study reported 42 total cases of neutropenia in Alberta and British Columbia, with over 50% of those affected reporting cocaine use (Knowles et al., 2009). The main route of cocaine consumption among those with neutropenia was smoking (72%), and 50% reported recurrent cases of neutropenia following continued smoking of crack cocaine (Knowles et al., 2009). Buxton and colleagues reported that between 2008 and February 2011, 45 incidents of neutropenia were reported by BC doctors, with at least three fatalities (2011). A U.S. report estimated that 69% of cocaine seized in the United States contains levamisole (Brackney et al., 2009). Since much of the cocaine found in Canada comes from the same sources as that found in the U.S, it is likely that similar concentrations of the adulterant are found in Canada.

Levamisole is a drug that is used to treat parasites in livestock and can be added to crack cocaine during its production to increase the volume (Larocque & Hoffman, 2012). The adulterant may also be converted by the body into a chemical with amphetamine-like properties and may induce many of the same pleasant sensations that are attributed to cocaine (Bertol et al., 2011). Levamisole impairs the normal functioning of the immune system, resulting in a condition called agranulocytosis or neutropenia (a severe depletion of circulating white blood cells) and vasculitis (Larocque & Hoffman, 2012). If untreated, the condition can quickly progress to septicemia (infection in the blood) and is life-threatening. The adulterant has also been known to lead to small, darkened areas on the skin (purpura) due to necrosis (cell death).

Immune system dysfunction has long been associated with the use of cocaine in all its forms (Cabral, 2006; Friedman et al., 2006). Crack cocaine use can decrease the ability of an individual's body to fight off infections. Levamisole increases this risk, and it is important to educate clients about the signs of infection, encourage regular check-ups with healthcare workers, and urge clients to seek medical attention if they notice any changes in their skin or feel feverish.

Fentanyl and its analogues (eg. furanyl-fetanyl, carfentanil, acetyl-fentanyl) have been increasingly detected in illicit drug supplies in Canada, including cocaine (Baldwin et al., 2018; Hayashi et al., 2018). The presence of fentanyl in the illicit drug supply is a public concern. Fentanyl and other drugs combined with fentanyl are much more potent that other opioids sold in the illicit market and can greatly increase overdose risk when users are unaware of its presence in their drugs (Amlani et al., 2015; Payer et al., 2020). In 2016, British Columbia reported the first cluster of overdoses in North America caused by crack cocaine laced with the fentanyl analogue, furanyl-fentanyl (Klar et al., 2016). Forty-three people were brought to the emergency department over four days and 51% (n = 22) of the individuals became unconscious after smoking crack cocaine (Klar et al., 2016). In Philadelphia in 2018, a cluster of 18 patients were brought to the emergency department for overdose symptoms after smoking crack cocaine, and 15 people had confirmed unintended fentanyl exposure (Khatri et al., 2018). Similar reports occurred in San Francisco, California in 2017 (Garcia &

Aragón, 2017). Data collected by Health Canada from April 2018 – August 2019 reported that 2% (n = 931) of cocaine samples analyzed contained fentanyl or fentanyl analogues (the form of cocaine is unspecified) (Prayer et al., 2020). A study conducted across harm reduction sites in British Columbia observed that individuals who prefer to smoke drugs were significantly less likely to possess a naloxone kit compared to those who prefer to inject. This study may indicate a need for increased awareness of the potential risk of opioid overdose with crack cocaine use (Moustaqim-Barrette et al., 2019).

Risky crack cocaine smoking behaviours

Sharing pipes

The sharing of pipes, including stems and mouthpieces, has been reported in many evaluations of safer smoking supply distribution programs across Canada (Backe et al., 2011; Barnaby et al., 2010; Benjamin, 2011; Goodman, 2005; Leonard et al., 2007; Leonard & Germain, 2009). Pipe sharing has also been reported in numerous Canadian studies of smoke crack cocaine use (Fischer et al., 2010; Ivsins et al., 2011; Leonard et al., 2008; Malchy et al., 2008; Hyshka et al., 2016; Poliquin et al., 2017; Cheng et al., 2015; McNeil et al., 2015; Roy & Arruda, 2015). While uptake rates of safer smoking supplies have been encouraging, a study from Vancouver reported that while 83% of respondents were using mouthpieces, 79% were sharing mouthpieces (Malchy et al., 2008). Anecdotal reports from those with field experience have noted that individuals find it difficult to remove the mouthpiece from the pipe while it is still hot, making them less likely to use their own mouthpiece while sharing (Jagoe, 2014). The presence of a mouthpiece (even if it is previously used) may prevent burns to the lips; however, it cannot protect against exposure to saliva, phlegm or blood from sores if it is shared. Education about the purpose and benefits of mouthpieces for people who smoke crack cocaine has been identified by frontline workers as essential to influence the uptake and proper use of mouthpieces in Ottawa (Leonard, 2010). This education may need to include explicit information about the risks related to all equipment sharing – not only stems.

Sharing of pipes can be influenced by factors such as smoking in small groups; allowing others to use one's pipe so that the owner can collect the "resin" (the residue that collects on the inside of a pipe while crack cocaine is being smoked); adhering to social pressures; opportunistic crack use of occasional smokers; and intimate relationships (Boyd et al., 2008; Poliquin et al., 2017; McNeil et al., 2015; Roy & Arruda, 2015). Voon and colleagues (2016) observed that of participants who smoke crack cocaine, 34.9% (n = 379) reported public crack smoking, which was significantly associated with crack pipe sharing (AOR: 1.98, 95 % CI: 1.60-2.46). Respondents in a survey from Calgary and qualitative interviews from Vancouver reported that the high cost of new pipes and lack of access to clean pipes promoted sharing in their community (Benjamin, 2011; Jozaghi et al., 2016). Difficulty in accessing pipes has previously been associated with pipe sharing (OR=1.91; 95% CI: 1.51–2.41) (Ti et al., 2011). A Quebec study found that occasional crack smokers more frequently reported difficulty in gaining immediate access to crack smoking equipment; whereas, frequent smokers found it was easy to find equipment through community services (Poliquin et al., 2017). Shannon and colleagues (2008) found that female sex workers who shared drugs with clients had a greater risk of smoking with a used pipe; being intensive smokers of crack cocaine; using condoms inconsistently with clients; and being verbally, physically, or sexually assaulted. It was also found that 49% (n = 101) of female sex workers in BC reported exchanging sex for crack and that this exchange was significantly associated with sharing smoking equipment with clients (Duff et al., 2013). Additionally, a Vancouver study observed that female crack users were often threatened with violence by men and forced to share their crack-smoking equipment (McNeil et al., 2015).

Sharing smoking supplies has been described by some as a ritualistic social practice (Fischer et al., 2010). Sharing may also be influenced by the physical form of the drug and the difficulty in dividing it up if numerous individuals have pooled their money to purchase it. These factors may prove difficult to influence and they deserve consideration because of the poverty associated with crack cocaine and the group norms related to drug consumption. The grouping of individuals during smoking episodes and the incidence of sharing may occur because of several influences. Despite the increased distribution of safer crack cocaine kits in jurisdictions across the country, the practice of pipe sharing persists. Malchy and colleagues noted in a study of Vancouver area people who smoke crack cocaine that after the implementation of the safer smoking distribution program, respondents reported an increase in their use of items that had been used by someone else (2011). The authors posited that drug sharing networks or lack of consistent access may explain this finding (Malchy et al., 2011). Poliquin and colleagues observed that participants who smoke crack cocaine reported continuing to share crack pipes despite their knowledge of the risks and easy access to smoking equipment through health services (2017). Reasons for this can include: individuals not wanting to visit health service points or carry smoking equipment for fear of being identified as a user by police officers or others; and having a loss of concern for safe practices while intoxicated (Poliquin et al., 2017).

Smoking intensity and frequency

Crack cocaine use is associated with high intensity (large amounts) and frequency (high number of smoking episodes; Macias et al., 2008; Roy et al., 2017). Data from Canadian settings has revealed crack cocaine smoking episodes ranging from 1 to 70 per day (Fischer et al., 2010; Leece et al., 2012; Leonard & Germain, 2009). Impaired memory and disinhibition due to heavy use can lead to behaviours such as sharing drug use equipment and risky sexual practices (DeBeck et al., 2009). A study conducted in Montreal by Roy and colleagues (2017) reported that crack binging episodes were significantly associated with sharing smoking equipment (AOR 1.30). High-risk sexual behaviours such as multiple sex partners and inconsistent condom use have also been linked to frequency and intensity of crack cocaine smoking (Hoffman et al., 2000; Schonnesson et al., 2008). As noted previously, higher intensity of crack cocaine smoking is also associated with sharing drugs with clients, which can increase exposure to violence (Shannon et al., 2008).

Smoking practices

"Seconds" and "Shotgunning" are risky practices that can transmit disease. Shotgunning is the practice of blowing inhaled vapours directly into the mouth of another person (Haydon & Fischer, 2005). For "seconds", vapours are blown into condoms and reinhaled or shared with others (Boyd et al., 2008). Having air/smoke blown into one's lungs, breathing in quickly, and holding the vapours for too long can lead to lung damage (Haim, 1995; Millroy & Parai, 2011). Shotgunning was implicated in a TB outbreak in South Dakota (McElroy et al., 2003). Therefore, it is important to educate service providers and service users about disease transmission, as well as the physical risks of these practices.

Impact of distribution of safer smoking equipment on risk behaviours

Evidence shows that Canadian safer smoking equipment programs have a positive impact on pipe sharing, use of hazardous equipment and binge drug use. The Safer Inhalation Program's evaluation revealed that the distribution of clean supplies could reduce usage of a pipe from an average of 288 times to 40 before disposal (Leonard, 2010). Repeated pipe use increases the likelihood that it will crack or break (Hopkins et al., 2012); this in turn increases the likelihood of cuts. The evaluation also reported a decrease in the proportion of respondents who shared pipes and decreased use of non-recommended pipe components such as metal pipes, car aerials, soda cans and inhalers (Leonard, 2010). Evaluation of the safer crack kit distribution in Toronto and Winnipeg yielded similar findings (Backe et al., 2011; Hopkins et al., 2012).

Among people who smoke crack cocaine in Prince George, 97.6% reported obtaining safer smoking supplies from the local safer crack smoking supply distribution program (Fischer et al., 2010). In Prince George, people who smoke crack cocaine credited the safer supply distribution program with reducing their need to share pipes, use makeshift materials, and rely on drug sellers for pipes (Fischer et al., 2010). Other evidence reflects the uptake of safer smoking supplies and practices by people who smoke crack cocaine. Ninety-two percent of Toronto participants in the I-Track study obtained safer smoking supplies from harm reduction programs (PHAC, 2006). A Vancouver area study showed that crack pipe distribution programs can be successful in reducing health problems experienced by crack users (Pragnell et al., 2017). It reported a significant increase in the proportion of individuals, 7.2% in 2005 to 62.3% in 2014, who reported obtaining crack pipes though a health service agency (Pragnell et al., 2017). The same study reported that obtaining crack pipes only through health service agencies was negatively associated with health problems related to smoking crack (AOR = 0.74).

Regular access to safer smoking kits may also decrease bingeing. Increases in pipe sharing and smoking binges were reported in Calgary due to program cancellation (Benjamin, 2011). Scarcity of pipes and rare opportunities to use were credited with driving people to binge and consume large quantities (Benjamin, 2011). Numerous factors hinder safer smoking practices, including harm reduction distribution sites where limited hours of operation may force clients to engage in unsafe smoking practices (Ti et al., 2012). Cancellation of The Safeworks Crack Kit Program in Calgary reportedly led to an increase in injecting drugs; demand for syringes increased by 5.9%, because they were free and readily available (Benjamin, 2011). Additionally, client reports in BC showed that when people were unable to access an unused pipe, 27% shared a pipe and 20% injected instead (Papamihali & Buxton, 2020). This complements findings from an Ottawa study that reported that safer smoking supply distribution led to a decrease in injecting drugs (Leonard et al., 2008). These reports indicate that drug use in many contexts is changeable and can be influenced by providing safer supplies.

Mouthpieces are currently promoted as an important piece of equipment for safer crack cocaine smoking. They insulate the pipe and help prevent cracks and burns to the lips. Cracks and burns can provide an entry into the client's bloodstream and present a risk for disease transmission. Backe and colleagues (2011) reported that since the distribution of kits that contained mouthpieces, 60% of the clients reported that incidents of cracked and burned lips declined.

Safer smoking equipment and distribution policies

Across Canada, safer smoking supply programs distribute the following pieces of equipment individually or in kits: glass stems, mouthpieces, push sticks, screens and alcohol swabs (Backe et al., 2011; Hopkins et al., 2012; Johnson et al., 2008; Leonard et al., 2006; Leonard, 2010; Leonard et al., 2008; Leonard & Germain, 2009; Bergen-Cico & Lapple, 2015; Miskovic et al., 2018). Kits may also include disposal education or resource materials, and additional items such as condoms, lubricant, lighters, matches, lip balm, gum, or adhesive bandages for small cuts or blisters. (Backe et al., 2011; Benjamin, 2012; Hopkins et al., 2012; Johnson et al., 2012; Leonard, 2010; Leonard et al., 2008; Bergen-Cico & Lapple, 2015). Reports from Quebec indicate that over 100,000 mouthpieces, 100,000 glass stems, 800,000 metallic screens and 48,000 push sticks were distributed between 2015 and 2016 (Gouvernement du Québec, 2017).

Studies of safer crack distribution programs have not evaluated the degree to which each individual piece of equipment decreases harm to the people who smoke crack cocaine. For example, no scientific studies have compared the risks from use of Pyrex/borosilicate glass stems to stems/pipes made from other materials. As well, no studies have evaluated whether brass or stainless-steel screens are indeed safer for clients to use than steel wool (i.e., significant reduction of inhalation of metal particles). Safer injection equipment (e.g., syringes and cookers) has been more extensively researched. Similar research is needed to evaluate the relative effectiveness and safety of crack cocaine smoking equipment.

Distribution of safer smoking equipment is based on client preference, historical precedent (e.g., glass rose vials have been used as pipes), sound judgment about the risks associated with crack cocaine smoking, and trial and error. The choice of many current safer smoking supplies is based on their use in similar ways in other contexts. For example, the recommended brass screens are intended for smoking tobacco in pipes. Since they are safe to use in a situation where smoking is involved, they have been deemed appropriate in this context. Similarly, Pyrex/borosilicate glass is used in laboratory settings because of its heat resistance, strength, lack of coatings and non-reactivity.

Client preferences, existing best practice documents that relate to infection control, manufacturers' instructions for use and peer-reviewed research (where available) were used to develop the following recommendations. Individual programs and/or provincial equipment distribution programs will need to consult these same sources to determine pieces of equipment to purchase and distribute. Four items have been deemed to be core supplies for the purposes of safer smoking: a Pyrex/borosilicate stem, non-reactive and uncoated metal screens, a non-scratching push stick, and a food-grade mouthpiece. These four items are essential components because they are required to construct a complete pipe.

a) CORE: Borosilicate glass (Pyrex) stems

Borosilicate glass tubing contains at least 5% borosilicate which makes it resistant to high temperatures. This material is used to manufacture glass "straight-shooters" (stems) to smoke crack cocaine. The heat resistance of the glass and the lack of any coatings that could burn or release vapours make stems of this material well-suited for smoking crack cocaine. Client preferences, mouthpiece diameter and cost may influence the physical characteristics of the stems (wall thickness, diameter of glass stems, and stem length). Wall thickness and diameters of glass tubes vary. Thicker walled stems may be more resistant to breakage if dropped and therefore, may last longer. Distribution of a standard stem is advisable; repeated changes in length, diameter or wall thickness require clients to learn how much heat is required to vapourize crack cocaine and to predict the point at which a pipe will be too hot to touch. Too much variation in the stem could lead to injury and discourage the replacement of stems that are damaged and hazardous. Borosilicate glass/Pyrex is not scratch-resistant, therefore use of metal objects such as wire hangers or car aerials to compact screens is not recommended. Scratches weaken the glass and increase the likelihood of breaking or shattering when exposed to heat (Care and Safe Handling of Laboratory Glassware - Corning, 2008). In a Vancouver pilot study, 81% reported using split or cracked pipes and 59% reported having a pipe that had explodede from smoking (Malchy et al., 2008). It is important to highlight that cracked or scratched pipes need to replaced, since they are at increased risk of exploding.

Suggested stem features:

- Stems that meet ISO standard 3585 are resistant to high temperatures (when ordering stems refer to the glass specification sheets available through supplier or manufacturer). Glass of this standard can withstand temperatures between 20°C to 300°C when properly manufactured and handled (International Standards Organization, 1998 T).
- Open on both ends with a light fire polish to remove the sharp edge.

b) CORE: Mouthpieces

Mouthpieces are placed at one end of a crack pipe to insulate lips from the hot pipe and may reduce the incidence of cuts from chipped edges (Goodman, 2005). This device needs to be made from a food or medical grade material. Medical grade vinyl tubing is widely available. The toxicity of mouthpieces composed of non-medical or non-food grade materials (e.g., rubber bands, spark plug boots, electrical tape, etc.) is unknown.

Suggested mouthpiece features:

- Composed of a food grade material.
- Available in variable lengths to meet client preference.
- Fit easily and securely over the end of the glass stem.
- More than one mouthpiece type may be necessary if the stems distributed vary in diameter.
- Easy to remove from a glass stem, even after it has been heated. (Removal of mouthpieces while stems are hot can result in burns to hands.)

Crack cocaine vapours can be easily deposited on the inside surface of a pipe. The longer the pipe or the mouthpiece, the greater the amount of resin that will form on the inside surface as the vapours cool and crystalize. Therefore, while longer stems and mouthpieces may protect the face and lips from being close to sources of heat, they may also decrease the amount of drug inhaled. The SCORE evaluation included a statement from a person who reported that they preferred to not use the mouthpiece since it was difficult to remove resin from it if it was about "2 inches long" (Johnson et al., 2008). At a minimum, the length of the mouthpiece should prevent the entire surface of the lips being exposed to heat from the pipe. The length of the mouthpiece may require explicit input from people who smoke crack cocaine to encourage uptake and continued use.

Low uptake of mouthpieces has been previously reported (Hopkins et al., 2012; Johnson et al., 2008; Leonard, 2006). Resistance to utilizing mouthpieces is linked to not understanding the purpose of the mouthpiece; inappropriate size matching (i.e., fit) between the stem and mouthpiece; and only using mouthpieces when sharing pipes with others (Johnson et al., 2008).

Mouthpieces cannot prevent formation of sores inside the oral cavity; their use does not prevent exposure of the mucous tissue in the mouth to crack cocaine vapours. Once the hot vapours enter the mouth, the risk of oral sores is ever-present (please refer to the discussion of changes that occur in the oral cavity upon exposure to crack cocaine vapours). Using mouthpieces are intended to protect lips from heat.

c) CORE: Push sticks

Push sticks are used to compact and (re)position screens and to recover the resin that accumulates on the inside of the pipe. Push sticks need to be made from a reusable material that will not scratch the interior or chip the stem. Wooden or bamboo chopsticks are less likely to scratch or chip glass stems or cause them to break when loading screens (Johnson et al., 2008). Borosilicate glass/Pyrex is not scratch-resistant, therefore using metal objects (e.g., car aerials) may stems to get scratched. Scratches weaken glass and increase the likelihood of breaking and shattering when exposed to heat (Care and Safe Handling of Laboratory Glassware - Corning, 2008).

Malchy and colleagues (2011) reported that syringe plungers have been used to scrape resin out of pipes resulting in melted plastic in the pipe and the unnecessary waste of unused needles and syringe barrels in the community. Eighty-seven percent of the respondents from this survey also reported using metal push sticks which can impair the integrity of the glass stems (Malchy et al., 2011). Wooden chopsticks and craft dowels (wooden rods) are distributed for this purpose since they will not scratch stems; their use should be encouraged (Malchy et al., 2011).

Suggested push stick features:

- Made from wood or another material that will not scratch or chip glass or lead to stem breakage when loading screens.
- No rough edges that could lead to splinters and cause injuries to the skin.
- The length and thickness of push sticks need to match the length and inside diameter of the stem(s) distributed. Push sticks must be long enough to allow a comfortable grip on the stick while pushing screens from one end of the stem to the other. Push sticks may need to be short enough to conceal when not in use (Johnson et al., 2008).
- The push stick must be thick enough so that it does not break when loading screens; but narrow enough to collect and scrape the resin off the side of the pipe when it is being pushed through.

d) CORE: Screens

Screens are used to prevent crack cocaine crystals and the melting crack cocaine from being inhaled through the stem and into the mouth. Commonly used materials include metal wool (steel or copper) and copper cable wire. When smoking, these materials may break apart into fragments which are then inhaled and can cause injuries to the oral cavity and lungs. These fragments may be responsible for the black sputum (phlegm) reported by 75% of the participants in a study of respiratory issues among people who smoke crack cocaine in Toronto (Leece et al., 2012). Many of these materials are also coated with substances that are not intended to be inhaled such as soap and cleaning products (e.g., Brillo. and Chore Boy).

Tobacco pipe screens that are made from steel or brass are designed for smoking and are a safer alternative to these materials. Brass screens are currently distributed by many safer smoking programs across Canada. However, some have prickly edges and reports from clients indicate that this deters their use of them (Hopkins et al., 2012). Other options may need to be explored. However, educating clients on how to properly fold and compact screens has been reported to reduce reports of pricks (personal communication, Lampkin, 2012).

Reports and studies have recorded persistent use of metal steel wool such as Brillo. in pipes, despite the distribution of brass screens in Canada (Hopkins et al., 2012; Ivsins et al., 2011; Leonard et al., 2006; Malchy et al., 2008). The continued use of metal wools such Brillo has been attributed to its ease of use (Hopkins et al., 2012). However, metal wools are coated with cleaning products that may be toxic and that disintegrate once exposed to heat. Therefore, these are not considered to be a safe option when compared to brass screens. An observational study from Vancouver reported that peer educators have been successful in improving proper preparation of screens and increasing brass screen use instead of Brillo (Jozaghi et al., 2016). Further education may be required for clients regarding the harms associated with the use of metal wools.

Suggested screen features:

- A small gauge mesh or screen that can act as appropriate surface to hold the crack cocaine in the stem when compacted.
- Made from a non-reactive substance that has high heat resistance and no chemical coatings.
- Able to be easily manipulated by hand.
- Will not cause injuries to the hands when being loaded and that will not damage the glass stem.
- The number of screens necessary will be determined by the size of the stem. It has been recommended that several brass screens be layered, and compacted into the pipe (Leonard et al., 2010). This will ensure a larger surface area for the crack cocaine to melt into once heated.
- Screens per pipe need to be distributed in sufficient quantities to prevent the inhalation of "rocks" and melted crack cocaine.

Other materials to distribute

Distribution of educational materials is recommended to provide clients with information about how to maintain a safe pipe, prevent injuries, engage in safer sex, and access services. It has been reported that clients find the tip cards contained in kits useful (Johnson et al., 2008). Distribution of condoms and lubricant with safer smoking equipment is recommended to assist clients to reduce harms from risky sexual behaviours.

Across Canada, many harm reduction programs offer supplies beyond the core supplies listed. This document is intended to provide guidance regarding safer supplies for crack cocaine smoking; therefore, there are no recommendations about the following supplies. It is also unclear how the following supplies reduce injury and risk of disease transmission for people who smoke crack cocaine since there have been no evaluations of these supplies in safer crack cocaine kit distribution programs.

Other supplies distributed are listed below (Table 9.1) with a brief rationale for their inclusion.

Table 9.1 Safer crack cocaine smoking kit items: Item and Rationale

Item	Rationale
Alcohol swabs (BCHRSS, 2008; Johnson et al., 2008; Backeet al., 2011; Hopkins et al., 2012;)	Can be used to remove surface/visible dirt from pipes and hands prior to smoking.
Antiseptic wipes (Benjamin, 2012); **Moist towelettes** (Benjamin, 2012)	NB: Topical antiseptic products such as alcohol swabs and wipes containing alcohol should not be used to clean wounds, sores, blisters, ulcers or cuts because they impair healing and therefore increase risk for infection (Atiyeh, Dibo & Hayek, 2009; McCord & Levy, 2006).
Lighter/matches (BCHRSS, 2008; Johnson et al., 2008)	Lighters may provide a more consistent heat source compared to matches. Lack of access to a lighter has been reported by people who smoke crack as increasing exposure to communal drug use situations and sharing of pipes and/or mouthpieces; public drug use and risk of victimization and/or arrest (Johnson et al., 2008).
Lip balm (Hopkins et al., 2012)	Lip balm has been distributed to moisturize dry, cracked lips that result from repeated exposure to heat.
Chewing gum (Hopkins et al., 2012)	It has been distributed to promote oral hygiene and prevent teeth grinding.
Adhesive bandages (BCHRSS, 2008; Johnson et al., 2008)	Physical barrier to protect burns and cuts to the hands.

Program coverage

Program coverage can be assessed in numerous ways such as availability within a community, across a community over time, and as a proportion of pipes needed versus those distributed. A 2017 study of needle and syringe programs across Canada (with the exception of British Columbia) found that 64% of those surveyed reported distributing safer crack cocaine smoking equipment (Strike & Watson, 2017). Crack and meth pipes and foils were added on the British Columbia's provincial order form in 2020 (Buxton, personal communication, 2021). The availability and distribution of safer crack cocaine smoking equipment is difficult to assess because it is not systematically measured (Haydon & Fischer, 2005; Strike 2011). Available data show that there is distribution of safer smoking supplies in some capacity in every province and territory except PEI, Northwest Territories, and Nunavut; however, the extent of accessibility, including the number of distribution locations and the equipment provided, varies (Anderson-Baron et al., 2017). The total number of programs that distribute safer crack cocaine smoking equipment is unknown. A summary of safer smoking supplies distributed by British Columbia's central harm reduction supply program in 2019 and by OHRDP in Ontario in 2020 is included in the following tables 9.2 and 9.3, respectively:

Table 9.2 Total safer smoking equipment ordered in British Columbia in 2019 (Papamihali & Buxton, 2020).

Equipment	Total Units
Mouthpieces (100 ft tubing)	3,656,100
Screens	684,000
Push Sticks	1,323,504
Pipes	968, 520

BC province totals include order numbers by five regional health authorities. Pipes are not currently provided through the BC harm reduction supply program. This figure represents a subset of crack pipe orders from BC health authorities through the primary distributor in 2019.

Table 9.3 Total safer smoking equipment ordered in Ontario in 2020 (OHRDP, 2021).

Equipment	Total Units
Mouthpieces (100 ft tubing)	1,040,000
Screens	2,955,400
Push Sticks	1,250,000
Pipes	2,465,760
Baggies	2,481,300

Ontario province totals include order numbers by total of 36 core harm reduction programs.

Numerous factors have combined to restrict, limit or prevent the implementation of safer crack cocaine smoking kit programs, including: political and community opposition, questions regarding efficacy and need, lack of funding and municipal regulations (Bungay et al., 2009; Canadian AIDS Society, 2008; Canadian HIV/AIDS Legal Society, 2008; De Beck et al., 2009; Haydon & Fischer, 2005; Hopkins et al., 2012; Ivsins et al., 2011; Johnson et al., 2008; Leonard et al., 2008; Shannon et al., 2008; Strike et al., 2011; Strike & Watson, 2017). Poor coverage can negatively impact attempts by individuals and communities to "adopt and maintain safer crack-smoking practices" (Leonard, 2010). Bayoumi et al. (2012) reported high rates of crack pipe lending or selling and highlighted the capacity of safer smoking supplies to be used as currency in contexts where there is high demand and low supply. Clean stems may also be bartered for sex in these situations (Hopkins et al., 2012). Greater distribution is therefore needed to ensure that supply meets demand.

Evaluations of existing programs show that, once implemented, people who smoke crack cocaine report increased access and utilization of the equipment (Backe et al., 2011; Benjamin, 2011; Hopkins et al., 2012; Johnson et al., 2008; Leonard, 2010; Malchy et al., 2011; Pragnell et al., 2017). When programs first opened, many reported insufficient quantities of equipment to meet demand, but many have since increased their distribution volumes (Backe et al., 2011; CAS, 2008; Johnson et al., 2008). Reports of outreach workers from the SCORE project being "swarmed'" on the street by clients for crack cocaine smoking kits pointed to great need in the face of limited quantities of safer smoking supplies (Johnson et al., 2008).

Data from evaluation studies point to accessibility issues related to limited program hours such as daytime-only hours of operation (Backe et al., 2011; Benjamin, 2011; Hopkins et al., 2012; Leonard 2010; Malchy et al., 2011). A desire for increased hours of service is a common theme reported in program evaluations (Backe et al., 2011; Benjamin, 2011; Hopkins et al., 2012; Leonard, 2010; Malchy et al., 2011). Clients report that when they cannot access safer smoking equipment, they are more likely to share; and some turn to injecting their drugs instead (Hopkins et al., 2012; Leonard, 2010; Jozaghi et al., 2016; Papamihali & Buxton, 2020). However, data from the Toronto evaluation study indicates that clients can respond to limited hours of operation by requesting more smoking equipment per visit (Hopkins et al., 2012). The Toronto program has no limits on the quantity of equipment that can be obtained per visit and some clients are given boxes of stems (Hopkins et al., 2012).

Coverage can also be assessed in terms of reach beyond clients who attend a program. Data show that clients often obtain supplies for themselves and for others (Benjamin, 2011; CAS, 2008; Hopkins et al., 2012; Leonard, 2010). In Ottawa, 94% (n=157) of study participants reported obtaining supplies in this way after the program had been in operation for 12 months (Leonard et al., 2008). Leonard (2010) cautions, however, that people who access supplies exclusively through their peers will not have access to the services, supports and referrals provided by harm reduction service providers; therefore, all individuals should be encouraged to obtain their own safer smoking supplies.

Distributing safer smoking equipment alongside safer injecting supplies

Studies in Calgary and Ottawa demonstrate transitions between different modes of drug consumption (Benjamin, 2011; Leonard et al., 2008). Studies conducted in Quebec, from 2003 to 2014, and British Columbia, from 1996 to 2011, reported that the prevalence of crack smoking has increased significantly, while reports of cocaine and heroin injection decreased (Roy et al., 2017; Ti et al., 2013). These transitions may lead to bridging between different drug-using populations - from a group with high endemic levels of certain infections to one with lower levels (Strathdee & Stockman, 2010). This bridging may facilitate the transmission of viruses such as HIV and HCV through sharing equipment within social networks and sexual activities (Strathdee & Stockman, 2010). Crack cocaine smoking may also be associated with increased risky injection drug use practices, as a Quebec study reported that in comparison to people who only inject drugs, people who both smoke crack and inject were more likely to use shared injection material including: syringes (aPR = 1.23, CI: 1.05–1.44), water (aPR = 1.27, CI: 1.09–1.49), filters (aPR = 1.42, CI: 1.14–1.78), and cookers (aPR = 1.37, CI: 1.16–1.62) (Roy et al., 2015). Shifting drug use patterns also require safer use education related to several different drugs and modes of consumption (i.e., smoking, injection, or snorting).

Smoking and drug injection are associated with different risks of infection. Observational studies have reported that some people who smoke crack cocaine perceive that there is minimal risk of infection when sharing inhalation equipment compared to injection equipment (Poliquin et al., 2017; Persaud et al., 2013). Believing that one route of drug consumption is "safer" than another can provide a false sense of safety for people who consume drugs. While injecting drugs can introduce pathogens directly into the bloodstream, people who smoke crack cocaine experience different risks, social harms, and health issues than those who inject drugs (Malchy et al., 2008; Butler et al., 2017). Common health problems related to smoking crack cocaine frequently reported include burns, cuts, mouth sores, sleeping problems, weight loss, and respiratory complications (Hyshka et al., 2016; Cheng et al. 2015). Additionally, issues related to criminality and marginalization increase the vulnerability of people who smoke crack cocaine (Fischer et al., 2006). Therefore, offering safer smoking supplies alongside injecting supplies is responsive to polysubstance use, changing drug use patterns, and individual risks, and may increase access among individuals who only smoke crack cocaine to other services.

Safer smoking equipment distribution evidence summary

The evidence that informs this chapter and its recommendations came from a variety of studies. Laboratory evidence and clinical reports were used to explain how risky practices associated with smoking crack increase the chances of acquiring HIV, HCV or other pathogens. Observational studies (e.g., cross-sectional and prospective cohort studies) were the primary sources of evidence used to document risky smoking behaviours and provide estimates of the prevalence of HIV, HCV and other diseases among people who smoke crack cocaine. Studies using qualitative methods provided greater insight into the role of behaviours and experiences of people who smoke crack cocaine. Systematic and meta-analytic reviews of scientific literature provided insight into interactions between crack cocaine and infectious disease. Data from program evaluations conducted in varied jurisdictions across Canada and published as grey literature were used to describe program distribution practices, demographic characteristics of program clients and the impacts of safer crack use kit distribution. Most of the evidence used in this chapter was obtained from observational studies. While RCTs are generally considered to provide the highest quality evidence for interventions, it is not always feasible or ethical to conduct this type of research within populations or with harm reduction programs (WHO, 2004, p. 5).

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Chapter 10: Safer crystal methamphetamine smoking equipment distribution

Recommended best practice policies to facilitate use of safer crystal methamphetamine smoking supplies:

DISTRIBUTION

- Distribute safer crystal methamphetamine smoking supplies – bowl pipes and mouthpieces
- Distribute safer sex supplies, such as condoms and lubricant
- Distribute safer crystal methamphetamine smoking supplies without requiring exchange of used
- Distribute based on the quantity requested by clients with no limits
- Offer mouthpieces with each bowl pipe provided

EDUCATION

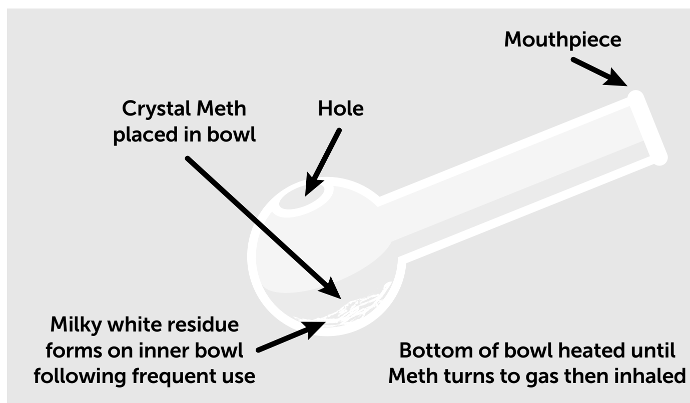
- Educate about:
  - safer use of equipment
  - the proper disposal of used safer smoking equipment
  - safer smoking practices
  - the risks of sharing smoking supplies and
  - safer sex and
  - overdose prevention practices
- Educate about the importance of replacing a bowl pipe when:
  - The bowl pipe and/or the mouthpiece have been used by anyone else
  - The bowl pipe is scratched, chipped or cracked
  - The mouthpiece is burnt

DISPOSAL

- Dispose of used smoking supplies in accordance with local regulations for biomedical waste
- Encourage clients to return and/or properly dispose of used or broken pipes
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings

Description of how methamphetamine is smoked using a pipe

Methamphetamine is a synthetic central nervous system stimulant that can be ingested via vapourizing/smoking, injecting, intranasal administration (snorting), or taken orally depending on its form. Common street names include "meth", "crystal meth", "crystal", "ice", "speed", "Tina", "T", "shards"and "crank" – "ice" and "crystal (meth)" are often used when the drug is in its smokable form (Anglin et al., 2000; Buxton & dove, 2008; national Institute on drug Abuse, 2006). The instruments used to smoke methamphetamine can vary, but typically people who smoke the drug heat it in a small, glass pipe and then inhale the resulting vapours. In a qualitative focus group study of 32 people who smoke methamphetamine recruited from community agencies in Toronto, participants reported commonly using store-bought "ball pipes" for smoking methamphetamine (Hunter et al., 2012).



Picture recreated from www.tpub.com/maa/12740_files/image130.jpg

Some reported using pipes or stems typically used for smoking crack cocaine, but these stems were considered unsuitable for smoking methamphetamine. According to Hunter et al. (2012), ball pipes were preferred because when heated, methamphetamine liquefies and turns into vapour that is then inhaled; the ball or bowl on the end of the pipe collects the liquid, preventing it from being inhaled and/or swallowed. When ball pipes are unavailable, people might construct makeshift pipes (e.g., out of light bulbs, soft drink cans) or convert crack cocaine stems into ball pipes by heating the stem and blowing out a ball on the end (Hunter et al., 2012); these practices may carry their own risks of injury or burns. When asked about what type of equipment should be distributed if a new program were implemented, participants recommended ball pipes made of durable glass or Pyrex because these materials are less likely to break. Also, participants noted that bowl size should be large enough to collect the liquefied methamphetamine and the "ventilation hole" should be large enough to allow oxygen into the bowl for vaporization, although the pipe itself should not be so large that it is difficult to carry and conceal. There were differences of opinion regarding preferred stem length. While these findings came from a large urban centre, it should be noted that people in rural settings may have little or no access to specialized ball pipes.

In the chapter regarding distribution of safer crack cocaine smoking equipment, we recommended distribution of mouthpieces. These are considered integral pieces of equipment because they help to prevent cuts and burns to the mouth and lips from crack cocaine pipes. There is very limited evidence to determine if high temperatures and damage to crystal methamphetamine pipes lead to a similar set of injuries among people who smoke crystal methamphetamine.

In addition to pipes, other methods reportedly used to smoke methamphetamine include using foil and straws, similar to "chasing the dragon" and heating a crack cocaine stem and inhaling vaporized methamphetamine through the nose ("hot railing"; Hunter et al., 2012). However, it is generally unclear how often these methods are used. In a study of 100 street-involved youth in Toronto, Barnaby et al. (2010) reported that among those who smoked methamphetamine, 83% used a glass pipe, typically with a bowl on the end; 40% used a pipe made from a light bulb; 21% used tin foil; 19% used a crack cocaine pipe; and 8 % used a metal pipe.

Evidence about smoking methamphetamine as a vector of transmission

There is currently no biological evidence linking crystal methamphetamine smoking and transmission of HIV, hepatitis C (HCV), and other blood-borne pathogens. Extrapolating from the research about crack cocaine smoking, the rationale for providing safer inhalation equipment can be applied to smoking crystal methamphetamine as well, because many of the risks associated with smoking crack cocaine are shared (Shirley-Beavan, 2019). A report from the European Union in 2019 (Shirley-Beavan, 2019) found that, based on the research data from Canada and Mexico, providing safer inhalation equipment can be effective in reducing injection (Malchy et al, 2011; Hunter et al, 2012), reducing the use of makeshift or shared equipment (Prangnell et al, 2017) and reducing the incidence of cuts, burns, blisters and other pipe related injuries to the lips, mouth and gums (Grund et al, 2010; Collins et al, 2005).

People who use methamphetamine are at increased risk of HIV due to the relationship between the drug and sexual risk behaviours (Maxwell et al., 2006). Recognizing that crystal methamphetamine and crack cocaine are different stimulants with different implications for people who use them, we extrapolate from the literature on sharing equipment for smoking crack cocaine to suggest that sharing pipes for smoking methamphetamine could also pose risks for pathogen transmission. Although it is possible that there are fewer risks for smoking-related injuries like cuts and burns from smoking methamphetamine compared to smoking crack cocaine (e.g., due to less heat required, homemade pipes less common; Hunter et al., 2012), more research is needed to determine the level of risk.

Evidence of the prevalence of methamphetamine smoking and associated risk behaviours

When smoked, crystal methamphetamine is rapidly absorbed through the lungs and studies have found moderate to high bioavailability (Cook et al., 1993; Harris et al., 2003). Smoking crystal methamphetamine appears to be a common route of administration across various countries in the world (Farrell et al., 2002; Laidler & Morgan, 1997; Matsumoto et al., 2002). Brands and colleagues (2012) surveyed 100 addiction treatment agencies in Ontario about methamphetamine admissions. Between 2004 and 2005, 53% of respondents reported an increase in clients with methamphetamine problems. Only 9% considered methamphetamine as a significant problem in 2005, while 60% reported that methamphetamine was a minor problem or not a problem. Further, Brands and colleagues (2012) found that admissions for methamphetamine peaked in 2005 (at 2.4% of admissions) and then dropped to a lower percentage of admissions between 2006 and 2008. Again, we lack Canadian estimates of methamphetamine smoking. Overall use of methamphetamine in the population appears low, though more national prevalence estimates are needed. Data from the Canadian Alcohol and Drug Use Monitoring Survey 2009 showed that only 0.1% of Canadians aged 15 and over reported methamphetamine use in the prior year (Health Canada, 2009).

In a serial cross-sectional study conducted in three waves (1996-1997, 1999-2000, and 2003), Das-Douglas et al. (2008) examined methamphetamine trends among 2,348 homeless and marginally housed participants recruited in San Francisco. Overall, the authors found nearly a tripling in the proportion of people (from 5.7% to 15.1%) reporting any methamphetamine use from 1996 to 2003. Injecting was the most common route of administration and the proportion of participants who reported injecting was 3.9% in 1996/1997 and 9.3% in 2003. However, smoking had the largest increase as the proportion of those who reported smoking methamphetamine increased sevenfold, 1% in 1996-1997 and 7.1% in 2003. Das-Douglas et al. (2008) observed methamphetamine use increases across all routes of administration in almost all participant subgroups, with the largest increases seen in HIV-positive participants, adults under the age of 35, non-injecting drug users, heavy drinkers, and people reporting three or more sexual partners in the last year.

Hunter et al. (2012) noted that among Toronto study participants, sharing methamphetamine pipes was "common and widespread" at the parties and/or bathhouses they attended. Sharing was considered "automatic" in these settings. Many participants were unconcerned about potential health harms related to sharing. More often, participants expressed concern that if they shared a pipe, the person(s) might: damage or break the pipe and render it unusable, smoke more than their share of the drug, and/ or burn and waste the drug. In another qualitative study involving approximately 60 young adults who used methamphetamine and other drugs and were connected to the electronic music scene in Perth, Australia, Green and Moore (2013) reported that arguments sometimes occurred in "meth circles" over undesirable group behaviours such as someone keeping the pipe too long or not passing quickly enough. These studies suggest that methamphetamine is not only smoked in group settings, but that certain settings have norms endorsing pipe sharing instead of individual group members using their own pipes.

PnP (Party and Play), also known as chemsex, is the term used for the use of drugs such as crystal methamphetamine, gamma-hydroxybutyrate and ketamine among some men who have sex with men (MSM) before and/or during sex to facilitate, initiate, prolong, sustain and/or intensify pleasure (Edmundson et al, 2018). It is difficult to estimate the prevalence of PnP among MSM in Canada and likely varies across Canada depending on the local culture. Studies in Europe show participation in PnP varies between countries and cities (2016). In the systematic review by Tomkins et al. (2018), methamphetamines of any type were the most reported drug used among MSM who engaged in chemsex (reported in 39% of the studies). Crystal methamphetamine was specifically reported in 34% of 112 studies included in the review and is one of the most common drugs used in chemsex overall (Tomkins et al, 2018). Engagement in chemsex was found to be associated with unprotected sex, group sex, transactional sex, and negative health outcomes such as sexually transmitted infections and mental health issues (Tomkins et al, 2018). In the Toronto study, MSM who disliked using condoms reported that they used to smoke crystal methamphetamine to give them "permission" to not wear a condom during sex (Hunter et al, 2012).

Evidence about the link between methamphetamine smoking and sexual risk behaviours

The euphoria experienced from methamphetamine use is the result of dopamine released in the brain (Anglin et al., 2000). In addition to the high, people have reported using methamphetamine for various physical, psychological, and emotional reasons – including enhancing sexual experiences (Hunter et al., 2012). Methamphetamine use is also associated with sexual risk behaviours in MSM (men having sex with men), as the drug has been relatively popular within this diverse population (Carey et al., 2009; Halkitis et al., 2007; Mansergh et al., 2006; Wong et al., 2005).

In a systematic review of the literature, Muflih et al (2019) reported the causal link between the usage of crystal methamphetamine and risky sexual behaviours for HIV transmission. The authors found high prevalence of methamphetamine use among populations that are at high risk of acquiring HIV infection. A study in Switzerland found that the use of methamphetamine among men who have sex with men living with HIV increased 10 times from 2007 to 2017, from 0.2% to 2% (Hampel et al, 2018). The authors (Hampel et al, 2018) found that methamphetamine use was associated with increased hepatitis C coinfection and incidence of depression.

Methamphetamine is sometimes used along with sildenafil (commonly known as Viagra, an orally administered medication used to treat erectile dysfunction) and this combination is associated with higher risk sexual behaviour (Fisher et al., 2010, 2011; Prestage et al., 2009; Semple et al., 2009; Spindler et al., 2007). In a cross-sectional study of 1,976 MSM in San Francisco, California surveyed by telephone, Spindler et al. (2007) found that 7.1% used methamphetamine without Viagra and 5.1% used methamphetamine with Viagra. Among the latter group, 57% reported being HIV-positive and 24% of these participants reported having "serodiscordant unprotected insertive intercourse". Fisher et al. (2011) examined the use of methamphetamine and Viagra among men recruited from HIV prevention and HIV and sexually transmitted infection (STI) testing programs in Long Beach, California. Data were collected between May 2001 and July 2007, and out of 1,794 complete cases in the study, 11.1% had used both methamphetamine and Viagra. Men who used both substances showed significantly higher prevalence of HBV, untreated syphilis, and HIV compared to men who used one or neither drug. Viagra use was associated with insertive anal intercourse while methamphetamine use was associated with receptive anal sex. Fisher et al. (2011) reported that being heterosexual was a protective factor, although even heterosexual men who took both Viagra and methamphetamine had (not significantly) elevated frequencies of insertive anal sex. In a short review, Fisher et al. (2010) noted that methamphetamine use has also been associated with high-risk sexual behaviours among heterosexual people. Together these studies show a robust link between methamphetamine use and sexual behaviours associated with HIV and STI transmission, but these studies did not specifically focus on or analyse data with a specific focus on people who smoke methamphetamine.

Semple et al. (2009), however, noted that among a sample of 341 HIV-positive MSM who use methamphetamine and were enrolled in a sexual risk reduction intervention in San Diego, the most common routes of methamphetamine use were smoking (80%) and snorting (78%). Semple et al. (2009) explored the phenomenon of marathon sex (i.e., prolonged sexual activity occurring over hours or days) among these MSM and found that 84% reported engaging in such activity while using methamphetamine. Compared to men who did not engage in marathon sex, those who did were more likely to use Viagra and significantly more illicit drugs. Unprotected oral and anal sex was also common among those who engaged in marathon sex. In the study mentioned above, McKetin et al. (2008) also compared people who inject methamphetamine to people who only smoke methamphetamine and found that smokers engaged in more sexual risk behaviours (i.e., more likely to have had more than one sexual partner and to have had unprotected sex with more than one person in the month prior to treatment). This study included men and women. Compared to those who inject, people who smoke methamphetamine were significantly younger and more likely to be female.

Other health-related harms

Methamphetamine use can have acute negative side effects including increased body temperature, cardiac arrhythmia, stomach cramps, risk of stroke, anxiety, insomnia, feelings of paranoia, and aggressive behaviour (Anglin et al., 2000; NIDA, 1998). Prolonged use may also lead to irritability and psychosis, called "tweaking" (Buxton & Dove, 2008). The oral effects from using the drug (e.g., dry mouth from smoking, teeth grinding and jaw clenching), when coupled with poor oral health, can accelerate dental decay (Buxton & Dove, 2008). Long-term use of methamphetamine can lead to changes in the brain, and thus affect cognitive and motor functioning (Potvin et al, 2018; Prakash et al, 2017; NIDA, 2006). As discussed above, due to sexual risk behaviours, people who use methamphetamine are at risk for HIV and a range of other STIs.

Zamanian et al (2018) found that smoking crystal methamphetamine can worsen existing conditions like chronic obstructive pulmonary disease and asthma. Several studies (Lawson et al, 2020; Salamanca et al, 2015, Potula et al, 2008; Toussi et al, 2009; CDC, 2007) found that the regular use of crystal methamphetamine may speed up the progression from HIV to AIDS, sometimes within a few months, although the exact mechanism is still unknown.

With prolonged use, users can develop a tolerance that requires them to increase their dosage to obtain the same effect; over time, dependence or addiction may develop (NIdA, 2006). Because smoking delivers drugs to the brain quickly, this route might increase the risk of dependence over routes such as snorting or swallowing (Cook et al., 1993; McKetin et al., 2006). However, some studies have found that people who smoke methamphetamine were less likely to report dependence compared to people who inject the drug (Matsumoto et al., 2002; McKetin et al., 2006). Discontinuing methamphetamine use can result in fatigue, depression, anxiety, and intense cravings (NIdA, 2006). Methamphetamine dependence can be difficult to treat (Anglin et al., 2000). Different treatment modalities have been used and are being investigated, including pharmacotherapies (Vocci & Appel, 2007). In a randomized clinical trial of treatments for methamphetamine dependence, Hillhouse et al. (2007) found that people who smoke methamphetamine were difficult to engage and retain in treatment, although smoking did not seem to predict poor post-treatment outcomes. McKetin et al. (2008) noted that differences between people who smoke methamphetamine and those who inject the drug illustrate a need for "multi-faceted" treatment responses, including services appropriate for people who may exhibit less dependence but are at increased risk of drug-related harms. Brands et al. (2012) found that most (89%) of the addiction treatment agencies they surveyed in Ontario integrated their methamphetamine clients into their regular programs and that 73% of agencies had not considered establishing specific or tailored methamphetamine programs.

Methamphetamine pipe distribution

Given the potential for disease transmission from sharing methamphetamine pipes, it is recommended that harm reduction programs distribute pipes. Bourque et al (2018) reported a significant increase in the uptake of the safer inhalation service from March to June 2018 at the supervised inhalation site in Lethbridge, Alberta. It is the first regulated supervised inhalation site (safer smoking room) in North America, located within the supervised consumption site. A majority of clients (84.7%) who used safer inhalation site reported smoking crystal methamphetamine, followed by opiates (5.27%), and crack cocaine (4.3%) (Bourque et al, 2018). The number of visits in the safer inhalation site increased from 967 visits in March 2018, the first month of operation, to 3576 visits in June 2018. Among unique clients in the supervised consumption site, 70.2% used safer inhalation site at least once in the previous month (Bourque et al, 2018). A study of 100 street-involved youth in Toronto reported that 74% of participants said that provision of safer methamphetamine use kits would be a high priority (Barnaby et al., 2010). However, participants in the Hunter et al. (2012) study – especially those who identified as gay men – were not sure whether distributing such kits would reduce pipe sharing and change their own behaviour, due to the social aspect of sharing pipes at parties and that pipe sharing is also part of the sexual experiences and transactions that occur in bathhouses. Thus, there are unanswered questions about uptake that require further research and evaluation.

Coverage

National data about NSP crystal methamphetamine pipes distribution in Canada is lacking. We can employ numbers from Ontario and British Columbia as examples of crystal methamphetamine pipe distribution volume. A total of 1,461,456 crystal methamphetamine pipes and 144,288 mouthpieces for crystal methamphetamine pipes were distributed from January to December 2020 in Ontario. British Columbia distributed a total of 144,288 crystal methamphetamine pipes in 2019.

Safer crystal methamphetamine smoking equipment distribution evidence summary

The evidence base that informs this chapter and its recommendations is limited. Much of the evidence included in this chapter came from cross-sectional studies, contributing primarily data on methamphetamine use patterns and risk behaviours (and, namely, sexual risk behaviours). Several review articles provided context on methamphetamine use. Other study types varied and included one randomized clinical trial, prospective cohort studies, qualitative research (e.g., focus groups and interviews), and laboratory studies.

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Chapter 11: Foil distribution

Recommended best practice policies to facilitate use of foil sheets for safer smoking of heroin and other drugs:

DISTRIBUTION OF FOIL

- Distribute foil based on the quantity requested by clients with no limits

EDUCATION

- Educate about:
  - safer use of foil
  - the proper disposal of used foil
  - safer smoking practices and
  - the risks of sharing smoking supplies and
  - overdose prevention practices

DISPOSAL

- Dispose of used foil in accordance with local regulations for biomedical waste

Description of how heroin and other drugs are smoked using foil sheets

Aluminum foil is used to smoke drugs that are in a form that produce inhalable vapours when heated, including brown heroin, crack cocaine, methamphetamine, other illicit drugs, and pharmaceuticals such as Oxycodone (Lautieri, 2019). Drugs in tablet form, such as prescription opiates, can be crushed so that the resulting powder is placed on the foil and heated from underneath while a tube or cylindrical instrument (e.g., a straw) is used to direct and inhale the vapours. The tube or "pipe" can also be fashioned out of pieces of foil. Smoking heroin in this way is commonly referred to as "chasing the dragon," a practice that originated in Hong Kong during the 1950s (though earlier forms of heroin smoking were reported in Asia in the 1920s; Strang et al., 1997). After its emergence, the practice of "chasing the dragon" subsequently spread to other parts of Southeast Asia, the Indian subcontinent, and parts of Europe, notably the Netherlands, the UK, and Spain, with little appearance in the United States (Strang et al., 1997).

Heroin in its base form is suitable for heating since "it melts without decomposition" (Strang et al., 1997, p. 679) at a lower temperature than its hydrochloride form which is more water soluble and thus more suitable for injection. Some people choose not to inject heroin or prefer smoking heroin because they do not like needles and/or are concerned about heroin injection-related risks of addiction, overdose, infection, and damage to skin and veins (Stillwell et al., 2005). People who use drugs also have concerns specific to smoking heroin such as concern about achieving a less intense high from smoking, harmfulness (e.g., harms to the lungs), and other unpleasant experiences (e.g., nausea, dislike the smell of smoked heroin) (Pizzey & Hunt, 2008; Stillwell et al., 2005). However, absorption of heroin through the lungs is rapid and bioavailability estimates suggest that heroin administration via this method is quite efficient (Klous et al., 2006; Rook et al., 2006a, 2006b).

To date, foil is not considered to be a direct prevention intervention for HIV, hepatitis C (HCV), hepatitis B (HBV), and other blood-borne infections. Despite this, it is recommended that a new piece of foil is used each time and should not be shared among individuals (Ministère des solidarités et de la santé, 2020). It is recommended that foil of at least 12 microns thick is used to minimize the risk of inhaling dangerous chemicals (Ministère des solidarités et de la santé, 2020; Centre d'Accueil et d'Accompagnement à la Réduction des risqué pour Usagers de Drogues, 2020). While smoking various drugs on store-bought aluminum foil is possible, there is concern that it may be coated with cooking or vegetable oils. Although there is no evidence to suggest that such coating on store-bought aluminum foil is a health risk, people who smoke heroin may desire foil without coating (Pizzey & Hunt, 2008).

Evidence of risks from smoking heroin

Lung and breathing problems are some of the risks associated with smoking drugs, although there are gaps in our knowledge regarding the risks of smoking heroin. According to Pizzey and Hunt (2008): *'Heroin smoking is not without its own harms. Dependence certainly occurs and (long term) heroin smoking is associated with respiratory health problems, although research has not yet adequately quantified these risks or distinguished them from confounding factors that are common among heroin users such as tobacco and cannabis smoking. Although the risk of overdose is lessened when heroin is inhaled, it is not eliminated.'* Boto de los Bueis et al. (2002) analysed self-reported behavioural and lung function data from people (n=62) recruited from a drug rehabilitation centre who inhaled heroin mixed with cocaine on foil. Among this sample, 41.9% reported wheezing over the last 12 months, 44.4% reported bronchial hyperreactivity (BHR), and 22% reported asthma. These rates of BHR and asthma were significantly higher than those found in a control group of 122 people randomly chosen from the general population who did not inhale heroin-cocaine mixtures. In a prospective epidemiological study, Mientjes et al. (1996) reported that smoking heroin was a risk factor for pneumonia among a sample of HIV-negative people who use drugs, but it did not seem to be a risk factor among those who were HIV-positive. Similar findings were reported by Health & Wellbeing Directorate (2014) in England who explained the risks of throat and lung damage, contracting TB and obtaining an anthrax infection along with asthma when smoking heroin.

In terms of other health-related harms, leukoencephalopathy is a disease that involves the white matter of the brain and can have effects on motor, sensory, visual, cognitive, and emotional function. While an association between toxic leukoencephalopathy and smoking heroin has been long recognised, more research on etiology is needed (Buxton et al., 2011). In 27 cases of heroin-associated leukoencephalopathy identified in Victoria and Vancouver, with onset between 2001 and 2006, 13 died (Buxton et al., 2011). The authors obtained drug history information for 18 (67%) of the cases; other illicit drug use (e.g., cocaine, marijuana) was reported and in three of the Victoria cases smoking heroin was the only form of illicit drug use reported. In addition, in a letter to the editors, Nyffeler et al. (2003) described a case study suggesting that chronic progressive myelopathy is a neurological abnormality associated with "chasing the dragon." Similar findings were documented in a case study of a young man who smoked heroin and presented with toxic leukoencephalopathy symptoms, ranging from motor impairment, mental state deterioration and mortality (Do et al., 2019).

Evidence of risks from smoking with foil

There is little research that documents the potential health risks associated with using aluminium foil to smoke drugs such as heroin. However, aluminum is a neurotoxin (Exley et al., 1996) and could be volatilised and inhaled if used for "chasing the dragon" (Exley et al., 2007), and thus may lead to an accumulation of aluminum in the body. Exley et al. (2007) studied samples of urine from current heroin users and past heroin users (i.e., had not used heroin for at least three months) and compared these to samples from non-drug using individuals. Urinary aluminum values were wide-ranging, though the values for current and past heroin users were significantly higher ($p<0.001$) than the control group. In their lab-based study, Brenneisen and Hasler (2002) heated samples of street heroin on foils at 250 to 400° Celsius and analysed the vapours. Seventy-two thermal decomposition products of the street heroin, residues from the foils, other by-products, and adulterants were detected, but only about half of these products could be identified. Again, further research is needed to identify the by-products of smoking to determine the specific health risks associated with using foil to smoke drugs.

Although there is no available research on people sharing the tubes or pipes they may fashion out of foil to direct the vapours when "chasing," in theory these items can be shared like other types of pipes. If such sharing occurs, it might present risk of pathogen transmission.

Foil sheet distribution

Pizzey and Hunt (2008) examined a foil distribution initiative that involved four needle and syringe programs (NSPs) in South-West England. Programs offered 50-sheet foil packs. During their study, conducted between 2006 and 2007, 320 people who use opiates attended the NSPs and made a total of 1,672 visits; 174 (54%) of those who attended across the sites chose to take foil packs. Frequency of foil use varied considerably and was often intermittent, but among those who used the foil, most reported that having it led to at least some replacement of injecting with smoking. Pizzey and Hunt (2008) also reported that some people might not have accessed foil outside of the NSPs due to lack of money, inconvenience, and/or embarrassment about purchasing foil from shops.

Stöver and Schäffer (2014) examined the 'SMOKE-IT!' project, an intervention and survey implemented at several German drug consumption rooms (DCRs). People who use heroin were invited to take foil packs and to fill in questionnaires at three different times: immediately after survey participant recruitment (177 surveys received, 12 people refused the foil), after using the foil or returning to the facility (141 re-interviewed), and no earlier than 30 days after the second questionnaire was completed (89 re-interviewed). Intravenous use of heroin was common among the sample (practised on average for 10.4 years), but a majority of participants who received a 'SMOKE-IT!' pack were also familiar with smoking as a method of administering heroin. Close to half (45.4%) reported smoking heroin at least once a day and 72.4% smoked heroin several times a week. The high familiarity with smoking heroin likely contributed to the finding that DCR clients were generally accepting of the foil packs. Further, store-bought foils had already been available at the DCRs before the study. Participants were asked which type of foil they preferred and 85.5% favoured the 'SMOKE-IT!' foils over household foil. Many participants also said that they would be willing to pay for the 'SMOKE-IT!' foil if it was available.

Stöver and Schäffer (2014) suggested numerous ways that programs might promote a 'SMOKE-IT!' type intervention that include video tutorials, training courses on pipe/tube building, offering 'SMOKE-IT!' packs, providing informational literature (e.g., flyers, cards), and putting up eye-catching posters. The authors concluded that offering new types of drug use equipment is a way for programs to renew or generate new prevention messages and engage clients.

Reports from the Ontario Harm Reduction Distribution program indicate that foil is distributed to individuals in the form of 20 gauge (10cm X 22 cm) non-textured sheets (www.ohrdp.ca). The distribution of these sheets is advantageous to common household aluminum foil, as they do not contain oils, thus reducing the risk of harmful vapour ingestion (www.ohrdp.ca).

Foil distribution evidence summary

The evidence that informs this chapter and its recommendations is limited. Laboratory studies, including use of simulated smoking conditions, have contributed knowledge regarding the pharmacokinetics and bioavailability of smoking heroin. There is a need for more observational studies specific to people who smoke drugs like heroin and people who use foil sheets when doing so. There is also a need for evaluative studies about harm reduction program distribution of foil sheets, particularly in Canadian contexts.

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Chapter 12: Straw distribution

Recommended best practice policies to facilitate use of straws for safer snorting of drugs:

DISTRIBUTION OF STRAWS

- Distribute straws based on the quantity requested by clients with no limits
- Offer straws in a variety of colours

EDUCATION

- Educate about:
  - safer use of straws
  - proper disposal of used straws
  - safer snorting practices
  - risks of sharing straws and purpose of straws in different colours
  - overdose prevention practices

DISPOSAL

- Dispose of used straws in accordance with local regulations for biomedical waste

Description of how straws are used

Drinking straws are used to snort drugs or for inhaling drugs that have been heated on foil and vapourized. For more information about smoking/vaporizing drugs using foil, refer to Foil distribution chapter. Snorting drugs (also known as insufflation) involves inhaling finely crushed drugs through the nose using a device like a straw or rolled banknote. If a drug is in a solid form (tablet, pill, capsule, coarse powder, crystalline), it can be crushed into a powder and snorted. The types of drugs that can be snorted, include both opioids (e.g., heroin, fentanyl, Oxycodone, Hydrocodone, OxyContin®, methadone tablets, hydromorphone, morphine, buprenorphine) (Young et al, 2010) and stimulants (e.g., amphetamine, methamphetamine, methylphenidate, cocaine, mephedrone; Rigoni et al, 2016).

When powdered drugs are snorted, the mucosa inside the nose enables fast absorption into the bloodstream with the effects being felt within minutes. Snorting bypasses the stomach and liver, where drugs that have been swallowed may be degraded before being absorbed into the bloodstream. Snorting drugs can cause the blood vessels inside the nose to rupture leading to small, microscopic cuts or tears that can bleed. Bleeding in nasal passages can result from the erosion of mucous membranes from exposure to drugs or from rigid or sharp edges on snorting equipment that may cause small tears in the tissue (Scheinmann et al., 2007). If straws or other devices used for snorting are exposed to blood contaminated with HIV or HCV and shared, there is potential for disease transmission from rupture, tears, and cuts in the nose (Aaron et al., 2008; McMahon et al., 2004; Fernandez et al., 2016).

While drugs that are snorted or vaporized are quickly absorbed, the risk of overdose and other health problems (e.g., abscesses, transmission of blood-borne viruses) is lower than when drugs are injected. Distributing paper straws is a harm reduction strategy that may encourage people who inject drugs to switch to snorting and smoking/vapourizing drugs (IDPC, 2016; UNODC, 2017). As a safer smoking/vapourizing harm reduction strategy, distribution of straws along with foil is recommended. Distribution of straws may expand program reach by attracting non-injecting population of people who use drugs into programs (IDPC, 2016).

Evidence of straws and other snorting equipment as vectors of HIV, HCV, and HBV transmission

While HIV and hepatitis C (HCV) viruses are highly transmissible by injecting (Young et al, 2010), there is only evidence to show that HCV can be transmitted by sharing equipment used to snort drugs (Aaron et al., 2008; McMahon et al., 2004; Zaro et al., 2016; Fernandez et al., 2016; Vanhommerig et al., 2015; Hermanstyne et al., 2015; Schmidt et al., 2011). Extrapolating from the research about HCV transmission, several authors have suggested that HIV and/or HBV maybe be transmitted via sharing contaminated snorting equipment but there are no empirical studies demonstrating transmission (Aaron et al., 2008; McMahon et al., 2004; Fernandez et al., 2016). Aaron et al. (2008) examined the virological plausibility of intranasal transmission of HCV by confirming that blood and HCV RNA of HCV-infected people who snort drugs were present in the nasal secretions and on the equipment that they used for snorting drugs. In that study, 38 HCV-infected participants who used drugs by snorting, recruited from a community health clinic in New York City, were asked to insert a sterile straw intranasally and snort air to mimic the process of snorting drugs. The used straws were then analyzed and three (8%) were positive for blood and two (5%) were positive for HCV RNA. The authors also found that those 28 (74%) participants tested positive for blood and five (13%) tested positive for the presence of HCV RNA in their nasal secretion (Aaron et al., 2008). In another study (McMahon et al., 2004), the nasal secretions were tested for the presence of HCV among five patients from the Boriken Neighborhood Health Center in East Harlem, New York City. All five participants had previously tested HCV seropositive and reported a history of intranasal drug use. The presence of HCV was found in the nasal secretions of all five participants creating the necessary precondition for intranasal viral transmission (McMahon et al., 2004). Fernandez et al (2016) reported that of the 54 straws that were confiscated from people who use drugs by law enforcement authorities and tested, 13 (24%) tested positive for the presence of human blood.

Evidence of risk behaviours

A study from Spain (Zaro et al, 2016) investigated the drug consumption patterns among 486 MSM participants who were involved in chemsex (i.e., the act of having sex, primarily by MSM, under the influence of psychoactive drugs) in the previous 12 months. When participants were asked if they had shared any drug equipment, most (85.2%) reported that they shared a small tool/device to snort powder, although some participants reported never sharing (13.1%) or could not remember (1.7%). Conversely, most participants in this study who injected drugs stated that they had not shared injection material (87.7%). The authors concluded that the risk of transmitting HCV is not only present when sharing injection material but also when snorting drugs because of the widely accepted practice of sharing snorting equipment among study participants (Zaro et al., 2016). Similarly, Hermanstyne et al (2015) found that the sharing of straws and other equipment used to snort drugs was a common practice among homeless and marginally housed persons in San Francisco. To estimate HCV prevalence and examine the association of HCV status with sharing non-injection drug equipment, the study analyzed data from participants who denied ever injecting drugs. Of all participants in this study who reported ever using cocaine, 71% had ever shared a straw, dollar bill, key or spoon that was used by someone else to snort it (Hermanstyne et al., 2015). A case-control study by Schmidt et al. (2011) identified the risk factors for hepatitis C among HIV-positive MSM participants. For this study, 36 individuals who were HIV-positive and acutely HCV-co-infected with no history of injection drug use were selected as cases and 67 HIV-positive MSM without known HCV infection, matched for age group, served as controls. Among all non-sexual exposures, nasal administration of drugs (most commonly cocaine, amphetamines, or ketamine) was associated with HCV co-infection. A high prevalence of sharing straws was reported in both case and case-control groups, 79% and 71% respectively. These findings might indicate lack of knowledge about the risks of acquiring HIV and HCV through sharing of snorting equipment. In a study by Koman et al (2018), the authors examined the effect of a HCV education intervention among individuals seeking services at the local clinic for sexually transmitted diseases. Findings showed low level knowledge of the risk of HCV transmission from sharing straws or rolled banknotes (Koman et al., 2018).

Sharing snorting utensils (e.g., straws) was found to be a risk factor for HCV transmission among HCV infected pregnant patients who did not inject drugs (Fernandez et al., 2016). Among 189 HCV-infected pregnant women in eastern Tennessee, 94% reported snorting drugs and 164 (92%) reported sharing straws. Of these women, 29 (15%) reported snorting drugs and sharing straws but denied any other risk factor except sexual contact. The MOSAIC (MSM Observational Study of Acute Infection with hepatitis C) cohort study in Amsterdam examined the acute HCV infection among HIV-infected MSM. Sharing of straws was reported by 51% of MSM who snorted drugs and it was significantly associated with HCV acquisition (2.48; 95% CI, 1.14–5.37; Vanhommerig et al., 2015).

Hoornenborg et al (2020) reported that HIV-negative MSM using pre-exposure prophylaxis to prevent HIV infection were at high risk of incident HCV infection. The authors found that new infections occurred more frequently in those participants who reported having receptive anal sex without using condoms, having an anal sexually transmitted infection, injecting drugs, and sharing straws when snorting drugs (Hoornenborg et al., 2020).

Other health related harms

Street drugs frequently contain impurities (e.g., caffeine, laxatives, talcum powder, boric acid, creatine, powdered detergents) and other licit and illicit drugs that are added to bulk up the volume and occasionally to increase the potency of the original drug (Payer et al, 2020). Prescription drugs contain excipients, which are inactive substances other than the active ingredient, which are included in a drug formulation to deter people from injecting, maintain the stability of the drug and/or for other reasons (Fawcet et al., 2019). When the drugs are crushed, the added ingredients are snorted along with the active ingredients and may be cause irritation of the inner lining of the nose (Green et al, 2005; Grund et al., 2010). Most side effects of snorting drugs on the nasal cavity are usually relatively minor and typically subside after a few hours to a day (Angier et al, 2010). These problems commonly manifest as signs and symptoms of non-allergic drug-induced rhinitis (e.g., nasal blockages, runny nose, and inflammation of the nasal lining) (Angier et al, 2010; Yewell et al., 2002). Some more rare complications include lung infections that may require medical treatment (Reyes et al., 2018; Khurana et al, 2017; Tsapas et al., 2008; Pathak et al., 2016). Some drugs, like cocaine, when snorted shrink the blood vessels locally in the nose and can cause damage to the lining of the nose. Long term use of cocaine by snorting can also damage the structure of the nose and damage the septum (the bony/cartilage wall dividing the nasal cavities) (Grund et al., 2010; Pereira et al., 2018; John & Wu, 2017). The septum then becomes thinner or in some cases completely wears away. Damaged inner lining of the nose is susceptible to frequent infections and damage that over time can lead to complete perforation in the septum part of the nose. A nasal septum perforation is a medical condition in which the nasal septum develops a hole. Common symptoms include sneezing, runny nose, nasal congestion, and frequent nose bleeds (Strang et al., 1998; Glauser & Queen, 2007; Pereira et al., 2018; John & Wu, 2017; Sehgal et al, 2017). Several authors have described cases of nasal perforation caused by long-term intranasal use of other drugs, such as heroin, hydrocodone and Oxycontin (Green et al., 2005; Yewell et al., 2002; Peyriere et al., 2013; Zhang et al., 2017).

There is the potential for bacterial and fungal infections arising from rolling banknotes (e.g., dollar bills) to snort drugs. Research demonstrates that banknotes in circulation can be contaminated carry bacteria and fungi and has the potential to spread infectious diseases (Angelakis etal., 2014; Gedik et al., 2013; Kesavan et al., 2016). Banknotes can also act as potential reservoirs for antibiotic-resistant bacteria, such as MRSA (Angelakis et al., 2014).

Straw distribution policies

The distribution of straws is an important way to reduce the risks associated with sharing straws. Because it is a relatively new harm reduction supply, national data on straw distribution is sparse. The OHRDP began distributing blue and yellow paper straws in Ontario in April 2020 and added green and orange straws in January 2021. OHRDP identified two main reasons for introducing paper straws to the list of supplies they distribute to harm reduction programs: (1) core NSPs were requesting them and (2) to reduce the costs associated with distributing foil and straight glass stems for snorting, vapourizing or smoking. Paper as the material for the straws as opposed to plastic was selected for environmental reasons. Paper straws in different colours are distributed to help clients avoid using someone else's straw. In fiscal year, April 1, 2020 to March 31, 2021, in Ontario, 736,000 units of straws (combined colours) were distributed to core NSPs (blue: 329,750 units; yellow: 319,000 units; orange: 43,750 units; green: 43,500 units). OHRDP learned that harm reduction programs distributing the straight glass 'crack' stems in their 'Chasing the Dragon' and 'Hot Railing' kits. The distribution of paper straws was implemented as cost-saving measure while achieving the same harm reduction purpose (OHRDP, unpublished data, 2021).

At the time of writing, British Columbia planned to start distribution of paper straws in 4 different colours to over 400 harm reduction sites across the province. Each site will determine how straws will be distributed (e.g. ratio of foils to pipes, or in kit; Jane Buxton, personal communication, June 7, 2021).

Straws distribution evidence summary

The evidence that informs this chapter came from predominantly observational studies. Other types of studies were employed less frequently. One case-control study was focused on identifying risk factors for hepatitis C transmission. Laboratory studies have contributed knowledge regarding the potential transmissibility of HCV via sharing snorting equipment. We did not find reports of randomized controlled trials (RCTs) or other experimental designs that were applicable for this chapter. As noted previously in this document, although RCTs are considered to provide the highest quality evidence, it is not always feasible to conduct this type of research with harm reduction programs. No empirical studies that address straw distribution policies and coverage were found at the time of writing this chapter.

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Chapter 13: Disposal and handling of used drug use equipment

Recommended best practice policies to facilitate disposal of all used injection and non-injection equipment:

DISTRIBUTION

- Distribute tamper resistant sharps containers in a variety of sizes
- Do not penalize or refuse to provide new supplies to clients who fail to return used drug supplies
- Provide access to safety devices for staff and procedures for first aid and post-exposure prophylaxis (PEP)

EDUCATION

- Provide education on how to properly handle, secure and dispose of used supplies
- Encourage staff and clients to be vaccinated against hepatitis B (HBV)
- Encourage return and/or proper disposal of used injection and non-injection equipment

DISPOSAL

- Visually estimate the amount of returned equipment; never touch or manually count used supplies
- Offer multiple sizes of biohazard containers for safe disposal
- Offer multiple, convenient locations for safe disposal in rural and urban settings disposal in rural and urban settings

Needle and syringe programs (NSPs) and other harm reduction programs play a key role in the collection and disposal of used drug use equipment (Kaplan & Heimer, 1994; Leonard, 2010). Removing used equipment from circulation helps to reduce the risk of transmission of human immunodeficiency virus (HIV), hepatitis C (HCV), HBV, and other blood-borne pathogens associated with accidental needle-stick/sharps injury and equipment sharing (Heimer & Abdala, 2000; Ksobiech 2004). Through education and training with service providers and clients, harm reduction programs can reduce unsafe disposal practices such as: putting used equipment into the garbage; giving equipment to someone else to discard; discarding equipment in streets, parks, alleys, sewers, and other public spaces; and otherwise failing to dispose of equipment in an appropriate sharps container (Leonard, 2010).

Pathogens and used drug equipment

Viruses such as HIV, HCV and HBV have varying degrees of survival in the environment. Active HIV-1 particles have been found in syringes up to 42 days at 4 degrees Celcius and have been detected 21 days after use when stored at room temperature (Abdala et al., 2000). A more recent study detected viable HCV in syringes for up to 63 days (Paintsil et al., 2010). Heimer and colleagues (1996) detected HBV in syringes up to 8 months after storage at room temperature. The survival of these pathogens in injection equipment presents a potential risk for infection for all individuals who handle or reuse them.

HCV has been detected on crack cocaine smoking equipment (Fischer et al., 2008). Infectious HCV particles can be present after being dried on inanimate surfaces after 7 days (Doerrboecker et al., 2011). Ciesek and colleagues (2010) reported that HCV was stable and infectious at room temperature for many days when present on different surfaces and concluded that this presents a substantial risk for transmission for person-to-person infection and infection in healthcare environments. In this study, HCV particles were detected 28 days after inoculation of plastic surfaces, metal surfaces and rubber gloves (Ciesek et al., 2010). Mycobacterium tuberculosis can withstand extreme temperatures by forming spores and can also survive up to 4 months on inanimate surfaces (Kramer et al., 2006). HBV can also survive for more than a week on surfaces (Kramer et al., 2006). The survival of these pathogens on open surfaces underscores the need for proper disposal practices to reduce risk of transmission for crack cocaine smoking equipment.

Needlestick, other injuries, and risk of infection

Needlestick injuries are accidental punctures of the skin. Such injuries are a concern for all program staff members, clients, and others who come into contact with used needles and other sharps because of the risk of HIV, HCV, HBV, and other blood-borne pathogens. At the time of preparing this document, there were no estimates available of needlestick or other sharps-related injuries among staff members at NSPs, harm reduction programs, and/or public health settings.

In healthcare settings, it is estimated that among nurses the annual rate of needlestick injuries is 4.8 per 100 full-time equivalents (i.e., total hours worked divided by average annual hours worked in full-time jobs; Canadian Centre for Occupational Health and Safety, 2005). CCOHS (2005) estimates that approximately one-third of nursing and laboratory staff experience a needlestick injury every year. Estimates of needlestick related infections in occupational settings vary by pathogen: 1%-40% for HBV (among those who are unvaccinated); 1.8% for HCV; and 0.3% for HIV (CCOHS, 2005). From a study of sharps injuries in healthcare settings, Blenkharn and Odd (2008) reported an overall low rate of injury (1 injury per 29000) with no seroconversions due to sharps injuries among a group of medical waste disposal workers. However, they reported inconsistent use of puncture-resistant gloves among workers which resulted in injuries to hands from improperly closed or overfilled sharps containers; and sharps were placed into soft-walled bags which also resulted in injury (Blenkharn & Odd, 2008). Practices such as recapping needles or placing syringes in containers that are not puncture resistant can increase the chances of a needlestick injury (WHO, 2010).

Among those at risk of community-acquired needlestick injury are people who use parks or other public spaces, those who may pick up a discarded needle, and sanitation workers who may be injured by needles discarded in the garbage, sewers, or in toilets (Macalino et al., 1998). Injury from used syringes in community settings (e.g., outdoor spaces) is generally considered to have a low risk of infection (Canadian Pediatric Society, 2008; Elder & Paterson, 2006; Papenberg et al., 2008). Despite the low risk of infection, the risk of physical injury or acquiring an infection is not eliminated due to lack of knowledge regarding the previous users' serostatus and exposure of the device to the elements. Furthermore, needlestick injuries can be very emotionally distressing regardless of the low risk (Blenkharn & Odd, 2008; Canadian Pediatric Society, 2008).

Handling crack cocaine smoking equipment (stems or self-fashioned pipes) has the potential to lead to a sharps injury if the pipes are broken or the sharp edges are apparent. An estimate of the proportion of people who smoke crack cocaine and/or harm reduction staff who experience a sharps injury from a smoking device was not available at the time of writing this document. When available, results often present an aggregate of two or more types of injuries (e.g., sores, cuts, injuries, and burns) and do not specify the cause (e.g., wound from a sharp edge versus wound from a heat source). Leonard (2010) reported that between 21% and 23% of people who smoke crack cocaine in Ottawa reported an injury (i.e., sore, cut, crack, burn, or other) to the mouth due to smoking crack cocaine in the 6 months prior to the interview. Data from a Vancouver study showed that 52% of people who smoke crack cocaine had lesions from smoking and another 59% reported a pipe exploding while they were smoking crack cocaine (Malchy et al., 2008). Data from a large study in the United States reported that among those participants who smoked crack cocaine and had an oral sore, just under half (68 of 141; 48.2%) attributed the sore to crack cocaine smoking (Faruque et al., 1996). Other reports have noted that damaged crack cocaine pipes can lead to injuries; however, this risk is not quantified (Porter & Bonilla, 1993).

As well, pipe screens may also cause injuries to hands. Clients who participated in the evaluation of the Toronto Public Health safer crack kit evaluation noted that the sharp edges of the screens caused cuts to their hands (Toronto Public Health, 2012). Therefore, handling of used screens may require special consideration from programs to ensure safety of workers and service users.

Safer handling, disposal and "routine practices" for used equipment

Evaluations have shown that NSP disposal activities benefit communities by removing many potentially infectious syringes from the community (Tookes et al., 2012; Wenger et al., 2011). In a meta-analysis of data from 26 international studies, the overall return rate of needle/syringes for NSPs was 90%, ranging from 15% to 112% (Ksobiech, 2004). Four studies included in this review reported return rates of 100% or more (Ksobiech, 2004). Interpretation of return rates among NSPs must take into consideration returns of needle/syringes from other programs and returns of syringes to other programs. For example, Grund et al. (1992) reported that 13% of needles distributed were disposed of at other programs. Evidence shows that strict exchange policies, such as "one-for-one", are not necessary or desirable to achieve high return rates (Grund et al., 1992; Small et al., 2010; Strike et al., 2005). Utilization of NSPs is associated with safer disposal of used syringes (Bluthenthal, et al., 2007; Coffin et al., 2007; Doherty, 2000; Doherty et al., 1997; Khoshnood et al., 2000; Sherman et al., 2004).

Most literature and policy recommendations encountered in the preparation of this document addressed the disposal of used injection equipment. There is little research on the safe handling and disposal of non-injection drug use equipment such as safer crack cocaine smoking equipment (glass stems, mouthpieces, screens, etc.). However, the most thorough approach to biohazard waste management encountered is referred to as "routine practices" which assumes that all blood, body fluids, secretions, excretions, mucous membranes, non-intact skin or soiled items are potentially infectious (CCOHS, 2011). "Routine practices" also include administrative procedures and standards for immunization, training, and first aid to ensure safe management of contaminated materials (CCOHS, 2011). This approach is appropriate for used drug equipment since it addresses many of the key components required for proper handling and disposal and because pathogens such as HIV, HCV, HBV, Tuberculosis mycobacterium and others can survive in/on used injection and inhalation drug equipment. This equipment includes syringes, filters, cookers, alcohol swabs, tourniquets, stems, mouthpieces, and screens (see Table 13.1 for examples of routine practices).

In assessing injection related behaviours among 200 PWID in Indiana, Dasgupta et al. (2019) determined that 76% of participants disposed of injection equipment in the trash. Common reasons which contributed to these disposal practices included the limited availability of appropriate disposal units (Dasgupta et al., 2019). Similar findings were reported by the Medical Monitoring Project, which conducts a cross-sectional annual survey across the United States and aims to understand the clinical and behavioural characteristics of individuals who are HIV positive (Dasgupta, Tie, Lemons, Wu, Burnett, & Shouse, 2019). Survey results from 2015 to 2017, indicate that the most common response regarding the disposal for injection related material was in the trash or on the street, and the least common response was keeping injection paraphernalia for reuse (Dasgupta et al., 2019).

Table 13.1 Examples of routine practices for used needles and syringes, cookers, filters, tourniquets, alcohol swabs, glass stems, mouthpieces, stems, brass screens other smoking/inhalation devices

Disposal of sharps

Sharps are any device that can break the skin and include needles, scalpels, glass, and exposed ends of wires (WHO, 2010). Although some drug equipment is “soft” (e.g., swabs) and cannot puncture the skin, this equipment should also be handled with caution since it may be contaminated with blood.

Sharps containers – examples of routine practices

Sharps must be disposed of in containers with some of the following characteristics:

- Be rigid to avoid puncturing of walls by sharps
- Not have removable lids and be tamper resistant
- Labelled as containing hazardous materials
- Be able to withstand the weight of the waste without breaking, tearing or cracking
- Sharps containers may be offered alongside safer injecting equipment to encourage proper disposal practices
- Programs may dispose of full sharps containers for clients
- Sharps containers should not be filled more than 2/3 since this increases the chances of container malfunction, and therefore risk of injury
- If sharps containers are not available, clients should be encouraged to place used equipment into rigid plastic containers with tight fitting lids such as bleach bottles, fabric softener bottles, etc. Containers should be well-labelled, not recycled, and only be 2/3 full when brought in for disposal.

Handling of used equipment for clients and workers – examples of routine practices

- All used supplies should be considered contaminated and therefore must be handled and disposed of in accordance with local, provincial/territorial, and federal regulations regarding disposal of biomedical waste.
- Sharps containers should be tamper-resistant and secured to prevent used supplies/equipment from being removed.
- Sharps containers should be placed in a convenient location that is nearby to ensure prompt disposal of used equipment from the area.
- Needles should never be recapped. Recapping can increase the chances of a needlestick injury and expose the person to infection.
- Needlestick injuries from a used needle that has been exposed to the environment (e.g., on the street, in the park, lying on a table or the floor) pose a risk of infection because the needles are no longer sterile.
- Needles should not be placed or carried in bags, pockets, or sleeves of clothing because they are not puncture resistant and pose a risk for injury.
- Never handle someone else’s used equipment. If assisting someone else with disposal (i.e., bringing used equipment to an NSP), ensure that they place their used equipment into a sharps container first.
- Bending, breaking or forcing needles into already full sharps containers increases risk of injury. This may occur with glass stems as well.
- If used equipment needs to be counted, do not touch it. Estimate the amount returned.
- Collecting any supplies off the ground increases risk of injury. Anyone who is collecting discarded equipment should use tongs and/or wear puncture-resistant gloves and carry a sharps container for immediate disposal.
- Hand hygiene – washing hands with soap and water and/or an alcohol-based hand rub is encouraged after all handling of sharps, containers, used equipment, and after removal of gloves.

Collection and storage of used equipment for fixed site programs – examples of routine practices

- Programs may want to explore collection and storage options for sharps versus soft (e.g., alcohol swabs) equipment versus non-infectious waste (e.g., packaging) to reduce disposal costs. All options must comply with local, provincial/ territorial, and national guidelines.
- If returned equipment is separated for storage and disposal, staff should not manually separate equipment. Clients should not manually separate equipment that is not their own.
- All disposal containers (sharps or bags) should be monitored and stored securely.

Sources: BCHRSS, 2011; CCOHS, 2011; CPSO, 2012; Edmonton Community Drug Strategy, 2006; Health Canada, 2004; New York State Department of Health, 2011; Northwest Territories Health and Social Services, 2011; OSHA, 2011; ONA, 2004, 2010; PIDAC, 2010; WorkSafe BC, 2006, 2008,2009; WHO, 1999, 2004, 2006, 2010

Please note that the lists provided above and below are not intended to be exhaustive. To ensure that practices are safe, up-to-date and in accordance with all relevant guidelines, it is recommended that programs regularly review the local, provincial, and national guidelines regarding the handling and disposal of contaminated equipment. Listed at the end of the chapter are resources to provide the reader with more in-depth guidance about managing used drug equipment.

Hepatitis B vaccination

Currently no vaccinations exist against HIV or HCV; however, a vaccination against HBV is widely available through primary care clinics and many public health units across Canada. Vaccination is recommended for people where exposure to body fluids or contaminated devices can occur, including health care workers, people who inject drugs, men who have sex with men, incarcerated people, people with a history of sexually transmitted infection, and people who have unprotected sex (Health Canada, 2008; WHO, 2010). HBV vaccinations can significantly reduce the chances of infection (WHO, 2008) and offer protection against infection for more than 90% of healthy individuals (Shepard et al., 2006).

First aid and post exposure prophylaxis (PEP)

All harm reduction programs and satellite/partner organizations that collect and dispose of sharps should implement emergency first aid policies in case of accidental injury due to sharps, in accordance with provincial/territorial guidelines. In Canada, access to PEP is mandated through occupational health and safety. Depending on the jurisdiction, people exposed to infectious body fluids or tissues may access treatment in occupational settings, through public, emergency rooms and/or clinics. Below (Table 13.2 and 13.3) are excerpts from the WHO's (2010) recommendations upon exposure to blood.

Table 13.2 WHO recommendations regarding steps to take in cases of occupational exposure to blood

- Apply first aid care, as appropriate.
- Notify a supervisor. The worker should report immediately to the medical services and seek advice on the need for PEP for HIV and HBV.
- Carry out an immediate medical evaluation, including a risk assessment and follow-up care (e.g., counseling and PEP) as appropriate.
- Complete an exposure form documenting the circumstance and report the exposure in the needlestick injury surveillance system.

Source: WHO best practices for injections and related procedures toolkit, 2010.

Table 13.3 Example of a PEP policy

PEP is recommended if exposure meets ALL the following criteria (p.36):

- Exposure within 72 hours
- Exposed individual not known to be HIV-infected
- Source of exposure is HIV-infected or of unknown status
- Exposure was to one or more of the following: blood, body tissues, visibly blood-stained fluid, concentrated virus, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid or amniotic fluid
- Exposure was through one or more of the following: skin penetration with spontaneous bleeding or deep puncture, splash of significant amount of fluid to mucous membrane, prolonged contact of an at-risk substance with non-intact skin
- If skin penetration occurred, exposure was from a recently used hollow-bore needle

Source: WHO best practices for injections and related procedures toolkit, 2010.

Disposal options

A variety of options exist to increase access to safe disposal methods: NSPs, other harm reduction programs, drop boxes, syringe vending machines, residential pick-up, alley and street patrols, community clean up initiatives and supervised injection facilities (City of Ottawa, 2012; de Montigny et al., 2009; Gold & Schumann, 2007; Hayashi et al., 2010; Strike et al., 2002, 2005). To increase access to safe disposal across the city and for 24 hours a day, the Montréal Department of Public Health installed needle/syringe drop boxes in outdoor locations and in neighbourhoods with active injection drug use scenes. Convenience – a general predictor of whether people who inject drugs will use services (Coffin et al., 2007) – was a key design feature of this program. An evaluation showed a 98% reduction in discarded needles within 200m of the drop boxes (de Montigny et al., 2010).

Evaluation of programs in New York State after expansion of access to needles and syringes in 2001 showed increased disposal through the community collection drop boxes, hospitals, nursing homes and community pharmacies (Klein et al., 2008). The success of some community dropbox sites pointed to the need for continued monitoring to know how often they need to be emptied (Klein et al., 2008). Importantly, no adverse events such as needles/syringes found near the drop boxes or needlestick injuries were reported. Klein et al. (2008) noted that these efforts were consistent with the goal proposed by the Environmental Protection Agency to eliminate disposal of used needles/syringes in the trash. There are also conflicting reports about improper disposal around unsupervised disposal sites, such as community disposal bins and syringe vending machines. Klein et al. (2008) report that no syringes were discarded adjacent to community disposal bins, while McDonald (2009) reported that during 19% of visits, discarded syringes or plastic syringe kit containers were found adjacent to the syringe vending machine and adjacent to the disposal bins. Parkin and Coomber (2011) noted that location and design influence the utilization of drop boxes; people who inject drugs are more likely to use drop boxes which are in geographically relevant but also discrete locations. The effectiveness of syringe service programs was also documented in Indiana among 200 PWID (Dasgupta et al., 2019). After the program was implemented, disposal of used syringes in a designated medical waster container increased from 17% to 82%.

Syringe vending machines are used to increase access to needle and syringes and disposal services at times and locations not served by NSPs. Some vending machines dispense new equipment in exchange for old equipment thus ensuring disposal. However, to increase access to sterile equipment, other machines do not require an exchange of used materials for new equipment and provide adjacent disposal bins for used equipment. Evaluation data have shown that the installation of syringe vending machines does not result in an increase of discarded needles/syringes in the community and also that clients will use disposal bins attached or adjacent to syringe vending machines (Islam & Conigrave, 2007; Islam et al., 2008; McDonald, 2009).

Since 1998, the City of Ottawa has operated the Needle Hunters Program to locate and dispose of needles, crack cocaine pipes, and other drug use equipment found in the community. In 2011, the Needle Hunters recovered 6349 needles and 1271 crack cocaine pipes (City of Ottawa, 2012). Other than the City of Ottawa Needle Hunter Program, there are few other reports and studies about the disposal of crack cocaine smoking equipment. From Ottawa, Leonard (2010) reported modest declines and some increases in improper disposal of crack cocaine smoking equipment following the introduction of a safer inhalation program in Ottawa. Before introduction of the program, over 54% of people who smoke crack cocaine reported that they disposed of glass stems in the garbage. The next most frequent disposal methods included: placing stems in a container and into the garbage (29.5%), community disposal drop boxes (25.1%), biohazard containers (18.8%), and returning used stems to an agency that distributes stems (16.4%; Leonard, 2010). When asked for reasons for disposing stems on the street, parks, alleys or sewers, the most common reasons offered included: did not need it [stem] anymore (50%), did not want to carry it around (46.7%), worried about being caught by police with stems (43.4%), and there was no community disposal drop box around (40.0%; Leonard, 2010). Other reasons included: being too high, did not know where to dispose of stems, did not know there was a risk to others, too much hassle to go to an NSP, forgot and left stem behind, and did not think about it (Leonard, 2010). Data from Toronto showed a similar pattern; the two most common methods to dispose of crack cocaine smoking equipment were thrown in garbage (56%) and disposal in street/parks/alleys/sewers (18%; Hopkins et al., 2012).

Disposal behaviours among clients

Both individual and structural factors influence the ability of people who use drugs to properly dispose of used needles and syringes. At the individual level, issues such as lack of knowledge of correct practices or locations can impede proper disposal (Jackson et al., 2002). People who are homeless may also not be able to properly store and dispose of used equipment (Strike et al., 2002). On a structural level, NSP operating hours may be inaccessible for some people who inject drugs, and clients may not be able to return their needles to the NSP during operating hours. Identification (ID) codes are used by some NSPs to track service utilization and clients' needle exchange rates. The lack of anonymity associated with ID codes – whether real or perceived – may discourage clients from using an NSP and properly disposing of used equipment (Loue et al., 1995).

When asked, 62% of people who inject drugs in a San Francisco study reported disposing of used needles at the NSP in the past 6 months, but 67% reported at least one incident of improper disposal (i.e., street, sidewalk, park, parking lot, trash receptacle, toilet, sewer or manhole; Wenger et al., 2011). Wenger et al. (2011) estimated that 13% of syringes were improperly disposed of by study participants. In this study, improper needle disposal was associated with injecting in a public place, crack cocaine injection, and obtaining needles from an unauthorized source. Bluthenthal et al. (2007) found that having an income of less than $1000 USD, being injected by others, and concerns about arrest for possession of drug use equipment were associated with lower odds of safe syringe disposal. A novel study by Tookes et al. (2012) compared improper disposal patterns between San Francisco, a city with an NSP, and Miami, a city without an NSP. They found that people who inject drugs in Miami were 8 times more likely to improperly dispose of syringes than those in San Francisco who had access to an NSP. They estimated that 95% of all syringes used by people who inject drugs in Miami were improperly discarded compared with 13% in San Francisco (Tookes et al., 2012).

Evidence shows that intensified policing and 'crackdown' programs can impede access to both new equipment and disposal services. Fear of being identified and/or detained by the police discourages program attendance and also results in discarding of needles/syringes shortly after use to avoid increased scrutiny if detained by the police (Csete & Cohen 2003; Riley & Oscapella, 1996; Small et al., 2006; Springer et al., 1999; Strike et al., 2002). While police are noted above as a barrier to safe disposal, DeBeck et al. (2008) reported that the police may refer clients who improperly dispose of injecting equipment to programs such as a safer injection facility where they can properly discard of their used equipment.

Strategies to encourage proper disposal

To increase proper disposal, a number of strategies have been suggested including: adopting needle/syringe distribution policies instead of strict exchange policies (Small et al., 2010; Strike et al., 2002); providing multiple options and locations for return and disposal of equipment (Hankins 1998; Macalino et al., 1998; Small et al., 2010); lengthening the hours of operation of NSPs and other harm reduction programs (Wenger et al., 2011); conducting visits to retrieve biohazard bins and syringes from homes, social housing and communal drug use spaces (Hankins 1998; Small et al., 2010); installing public disposal boxes (de Montigny et al., 2010; Klein et al., 2008; Obadia et al., 1999; Riley et al., 1998); promoting pharmacy disposal (Golub et al., 2005); conducting community clean-ups to collect needles (Small et al., 2010); and providing safer spaces such as supervised injection facilities for people to use drugs (Wood et al., 2004).

An area which has documented gaps with respect to effective disposal practices are within prisons or correctional institutions. A study conducted by van der Meulen (2017) in Ontario, Canada among 30 prisoners and 10 key informants, documented that the lack of provision of safe and sterile injection paraphernalia equipment in prisons resulted in a majority of participants re-using equipment. Among those who wore out equipment such as syringes, methods of disposal included the toilet or the trash (van der Meulen, 2017).

Disposal and handling of used drug use equipment evidence summary

The recommendations in this chapter have been informed by numerous sources and studies. Laboratory evidence has been used to discuss infection risks related to used drug use equipment. Observational studies, program evaluations, geographic surveys, and reviews were the main sources of evidence documenting distribution and disposal practices of NSPs. Studies using qualitative methods provided greater insight into the role of behaviours and experiences related to disposal of drug use equipment. Finally, position statements and best practice guidelines were used to provide insight into practices for safer handling and disposal of used drug use equipment.

Most of the evidence in this chapter was derived from observational studies. Even though randomised control trials (RCTs) are considered to provide the highest quality data, they may not be feasible for ethical and practical reasons for research on public health initiatives. This is recognised by numerous public health experts and authorities, for example:

The difficulty of conducting a strictly randomized controlled trial to evaluate a public health intervention such as a NSP should not be underestimated. Potential sources of bias and confounding are impossible to control because of insurmountable ethical and logistical impediments. (WHO, 2004, p. 5)

In some cases, it is impossible for researchers to conduct RCTs since to do so would be unethical. Further, given the complexity of causal chains in public health, the external validity of RCT findings often needs to be enhanced by using observational studies. (NICE, 2009, p. 17)

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