

# Supervised Consumption Facilities – Review of the Evidence

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## DEFINITIONS

\*Throughout this report the term Supervised Consumption Facilities (SCF) will be used.

*Safe injection sites* are also called *safer injection facilities* or *safer consumption services*[1].

Supervised Consumption Facilities (SCF): Legally sanctioned facilities where people who use drugs can safely inject previously obtained drugs in the presence of medical staff.

*Insite*: The first legally supervised drug injection site in North America, located in the Downtown Eastside neighborhood of Vancouver, British Columbia. Opened September 22, 2003

HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
MAT	Medication-Assisted Treatment
MSIC	Medically Supervised Injection Center (Australia)
PWID	People Who Inject Drugs
SCF	Supervised Consumption Facilities
SIF	Safe Injection Facilities (Canada)
SUD	Substance Use Disorder
SSTI	Skin and Soft Tissue Infection

# EXECUTIVE SUMMARY

The intent of this document is to:

- Describe literature related to supervised consumption facilities as harm-reduction strategies in addressing overdose deaths, infections and community harms from heroin and other opioid use.
- Apply estimates of outcomes from other communities to the City of Philadelphia's data, where data are available, to approximate the possible impact of a supervised consumption facility located where deaths from overdose have been most likely to occur.

Background on the current crisis in opioid use and overdose deaths is reviewed in order to establish a context, at the national and local level, followed by a review of studies on the impacts on harm reduction from safe use consumption settings. The report then replicates models used to estimate the potential financial and health impacts of a supervised consumption facility in Philadelphia, in comparison to Baltimore and San Francisco, two cities whose officials are currently considering the implementation of a supervised consumption facility or facilities. The limitations on interpretation from these modeling approaches are discussed, and recommendations for metrics to be used in evaluation if the City determines to implement a supervised consumption facility are presented.

Supervised consumption facilities (SCFs) around the world have reduced overdose deaths within their service areas[2]. These facilities generally are staffed with health professionals available to educate and respond to overdoses promptly. Moreover, a safe and clean facility that makes sterile injection equipment readily available leads to less transmission of blood-borne infections and fewer soft tissue injuries. Perhaps most importantly, these facilities can make other types of health care available and serve as a conduit for substance abuse treatment services.

The impact from the opioid crisis has had a profound effect on communities, neighborhoods and families. To date, no evidence has been found that SCFs increase (or decrease) crime[3], but there is evidence of a reduction in overdose deaths, injections done in public, blood-borne disease infections, discarded injection equipment, and perceived neighborhood disorder, as well as potential cost savings in health services[2-4].

In the models, we find the infection-related impact associated with a hypothetical SCF in Philadelphia would be:

- between 1 and 18 averted cases of HIV infections annually; and
- between 15 and 213 averted cases of hepatitis C infections annually.

Given the complexity of estimating the potential impact on deaths from drug overdose, we apply two different models from the literature. In the first one, using data from the Philadelphia Department of Public Health, we estimate that overdose deaths could be reduced by a range

between 27 and 48 each year. In the second model, we estimate the potential of averted deaths from drug overdose to be between 24 and 76 annually.

We also replicate the models used to estimate the financial impact of a hypothetical SCF in Philadelphia and find the following:

- Reduced costs related to hospitalization for skin and soft tissue infections (SSTI) are estimated to be between \$1,512,356 and \$1,868,205 per year.
- We estimate the total value of overdose deaths averted is between \$12,462,213 and \$74,773,276 annually.
- Our estimates for the impact on health care costs annually are:
  - o a reduction of \$123,776 from ambulance costs,
  - o \$280,683 savings from a reduction in hospital emergency department utilization, and
  - o \$247,971 savings from reduced hospitalizations.

Evidence suggests that SCFs reach and are accepted by their target populations (e.g., marginalized street users, those at high risk of infectious disease or overdose). We conclude in this report that SCFs may be a viable strategy to reduce the harms of opioids on hard-to-reach populations and the communities in which they live.

### **Limitations from data and estimates presented in this report**

In this report we focused on replicating the analytical models of two peer-reviewed articles that estimated the impact of implementing a hypothetical SCF in Baltimore[5] and San Francisco[6]. Two key factors are particularly important to improve the accuracy of these estimates: more precise estimates of the facility model (size, staffing, programmatic availability) and reliable estimates of the population that would use the facility. The majority of the studies on the impact of SCFs and harm reduction are based on estimates from the *Insite* facility in Vancouver, Canada. If local estimates are used in these models, then utilization rates and other key metrics can be improved to give a more realistic representation of projected outcomes.

# 1. BACKGROUND

## **A National Crisis**

In 2017, the President’s Commission on Combating Drug Addiction and the Opioid Crisis released its report following the October 26, 2016, declaration of the opioid crisis as a national public health emergency under federal law[7]. Cities and states across the country are continuing to extend their efforts for appropriate, timely and evidence-based treatment of substance abuse. According to estimates from the CDC, 91 individuals die each day across the United States from an opioid overdose[8]. A recent survey by the Pew Research Center in August 2017 found that nearly half of Americans (46% of U.S. adults) report having a family member or close friend with a current or past drug addiction, regardless of age, education, gender or political affiliation.

Heroin and other opioid use, including prescription pain relievers, have significantly increased for more than a decade. According to 2016 data from the Substance Abuse and Mental Health Services Administration (SAMHSA), 0.4% of the U.S. population aged 12 and older used heroin in the previous year[9]. Among young adults aged 18 to 25, 0.7% reported heroin use in the past 12 months, an estimated 227,000 young adults (Figure 29 in SAMHSA report, Appendix B). An estimated 6.9 million people, about 2.6% of the population aged 12 or older, reported overuse of prescription pain relievers in 2016 (Figure 32 in SAMHSA report, Appendix C). The latest data from the CDC indicate that there are 5 deaths per 100,000 due to commonly prescribed opioids[10]. More generally, about 1 in 23 adolescents, 1 in 7 young adults, and 1 in 15 adults aged 26 or older had a substance use disorder (SUD) in the past year (Figure 44 in SAMHSA report, Appendix D).

Furthermore, adequate access to substance abuse treatment remains unmet. In 2016, an estimated 21 million people aged 12 or older in the U.S. needed substance abuse treatment. According to SAMHSA, “approximately 3.8 million people aged 12 or older received any substance use treatment in the past year, or 1.4% of people aged 12 or older”[9].

These statistics point to a national crisis in substance use, particularly heroin and other opioids, but also point out the crisis in access to treatment. On the local front where care delivery occurs, cities are struggling with increasing rates of overdose and overdose deaths. The crisis is heightened and demand on local services suggests a need for real solutions.



## Philadelphia

Per information available through the Philadelphia Department of Public Health, in 2016 there were 907 deaths attributed to overdose in Philadelphia, which equated to 46.8 overdose deaths per 100,000 City residents. Of these 907 deaths, 729 were attributed to some type of opioid. The age-adjusted death rate for opioid overdose was 40.4 deaths per 100,000 residents, up from 17.9 in 2010. This is more than three times the rate in Chicago and four times more than New York City[11]. Estimates from survey data collected by the Philadelphia Department of Public Health indicate that there are about 469,000 individuals who used a prescription opioid in the past year, and about 168,000 current prescription opioid users in Philadelphia[11]. In May 2017, a report released by the Mayor's Task Force to Combat the Opioid Epidemic in Philadelphia estimated that 50,000 people have overused prescription pain killers and opioids in the past year, and estimates that there are about 70,000 heroin users in the Philadelphia area[12].

The toll of heroin use is not merely overdose deaths. There are impacts on neighborhoods and families that emerge from the causes and consequences of substance abuse, including a more than three-fold increase in neonatal abstinence syndrome between 2002 (3 per 1,000 live births) and 2015 (11 per 1,000 live births)[12]. As noted by the Task Force, 40% of Philadelphians surveyed experienced greater than or equal to four adverse child experiences, and approximately 35% grew up in a household with substance abuse[13]. Discarded needles and syringes raise the public health risk for communicable disease. There are profound and lasting consequences to local public health from substance abuse, including increased rates of bacterial and blood-borne infections, which include Hepatitis C (HCV) and HIV. Indeed, 60% of acute HCV patients in Philadelphia reported ever having injected drugs[14]. Furthermore, there were 30 newly HIV-diagnosed cases reported in 2015 among the population of people who inject drugs (PWID)[14, 15].

In the context of substance use and the criminal justice system, the early-onset of substance use disorders increases the risk of incarceration, becoming both a cause and consequence of substance abuse. The Philadelphia Department of Prisons processes over 30,000 individuals for intake each year. This averages over 6,000 people per day, and though it does not test for drug use on admission, a 2014 study cited by the Task Force found that 74% of inmates tested positive for use of one or more drugs on admission, and 14% of those tested positive for opioids (15% of females and 12% of males)[12].

Across the nation and locally there remains an unmet need for substance abuse treatment. For instance, data from SAMHSA show that in 2017 there were only 493 certified physicians who can provide medication-assisted treatment for substance abuse to a maximum of 30 patients each, and 127 certified physicians who can provide medication-assisted treatment with Suboxone to a maximum of 100 patients each in the entire state of Pennsylvania[9]. Therefore, medication-assisted treatment could address only 27,490 individuals in Pennsylvania.

The crisis cuts across age groups, sub-populations, ethnicities, and neighborhoods within the City[11]. Thus, a multi-agency approach leveraging evidence-based strategies is needed. Currently, multiple strategies and agencies are used, including the Department of Prisons (which provides withdrawal management to about 8,000 annually), or naloxone administration by the Fire Department (which administered naloxone to 4,000 in 2016), or the Police Department (which administered naloxone 200 times). In addition, there is a syringe-exchange program in the City, operated by Prevention Point Philadelphia<sup>1</sup>, which distributed more than 5,500 doses of naloxone in 2016.

Cities are increasingly investigating how to implement additional strategies to address the opioid crisis. Some of these approaches involve the implementation of comprehensive user settings that offer a host of services, including an injection facility to those who are still actively using heroin and other drugs, as similarly investigated in the cities of San Francisco[6] and Baltimore[5]. The remainder of this report examines the evidence on supervised consumption facilities (SCFs), and replicates models developed and published in peer-reviewed research to obtain estimates of the potential harm reductions in Philadelphia. In a separate file, we provide all key tables and models so that, as data become available, these estimates can be updated to better reflect the City's conditions as well as for scenario planning.

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<sup>1</sup> <https://ppponline.org/>

## 2. LITERATURE ON HARM REDUCTION FROM SCFs

SCFs provide a sanctioned space for drug use and draw in populations of intravenous drug users who have remained largely absent from community health programs and the health care system[16]. Although there are more than 100 SCFs in 66 cities and 11 countries around the world today[17], the scientific evidence is limited — and there are no sanctioned SCFs currently in operation in the United States. Most of the evidence we discuss here is based on data and information from studies of the *Insite* SCF in Vancouver, Canada, European SCFs, and the Medically Supervised Injecting Centre (MSIC) in Sydney, Australia[18][3][5].

Often this population avoids treatment settings because of stigmatization and marginalization[19]. SCFs may counter some of these issues. Evidence from the SCF in Sydney, Australia, showed that 15,054 people have registered to use the MSIC, and 10,538 of those people had never accessed any local health service prior to having access to the MSIC[4]. The SCF and its staff become a trusted, stabilizing force in many hard-to-reach PWIDs' lives. In addition to providing a safe site for consumption, when available, SCF clients may seek addiction treatment, furthering the potential for harm reduction to themselves and the communities in which they live[20].

Below we discuss the available evidence from SCFs' harm-reduction effects on the following factors:

- 1) reduction in deaths from overdose,
- 2) injection cessation,
- 3) reduction of infections (including HIV, hepatitis C, and soft skin tissue infection),
- 4) impact on automobile crashes,
- 5) impact on crime,
- 6) impact on neighborhood disorder,
- 7) impact on drug sales.

### **Reduction in deaths from overdose**

There is evidence that SCFs can have a substantial effect on reducing mortality from overdose by intervening to prevent overdoses that may happen within the facilities, and additionally, by reducing mortality in the vicinity of the facility itself[6]. A study on the pre- and post-overdose mortality rate near the *Insite* facility in Vancouver, Canada, found that there was a 35% reduction in mortality within 500 meters of the facility within three years of opening. By contrast, overdose deaths in other areas of the city during the same period declined by only 9%[2]. In a separate study, 52 deaths were averted[21].

Some of the reductions in overdose mortality are immediate. *Insite* was opened in 2003, and data reported from March 2004 through February 2008 showed there were 766,486 injections at the facility, resulting in 1,004 non-fatal overdoses, but zero fatal overdoses[21]. The available models estimate that during this time period there could have been over 50 deaths had those non-fatal overdoses occurred outside the facility.

Moreover, large effects in reducing overdose mortality have been noted in European SCFs, and these reductions in mortality are not only sustained but increase over time. In Spain, overdose deaths were almost halved within a decade of opening a SCF[4]. Spain's SCF has been credited with reducing overdose deaths by over 50% from 1,833 in 1991 to 773 by 2008[22].

### **Injection cessation**

In Europe, research on SCF clients (i.e., PWID population) has shown increased understanding of hygienic and safe injecting practices[23], as well as a reduction in syringe sharing[24]. Similarly, the available evidence from Vancouver's *Insite* SCF has shown clients who regularly visit the facility and have contact with counselors were more likely to seek entry into addiction treatment services. Between the opening of *Insite* in 2003 and 2006, 46% of participants entered treatment[16]. Among *Insite* participants (between 2003 and 2005) who were part of the Scientific Evaluation of the Supervised Injecting (SEOSI) cohort, there was a 30% increase in detoxification service use referrals associated with the SCF opening. This implies that SCFs can act as a referral or connection point with addiction treatment[25].

## **Reduction of infections**

Bacterial infections remain a significant issue due to shared needles, old needles and haste in injecting to avoid detection. SCFs worldwide have been able to reduce bacterial infection by providing clean injection equipment, cleaning wounds and identifying serious infections early[26][6].

Evidence from Canada's *Insite* clinic has demonstrated it prevents more than 80 HIV infections annually, which results in an estimated annual savings of about \$13.7 million in HIV-related medical care[4]. Similarly, the evidence from Spain showed a substantial decrease in the number of new HIV infections from 19% in 2004 to 8.2% in 2008[4].

In particular, the *Insite* clinic has provided evidence that SCFs can reduce blood-borne disease transmission by providing clean needles and safer injection education [3, 6, 27]. A mathematical analysis of a closed unsanctioned SCF in Vancouver, Canada, showed that on average the facility prevented 30 HIV and 81 HCV cases among PWID annually[28].

Additionally, conservative estimates on the reduction of HCV and HIV cases for a hypothetical SCF in Montreal, Canada, demonstrated each additional SCF would prevent 11 cases of HIV and 65 cases of HCV annually[29].

The European Monitoring Centre for Drugs and Drug Addiction reviewed available evidence on harm reduction and found that hygiene and safety are important reasons clients use the facilities. Available studies have demonstrated that SCFs attract people at high risk of overdose, including those who inject in public and others at risk of blood-borne infection transmission[30,31]. In addition, evidence from *Insite* indicates that despite the multiple complexities of the PWID population attending the SCF, behaviors are changed, including a reduction in the reuse of syringes, using sterile water, less rushed injections, safe syringe disposal, and less public injecting[32].

Finally, as we discuss in this report, models aiming to estimate the cost-benefits of SCF facilities have consistently found them to be cost-effective, to a large extent, due to the proven effects of SCFs in decreasing the rates of HIV and HCV[33].

## **Impact on automobile crashes**

Drug-impaired driving is an increasingly serious issue. In 2009, 32.8% of fatally injured drivers tested positive for drugs in the United States, and this rate increased in 2015 to 43%[34]. Between 2010 and 2015, 7.2% of drivers from California, Hawaii, Illinois, New Hampshire, Rhode Island, and West Virginia tested positive for prescription opioids, with the most common being hydrocodone, morphine and OxyContin[35].

Automobile crashes caused by drivers who overdose on opioids are becoming so common that rescue crews in some areas are immediately administering naloxone to unconscious drivers[36].

However, we found no evidence reported in the available literature to support or negate a hypothesis that there is increased or decreased drugged driving in communities with a SCF.

### **Impact on crime**

The literature regarding disorder in neighborhoods where SCFs have been established has demonstrated that SCFs are not independently associated with either an increase or decrease in the crime rate for the area around the facilities. Specifically, neighborhood crime rates were measured before the opening of a SCF in Vancouver, Canada, and then every month for the first year of its existence. After a full year of data collection, there was no significant increase or decrease in crime or disorder following the opening of the SCF[3].

### **Impact on neighborhood disorder**

In a study investigating the before and after effects of injection-related public order problems during the initial period after opening *Insite*, within 10 blocks that surrounded the facility, it was found that the 12-week period after the facility's opening was independently associated with reductions in the number of drug users injecting in public (from a daily mean of ~4.3 to ~2.4 drug users in public), publicly discarded syringes (from a daily average of 11.5 to 5.4), and injection-related litter. Similarly, the pre/post daily mean count of injection-related litter decreased from 601 to 310. Externally collected data and statistics from the city of Vancouver corroborated the numbers[30].

An important dimension of potential harm reduction from SCFs is the public's perception of neighborhood disorder. A qualitative study conducted five years after the opening of a SCF in Sydney, Australia, found that — through a random sampling of local residents and business operators in the SCF's vicinity at baseline and in the 18 months following operations — respondents perceived a significant decrease in public injecting and publicly discarded injecting equipment, with no significant change in proportions offered drug for purchase. Residents were less likely to have seen public injecting in the past month. A very high percentage of respondents reported — as a perceived advantage of the SCF — the control of HIV/AIDS and HCV and reduced overdose risk[37].

### **Impact on drug sales**

SCFs have not been found to be independently associated with increasing drug sales in the areas around the facilities. A study of reports from the Vancouver Police Department found drug trafficking (which includes selling, administering, giving, transferring, sending, or delivering illicit drugs) had not significantly increased or decreased in the surrounding area a year after the opening of the *Insite* facility[3]. Another study, published in 2004, administered a pre- and post-field survey

over an 18-week period and found no significant increase in the number of drug dealers in the area surrounding the *Insite* facility[30].

### **Current limitations of the literature on Supervised Consumption Facilities**

There are four major limitations of the currently available literature on SCFs:

1. The vast majority of the available evidence in recent years comes from only one SCF, the *Insite* SCF in Vancouver, Canada. The current models for harm-reduction estimates are sensitive to population-specific factors. In turn, hyper-local population-level characteristics (e.g., the proportion of PWID, rates of blood-borne conditions), and social and economic factors determine the need and potential utilization by PWIDs of SCFs. The majority of the available literature with useful statistical methodology and analysis relies more commonly on the *Insite* SCF than on any other site. It is uncertain how relevant or applicable the assumptions are to communities in other geographies.
2. Potentially outdated estimates. The changes in prescription opioids, as well as changes in the prevalence of underlying causes of substance abuse, increase the complexity of using estimates for some of the relevant factors. This specifically relates to those factors that leverage rates of syringe sharing or other variables that may have changed in recent times.
3. The models available do not take into consideration other sources of access (or lack thereof) to life-saving resources such as naloxone, clean syringes, and the potential to access medication-assisted treatment (MAT). In the particular context of American cities, there may be factors (such as having been incarcerated or homeless) that put the PWID population in a much more vulnerable position to the harms from substance abuse (including higher rates of receptive needle sharing, a larger number of partners with whom PWIDs share needles, and higher rates of infections).
4. Because it appears that existing SCFs have not incorporated rigorous evaluation into their design and implementation, it has been difficult to disentangle the full impact of SCFs on relevant harm-reduction outcomes.

A valuable approach to overcome these limitations is to engage in systematically tracking relevant metrics and data sharing across agencies that frequently interact with PWIDs such as the Fire Department, Department of Prisons, and needle exchange sites. The evidence we reviewed emphasized the value of a hyper-local approach to addressing this crisis. The timely identification

of local presence of high-risk substances like fentanyl can save lives. Additionally, the higher impact in harm reduction from strategies like needle exchanges and SCFs is achieved in localities with high PWID population.

### 3. POTENTIAL IMPACT FROM SCFs IN PHILADELPHIA

As outlined, with the increased interest in SCFs across cities in the U.S, there have been studies aimed at modeling the potential health and financial impact of a hypothetical SCF. Specifically, here we focus on replicating the models estimated for the cities of Baltimore and San Francisco[5, 6].

In these studies, the most significant difference between a (hypothetical) SCF in San Francisco and Baltimore relates to the SCF's impact on overdose deaths. The predicted impact of a SCF in Baltimore is 5.9 lives saved per year, whereas the impact of lives saved is 0.24 in San Francisco. This difference — as the authors note — stems from the much higher overdose death rate in Baltimore (260) compared to San Francisco (13) [5, 6]. Despite both cities having approximately 20,000 active PWID, Baltimore has more than 20 times the heroin-related overdose deaths. Indeed, Baltimore has one of the highest overdose death rates in the country. From 2014 to 2015, heroin-related deaths increased substantially from 192 to 260[5, 38-41].

Roughly 18% of the PWID in Baltimore are HIV-positive (twice the national average of 9% and 50 times the prevalence in the general U.S. population). One in five PWID in Baltimore suffers from chronic SSTI. Ambulances are called to the scene in roughly half of all nonfatal overdoses, and 12% of PWID who experience an overdose reported being hospitalized in Baltimore[5, 42].

The majority of studies have focused on the prevention outcomes a SCF can offer, notably on a) HIV, b) HCV, and c) overdose deaths. Similar to the Canadian SCF, *Insite*, most sites for which estimates have been conducted have been found to generate cost savings on all three outcomes[6][28][43].

We primarily follow the methodology by Irwin et al. (2017) and Irwin et al. (2016) to estimate the potential financial and health impacts of a hypothetical SCF in Philadelphia. Wherever data were available, we focused our estimates in the neighborhood of Kensington as it is the locus of drug overdose deaths in Philadelphia. Wherever data were unavailable, we used the existing values from Baltimore that were found in the published article Irwin et al. (2017).

The salient assumption made through the following estimates is that costs associated with the hypothetical facility in Philadelphia assume similar size and scope to *Insite*. This includes the staffing model as in the vast majority of the current literature and estimates for a hypothetical SCF in Baltimore by Irwin 2017.

We describe in detail our estimates and calculations in the tables below.



**Table 1: Relevant Descriptive Statistics of the City of Philadelphia**

<b>Philadelphia (P)</b>	
<b>Variable</b>	<b>Value</b>
Median wage for Philadelphia (W)	\$41,233
PWID population (T)	26,400
Annual Philadelphia OD deaths (D)	907
Number of syringes distributed (millions) (N)	2,800,000
Rate of needle sharing (S)	28.30%
Proportion of PWID HIV+ (q)	5.5%
Proportion of PWID HCV+ (q)	84.00%
Hospitalization rate for skin and soft-tissue infection (h)	2.24%
Average length of skin infection-related hospital stays for PWID (L)	6.36 days
Cost of overdose ambulance call (A)	\$1,170
Cost of overdose ER visit (F)	\$3,640
Cost of overdose hospitalizations (Ave LOS 7-10 days) (E)	\$92,408
Average hospital cost per day (C)	\$9,240

\*Please refer to Appendix H: Variable Labels and Irwin et al. (2017) Models

**Table 2: Estimates of Health and Financial Impact from a Hypothetical SCF in Philadelphia**

Variable	Low Case	High Case	Notes	Units
<b>Population Health</b>				
Estimated SCF-averted HIV infections	1	18	Low case represents a needle sharing rate of 2%; High case represents a needle sharing rate of 28.3%	Cases
Estimated SCF-averted HCV infections	15	213	Low case represents a needle sharing rate of 2%; High case represents a needle sharing rate of 28.3%	Cases
Marshall et al. (2001) estimated number of annual overdose deaths averted within 500m of SCF	27	48	<b>fODavt = (0.35) x (# of annual fatal OD's in Kensington);</b> Assuming a 35% reduction in fatal ODs for the Kensington area based on 2016 statistics. Low case represents 76 fatal ODs, high case represents 135 ODs. Formula derived from Marshall et al. (2001)	Deaths
Milloy et al. (2008) estimated number of averted overdose deaths from opening a SCF	24	76	<b>fODavt = nfODSIF (fODKens/nfODKens)</b> where nfODSIF is the approximated number of nonfatal ODs that would occur in a SCF in Kensington, fODKens is the fatal number of ODs in the Kensington area for 2016, and nfODKens are the number of nonfatal ODs in Kensington for Q1 - Q3 2017. Low case represents a fODKens of 76 fatal ODs and high case represents a fODKens of 135 fatal ODs. Formula derived from Milloy et al. (2008)	Deaths
<b>Financial Impact</b>				
Estimated annual savings due to SCF SSTI reduction	\$1,512,356	\$1,868,205	Low case represents a SCF population of 1,700 clients; High case represents a SIF population of 2,100 clients	Dollars
Estimated total value of overdose deaths averted	\$12,462,213	\$74,773,276	Low case represents 5% of naloxone administrations within 500m radius of the SCF; High case represents 30% of naloxone administrations within 500m of the SCF	Dollars
Estimated annual savings due to SCF reducing ambulance calls for overdose	\$123,776		Low case represents Baltimore figures with the average cost of an advanced life support ambulance call in the Philadelphia area.	Dollars
Estimated annual savings from keeping PWID out of emergency rooms	\$280,683		Low case represents Baltimore figures with the average cost of an overdose ER visit for the Philadelphia area.	Dollars
Estimated annual savings on hospitals for PWID who overdose	\$247,971		Low case represents Baltimore figures with the average daily cost of overdose hospitalization for the Philadelphia area.	Dollars

## 4. ESTIMATES OF SCF IMPACT ON HEALTH IN PHILADELPHIA

### *Estimated SCF-averted HIV infections*

The estimated HIV infections averted range from 1 to 18 annually. Relevant to this estimate is that we include very conservative estimates of receptive needle sharing (2% low case, and 28.3% high case). The Philadelphia Department of Public Health estimates that 5% to 6% of the PWID population is HIV-positive, so we used 5.5% for our calculations. In addition, we include 1.2 as the number of sharing partners (as is included in Irwin et al., 2017). Updating these values as data become available will improve the accuracy of these estimates.

### *Estimated SCF-averted HCV infections*

Following Irwin et al. (2017) we estimate the number of annual HCV cases averted to be between 15, if the receptive needle sharing rate is 2%, and 213, if it is 28.3%. According to the Philadelphia Department of Public Health, the actual rate of needle sharing is believed to be closer to 28.3%<sup>[44]</sup>.

With respect to HIV and HCV estimates, both are sensitive to two key data points: rate of needle sharing and number of sharing partners. As stated above, following Irwin (2017) we are assuming the number of sharing partners to be 1.2.

### *Estimated number of annual overdose deaths averted within 500 meters of SCF (Model 1)*

Here we follow Marshall et al. (2001) to estimate the number of annual overdose deaths potentially prevented within a hypothetical SCF in Philadelphia. The estimated reduction in overdose deaths within the blocks of a 500-meter radius by Marshall is 35%. We apply his estimated reduction in overdose mortality to estimate a conservative impact using the lowest mortality rate within the neighborhood of Kensington in 2016 — 76 fatal overdoses — and we find 27 potential averted deaths. Using the published overdose deaths by the Philadelphia Department of Public Health in the locus of highest mortality by overdose in Kensington — 135 overdose deaths in 2016 — the potentially prevented deaths would be 48 annually.

### *Estimated number of averted overdose deaths from opening a SCF (Model 2)*

Here we follow Milloy et al. (2008). This approach differs from the above in that this model tries to estimate the number of potential overdoses that would have been fatal had they occurred outside of the SCF. Potentially, the number of fatal drug overdoses prevented is the product of the onsite overdoses multiplied by the ratio of fatal to non-fatal overdoses in the neighborhood.

Using data from the Philadelphia Department of Public Health, we estimate the potential averted deaths from drug overdose from a hypothetical SCF in Kensington to range from 24 (if we use the lowest rate of overdose deaths) to 76. If we use the highest rate of overdose deaths in Kensington (135 in 2016), this would imply that even the conservative estimate of 24 averted deaths would reduce about 30% of deaths, which is in line with what has been found for *Insite* and other SCFs. To put these estimates in context, in 2016 there were 47 overdose deaths within 500 meters of East Cambria and Boudinot Streets in the Kensington neighborhood of Philadelphia.

## 5. ESTIMATES OF SCF FINANCIAL IMPACT IN PHILADELPHIA

### ***Estimated annual savings due to SCF SSTI reduction***

Following the model in Irwin et al. (2017), we estimate the costs averted due to SSTI for a hypothetical SCF in Philadelphia is between \$1,512,356 and \$1,868,205 annually. By comparison, using the same model for a hypothetical SCF in Baltimore yields an estimated savings from averted SSTI infections of \$934,952, and in San Francisco \$1,659,295 annually.

Two key factors have implications for this estimate: First is the number of SCF clients, which for our estimates we are assuming to be 2,100<sup>2</sup>. We note that the estimate of SCF clients should be revised to more accurately reflect the local population of a SCF and the PWID population. Because no SCF has been sanctioned in the United States, all estimates follow the projected 2,100 SCF users, which is the one found for *Insite*. As data become available, this model could help in planning scenarios for higher or lower number of participants into a SCF.

Second, the average hospital cost per day due to SSTI is substantially higher in Philadelphia (\$9,320) than in San Francisco (\$4,000) or Baltimore (\$2,500). Here again, as more granular and accurate data become available, this estimate should be revised.

### ***Estimated total value of overdose deaths averted***

The vast majority of the academic literature evaluating the impact of SCFs does not generally include a cost-benefit analysis or analyses of potential financial impacts of SCFs. Given that cost-benefit analyses can aid in determining if and where a SCF could be located, as well as appropriate staffing models, we follow the Irwin et al. (2017) model where the estimated total value of overdose deaths averted is estimated for Baltimore.

It is important to note that these estimates are sensitive to two key metrics: First, the expected rate of overdose death reduction within 500 meters (evidence for the *Insite* SCF overdose death reduction was achieved not only within the SCF but also in a 500-meter radius). Second, the

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<sup>2</sup> The number of SCF clients at the *Insite* SCF, which are used by Irwin (2017) to estimate the models for Baltimore and San Francisco. This also implies the hypothetical facilities have similar staffing and space dimensions as *Insite*.

estimates include data reflecting the highest share of naloxone administrations within a 500-meter radius as a proportion of the City's total number of naloxone administrations.

As in Irwin 2017's model, we assume the rate of overdose death reduction to be 25.7%. We estimated the value per overdose death averted to be \$808,185 (this number takes into consideration an average of 30 years until retirement, the City of Philadelphia's median wage of \$41,233, and a discount rate of 3%).

We find that the projected total value of overdose deaths averted, if we assume 5% to be the highest share of naloxone administration in a 500-meter radius, as in Baltimore from Irwin 2017, to be \$12,462,213 for Philadelphia. This compares to the \$3,000,000 that Irwin et al. (2017) found to be the value of overdose deaths averted for the city of Baltimore.

In a separate scenario, assuming 30% to be the highest share of naloxone administration within a 500-meter radius, we find the total value of overdose deaths averted for Philadelphia to be \$74,773,276 annually.

Our estimates here incorporate the projected 1,200 overdose deaths for 2017 for the City of Philadelphia. Of note, Philadelphia's median wage is almost twice as high as for the City of Baltimore (\$25,707), and Philadelphia has almost three times the number of overdose deaths as Baltimore (463). Hence, the much higher estimated value of averted deaths for Philadelphia than Baltimore is driven to a large extent on these factors.

### ***Estimated annual savings due to SCF reducing health care utilization***

Irwin (2017) shows estimates of potential savings in reduced health care utilization from a hypothetical SCF in Baltimore. Access to similar data regarding the rates of ED visits, hospitalizations and ambulance calls for the City of Philadelphia were not available. However, through data provided by the Philadelphia Department of Public Health, average local costs were available. So, using the same values found in Irwin (2017) for health care utilization for the City of Baltimore, we estimated annual savings due to reduced ambulance calls, ED use, and hospitalization.

Understanding the limitations of these potential health care cost savings estimates, our goal is to present the context and describe the potential magnitude of any savings realized in association with a SCF in Philadelphia.

For instance, the potential savings from a SCF would be \$123,776 from reduced ambulance calls, \$280,683 from reduced ED use, and \$247,971 from reduced hospitalizations when using the average health care costs in Philadelphia. All of these potential savings are higher in relation to those in Baltimore due to higher health care costs in Philadelphia.

## 6. USERS OF SAFE CONSUMPTION FACILITIES

These safe environments provide a crucial opportunity to engage with populations that are generally disconnected from other social and public health access points. Therefore, in order to better design and tailor resources in these facilities, it is of utmost importance to understand what characterizes the groups of individuals who are most likely to use SCFs[45]. Evidence from the literature indicates that the populations most likely to use (and benefit) from SCFs are:

- of working age (between 30 and 40 years old);
- predominantly men (though women as a group of users of opioids is increasing);
- have been relatively long-term drug users (for the majority of the sites, over 10 years);
- have been in prison (rates for all existent sites well over 60%); and
- have multiple complex health conditions (substantially higher rates of HCV and HIV/AIDS than local population) [19][1, 23, 46].

The higher risk of acquiring and transmitting blood-borne infections due to drug use via injection, is exacerbated by the social and economic factors that limit PWIDs' access to prevention and treatment. In a study by the CDC of U.S. cities with high levels of HIV, more than half (51%) of HIV-positive PWID reported being homeless, 30% reported being incarcerated, and 20% reported having no health insurance in the past 12 months[47]. In the case of the Canadian SCF *Insite*, 18% were HIV positive, 87% HCV positive, and 38% had been involved in the sex trade[19], a much higher rate than in the overall population in Vancouver.

While there are no sanctioned SCFs in the United States yet, a published report from an unsanctioned SCF located in an undisclosed urban center in the United States has provided unique insights on the demographics of clients who regularly used the facility to inject drugs. In line with demographic and health factors of users of other SCFs around the world, the clients in this facility consisted mainly of white (80.1%), homeless (80.5%) males (91.3%), and had contact with the police in the past 30 days (75.9%)[1]. Within this population, 79.3% inject heroin, and over 90% injected in public locations before they began injecting at the SCF. Additionally, 70% admitted to often rushing injections while they were in public, and 67.4% reported unsafe disposal of used syringes and equipment in public locations[1].

In light of the evidence provided by the literature, it is important to note that each city has a unique demographic distribution, and the profile of a SCF client may vary from city to city. Many of the studies cited above are based on the population from the *Insite* clinic. Due to the current absence of sanctioned SCFs in the U.S., it is difficult to describe what the typical user would look like for any given city.

## 7. POPULATION-LEVEL FACTORS THAT MAY IMPACT SCFs

### **Incarceration Rates in the PWID Population and SCFs**

The United States has the highest rate of incarceration compared to any other country in the G20[48]. Given the evidence on the role of incarceration as both a cause and a consequence of substance abuse, understanding the population-level factors (such as rates of incarceration of PWID, age demographics and groups at-risk of substance abuse and incarceration) at a very local level is important.

The local trends of incarceration rates in the City of Philadelphia are decreasing, and several strategies are being used to decrease the prison population, including programs funded by the MacArthur Foundation<sup>3</sup>. Therefore, a SCF could leverage some of the ongoing strategies to identify potential coordination with ongoing efforts to reduce the prison population [49].

A 2016 randomized control trial implemented a common collaborative protocol to evaluate extended-release naltrexone to prevent opioid relapse in criminal justice offenders[50]. This multi-site approach proved successful, and the sites were The University of Pennsylvania (Philadelphia), New York University School of Medicine and Bellevue Hospital Center (New York), Rhode Island Hospital and Brown University (Providence, Rhode Island), Columbia University Medical Center (New York), and Friends Research Institute (Baltimore)[50]. This indicates that cross-regional approaches that connect solutions to address substance abuse and incarceration may be possible and used to enhance and sustain the impact of SCFs.

### **Homelessness and SCFs**

As noted above, there are high rates of homelessness among individuals using SCFs across geographies. In the unsanctioned SCF in the United States, the rate of homelessness was over 70%[1].

That said, there is no consensus on the effects from SCFs on reducing homelessness. A recent cross-sectional study recruited PWID from 19 large cities in the U.S. as part of a national HIV surveillance program. Using self-reported information and data from the U.S. Census Bureau and the Department of Housing and Urban Development, the authors sought to evaluate the association of local economic and housing characteristics with homelessness[51]. The authors found a high level of homelessness (about 60%) among PWID and discuss the role of abrupt changes to housing

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<sup>3</sup> <https://nextcity.org/daily/entry/philadelphia-3.5-mil-macarthur-grant-reduce-prison-population>



markets that may increase the demand for affordable housing, shelters and other safety-net services among low-to-moderate income residents. Thus, marginalized populations such as PWID become even more vulnerable to have unmet food and shelter needs.

In the specific context of the City of Philadelphia, according to information presented by Mr. Roland Lamb, Deputy Commissioner, Strategic Planning and Innovation Division of the Department of Behavioral Health and Intellectual Disability Services (DBHIDS):

*There were 296 deaths of individuals experiencing homelessness from 2009 to 2014 – in 106 the primary cause of death was drugs and/or alcohol – in an additional 27 deaths, drugs and/or alcohol was a contributing factor. This is the #1 cause of death for people experiencing homelessness in Philadelphia (Office of Supportive Housing City of Philadelphia) [52].*

These statistics underscore the role of homelessness on the observed deaths from overdose in the City of Philadelphia. Here again, the implementation of evidence-based strategies to address the opioid crisis, such as SCFs, will have to incorporate an understanding of the very local characteristics and environment of the PWID population in order to affect the highest impact.

## 8. MODELS OF SCFS

SCFs present a physical space and opportunity for real-time education about safe injection, potentially reducing the future of SSTI and other injection-related morbidities[1]. In addition, SCFs can leverage their environment for constructive discussions about how to mitigate negative consequences of their drug use and facilitate conversations related to entering substance use treatment programs.

Although there are different SCF models, all facilities typically aim to provide basic services and access to clean injection equipment, education for safer injecting, medical response in the event of an overdose, and treatment referrals[8].

Generally, SCFs offer an array of other comprehensive health and social services, including detoxification and other substance use treatment services, medical care, counseling, and legal assistance[31].

SCFs address various contextual risks associated with public injecting by enabling safer injection practices[53], providing refuge from street-based crime[28], mediating and facilitating access to healthcare and social resources[34], and delivering education regarding safer injecting practices that are highly accepted among clients[19].

European SCFs are categorized into three separate models:

1. integrated,
2. specialized,
3. mobile.

*Integrated models* are the most common model in Europe and serve as a one-stop-shop for SCF clients where they have access to a variety of services, such as counseling and medical services for general health care needs[54].

Danish SCFs follow 2 models: *integrated*, part of a shelter with additional services such as counseling, laundry and showers; or *mobile*, which have limited space and only function as hygienic, safe places for injection[19].

SCFs focus on being protected places for the hygienic consumption of drugs in a non-judgmental environment. They are usually set up close to other drug services and located near open drug scenes, or located in areas where there is an open drug scene and injecting in public places is common[55].

In the context of cities that do not have a large PWID concentration, mobile SCFs have been effective in these cities because they can reach people who do not want to be seen in different areas of a city[54].

SCFs are generally staffed with health professionals (e.g., registered nurses, nursing aides), and most staff members have advanced first aid training and are trained in the effects and side effects of the most commonly consumed drugs[19].

## 9. CONCLUDING REMARKS

Several efforts to address this crisis are ongoing such as Prevention Point Philadelphia (PPP), which is the only syringe-exchange program in Philadelphia and Eastern Pennsylvania. PPP was founded in 1991 and offers a range of medical and nonmedical services including: sterile syringe exchange; overdose prevention program; and stabilization, treatment and engagement program (STEP), among others.<sup>4</sup> However, as we describe in this document, the alarming increase of nonfatal and fatal overdose rates, as well as the trends in fentanyl presence in Philadelphia, indicates that several strategies need to be leveraged to address the ongoing crisis. Current estimates indicate that the overdose death rate will extend beyond 1,200 people as 2017 comes to an end, which translates to more than 3 lives per day in Philadelphia.

As the opioid crisis touches cities, neighborhoods and communities across the country, several additional strategies are being studied to complement ongoing efforts. One such strategy is the use of supervised consumption facilities (SCFs). Indeed, in recent years there have been analyses of hypothetical SCFs and their potential impact on reducing the harms of opioids for the cities of Baltimore and San Francisco.

Evidence suggests that SCFs reach and are accepted by their target populations, including marginalized street users and those at higher risk of infectious disease or overdoses[46]. Therefore, SCFs may be a viable strategy to reduce the harms of opioids on hard-to-reach populations and the communities in which they live.

Here, we examined the existing literature that assesses the impact of existing facilities outside of the U.S. Moreover, we followed the models used to estimate the potential harm-reduction impact for the cities of San Francisco and Baltimore with a hypothetical SCF in Philadelphia.

It is important to remind ourselves that each community is unique. The cultural history, demographic makeup, and economics of the community may influence how substance use is generally addressed. Thus, caution must be expressed as we estimate the real impact of these facilities in other places. In the absence of available data, we apply the published statistics from Irwin (2017) for the City of Baltimore, which does not currently have a SCF but is considering one, in order to create a model to understand the impact of a hypothetical SCF in Philadelphia.

It appears, with these limitations in mind, that a SCF located in the area most afflicted by overdose deaths in Philadelphia could anticipate substantial reductions in overdose deaths, needle sharing, and the spread of communicable diseases like HIV and HCV, and fewer SSTI. Furthermore, we

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<sup>4</sup> <https://ppponline.org/>

might anticipate some significant reductions in the cost of emergency care and hospitalization among those who use the services of the SCF.

It will be important to carefully evaluate any new programming that emerges. Beyond the data already captured by the Philadelphia Department of Public Health, we recommend a rigorous evaluation for this type of facility and program. It will be important to capture demographic characteristics of those using the facility, frequency of visits to the facility and services used, and data on the health status of those using the facility. While it will be important to maintain trust and assure those who use the facility that data are used to evaluate only the program, it will be important to establish metrics that aid the City and other cities in making clear decisions about the potential benefits of these programs.

This report was prepared by the Main Line Health Center for Population Health Research at the Lankenau Institute for Medical Research and commissioned by the Office of the Health Commissioner, Philadelphia Department of Public Health.

## ABOUT THE AUTHORS

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Dr. Larson completed her PhD at the University of Nebraska in sociology and followed with a post-doctoral fellowship in Psychiatric Epidemiology at Johns Hopkins University Bloomberg School of Public Health and has worked for the Agency for Healthcare Research and Quality (AHRQ), the Substance Abuse and Mental Health Services Administration (SAMHSA), and the Geisinger Health Systems Center for Health Research. Dr. Larson has worked in the area of behavioral health including mental health and substance abuse for more than 20 years. Her work spans a wide range of health services and outcomes research, including evaluation of federal programs, the development of methods for evaluating and reporting on integrated behavioral health outcomes, and research related to veteran's health, school health, and childhood obesity, as well as the use of health technology to improve patient outcomes.

### **Norma Padrón, PhD**

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Dr. Padrón's academic and professional experience is focused on health economics and policy. She received her PhD in Health Policy and Management at Yale University, a Master's degree in Public Health from Universitat Pompeu Fabra in Barcelona, Spain, and a Master's degree in Economics from Duke University. Prior to joining the MLH System, she was a research scientist at the Center for Health Innovation, The New York Academy of Medicine and assistant professor of health economics at the Icahn School of Medicine at Mount Sinai.

## APPENDICES

- A. Drug Names and Descriptions
- B. Past Year Heroin Use among People Aged 12 or Older
- C. Past Year Prescription Pain Reliever Misuse among People Aged 12 or Older
- D. Substance Use Disorder in the Past Year Among People Aged 12 or Older in the United States
- E. Health Care Providers are the Main Source of Prescription Opioids
- F. Benzodiazepine Use is Very Common in Philadelphia
- G. Philadelphia Drug Overdose Deaths
- H. Variable Labels and Irwin et al. (2017) Models

## Appendix A: Drug Names and Descriptions

DRUG CATEGORY	NAME OF DRUG	DESCRIPTION
Benzodiazepines	Clonazepam (Klonopin)	An anticonvulsant used for several types of seizures, it is also used as a mild tranquilizer for people who have insomnia and panic attacks. Also prescribed as a calming agent.
	Diazepam (Valium)	Used to treat anxiety disorders, alcohol withdraw symptoms or muscle spasms.
	Xanax (Alprazolam)	Prescribed to treat anxiety and panic disorder. Those without a prescription abuse the drug for its fast-acting sedating and relaxing.
Cocaine		A strong stimulant that is commonly used as a recreational drug. Can be snorted, smoked, inhaled and injected as a solution.
Heroin		An opioid that is commonly used as a recreational drug. Usually it is injected into a vein; however, it can be smoked, snorted or inhaled
Other Illicit Drugs	Lysergic Acid Diethylamid (LSD)	A hallucinogen that distorts perceptions of reality. No accepted medical uses, and its manufacture is illegal.
	Methamphetamine	A powerful, highly addictive stimulant used to treat attention deficit hyperactivity disorder (ADHD) and obesity.
	Phencyclidine (PCP)	Developed in the 1950s as an intravenous anesthetic but discontinued due to the side effects. On the illicit drug market it contains a number of contaminants.
Methadone		A synthetic narcotic analgesic and opioid agonist commonly associated with heroin detoxification.
Ritalin		A schedule II drug (stimulant) used to treat attention deficit disorder. When snorted the effects can mimic the euphoric effects of cocaine.

Source: The PubChem Substance and Compound databases, By Kim et al.,2016 [56] and Drugs.com [Internet]. Drugs A-Z, 2000-2017. Available from <https://pubchem.ncbi.nlm.nih.gov/> [57] and Analysis of Overdose Deaths in Pennsylvania, By DEA Philadelphia Division and University of Pittsburgh, 2017 [58](information aggregated by MLHS Center of Population Health at LIMR)



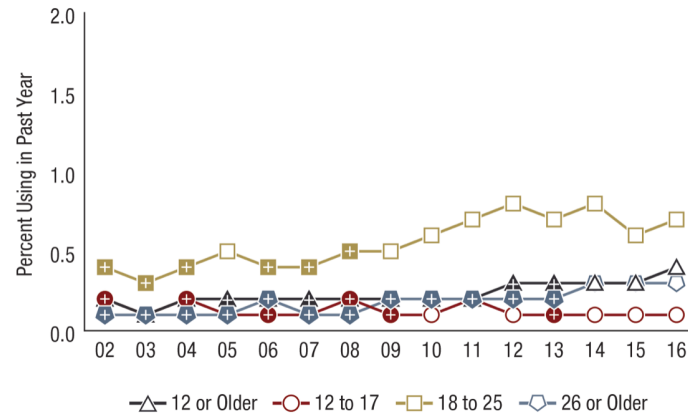
## Appendix A: Drug Names and Descriptions

DRUG CATEGORY	NAME OF DRUG	DESCRIPTION
Prescription Opioids	Codeine	A drug used to relieve mild to moderately severe pain, a weaker opioid than morphine or oxycodone, but the effects are similar.
	Hydrocodone (Vicodin)	Narcotic analgesic related to codeine, put more potent and addicting by weight. Used for managing pain and suppressing coughs.
	Hydromorphone (Dilaudid)	A fast-acting narcotic analgesic (pain killer) made from morphine. It has a shorter duration of action than morphine.
	Demerol (Meperidine)	A narcotic analgesic used for the relief of most types of moderate to severe pain, including postoperative pain and the pain of labor.
	Fentanyl	Synthetic narcotic analgesic (pain killer) that is similar to morphine but 50 to 100 times more potent. It is typically used to treat patient with severe pain after surgery.
	Morphine	A narcotic analgesic (pain killer) used to treat moderate to severe pain, dispensed in pill or liquid form. Some who abuse this drug will take it intravenously or by insufflation.
	Oxycodone	A narcotic analgesic (pain killer) also known as Oxycotin, Percocet, Percodan, Roxicet, Tylon and Roxicodone
	Oxymorphone	An opioid analgesic with actions and uses similar to those of morphine. Used in treatment of moderate to severe pain, including obstetrical pain, or as an adjunct to an anesthesia.

Source: The PubChem Substance and Compound databases, By Kim et al.,2016 [56] and Drugs.com [Internet]. Drugs A-Z, 2000-2017. Available from <https://www.drugs.com/> [57] and Analysis of Overdose Deaths in Pennsylvania, By DEA Philadelphia Division and University of Pittsburgh, 2017[58] (information aggregated by MLHS Center of Population Health at LIMR)

Appendix B: Past Year Heroin Use among People Aged 12 or Older in the United States

**Figure 29. Past Year Heroin Use among People Aged 12 or Older, by Age Group: Percentages, 2002-2016**



<sup>+</sup> Difference between this estimate and the 2016 estimate is statistically significant at the .05 level.

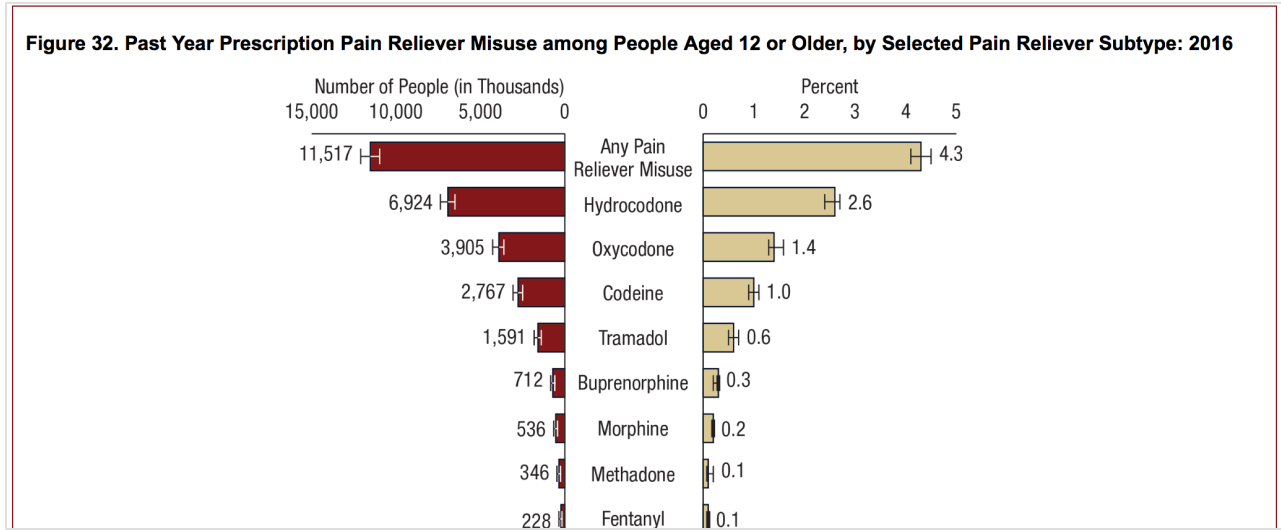
**Figure 29 Table. Past Year Heroin Use among People Aged 12 or Older, by Age Group: Percentages, 2002-2016**

Age	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	
≥12	0.2 <sup>+</sup>	0.1 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.3 <sup>+</sup>	0.3 <sup>+</sup>	0.3	0.4
12-17	0.2 <sup>+</sup>	0.1 <sup>+</sup>	0.2 <sup>+</sup>	0.1 <sup>+</sup>	0.1 <sup>+</sup>	0.1	0.2 <sup>+</sup>	0.1 <sup>+</sup>	0.1	0.2 <sup>+</sup>	0.1	0.1 <sup>+</sup>	0.1	0.1	0.1	0.1
18-25	0.4 <sup>+</sup>	0.3 <sup>+</sup>	0.4 <sup>+</sup>	0.5	0.4 <sup>+</sup>	0.4 <sup>+</sup>	0.5 <sup>+</sup>	0.5	0.6	0.7	0.8	0.7	0.8	0.6	0.7	0.7
≥26	0.1 <sup>+</sup>	0.1 <sup>+</sup>	0.1 <sup>+</sup>	0.1 <sup>+</sup>	0.2 <sup>+</sup>	0.1 <sup>+</sup>	0.1 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.2 <sup>+</sup>	0.3	0.3	0.3

<sup>+</sup> Difference between this estimate and the 2016 estimate is statistically significant at the .05 level.

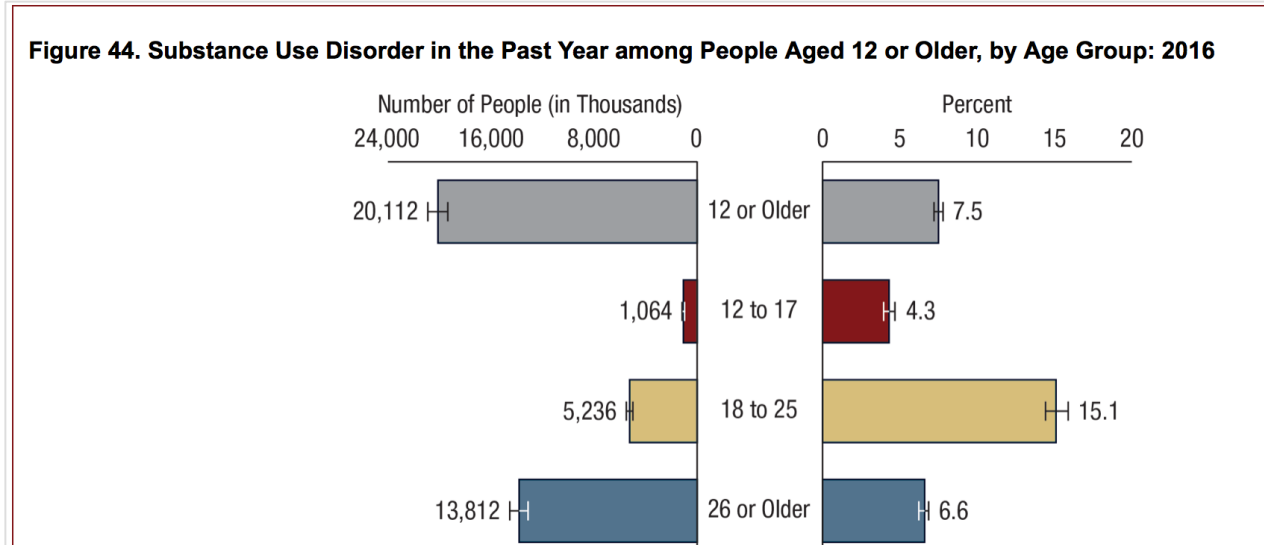
Source: Substance Abuse and Mental Health Services Administration, Report on Key Substance Use and Mental Health Indicators in the United States, 2017[59]

Appendix C: Past Year Prescription Pain Reliever Misuse among People Aged 12 or Older in the United States



Source: Substance Abuse and Mental Health Services Administration, Report on Key Substance Use and Mental Health Indicators in the United States, 2017[59]

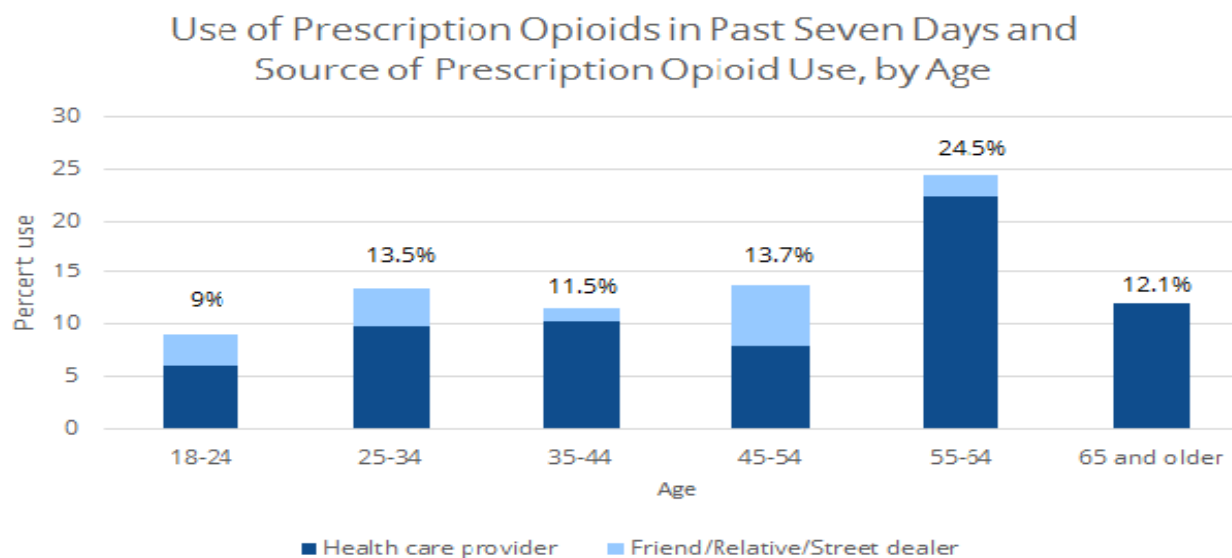
Appendix D: Substance Use Disorder in the Past Year among People Aged 12 or Older in the United States



Source: Substance Abuse and Mental Health Services Administration, Report on Key Substance Use and Mental Health Indicators in the United States, 2017[59]

## Appendix E: Health Care Providers are the Main Source of Prescription Opioids

### Health Care Providers are by far the Main Source of Prescription Opioids



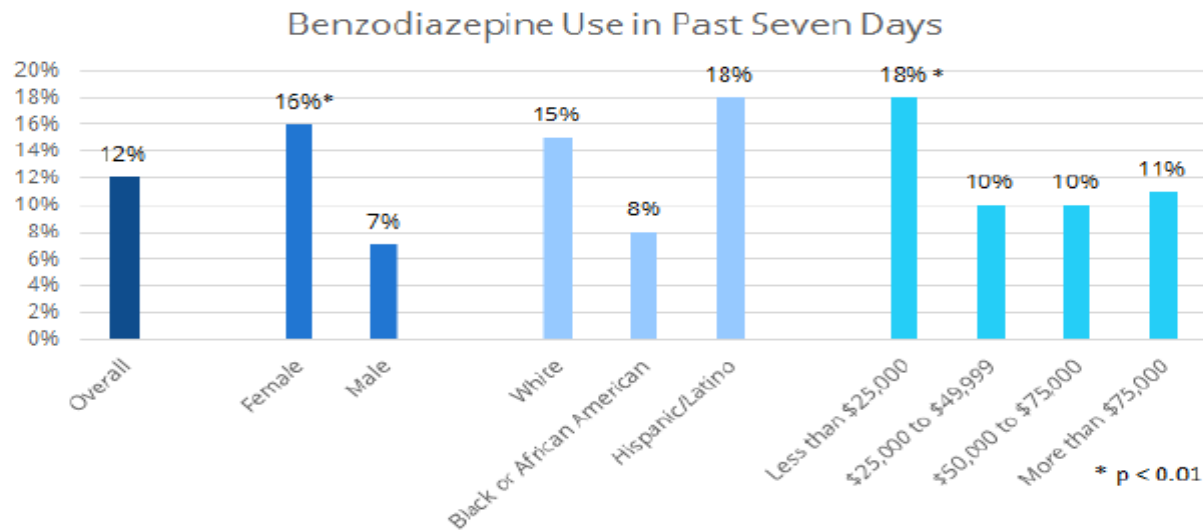
- Opioid use was highest among persons age 55-64.
- The majority (76%) of current opioid users across all age groups obtained their prescription opioids from health care providers.
- 19% of current opioid users obtained their prescription opioids from friends, relatives or street dealers.

PHILADELPHIA DEPARTMENT OF PUBLIC HEALTH  
AUGUST 2017

Source: Philadelphia Department of Public Health, Prescription Opioid and Benzodiazepine Use in Philadelphia, 2017[60]

Appendix F: Benzodiazepine Use is Very Common in Philadelphia

### Benzodiazepine Use is Very Common in Philadelphia



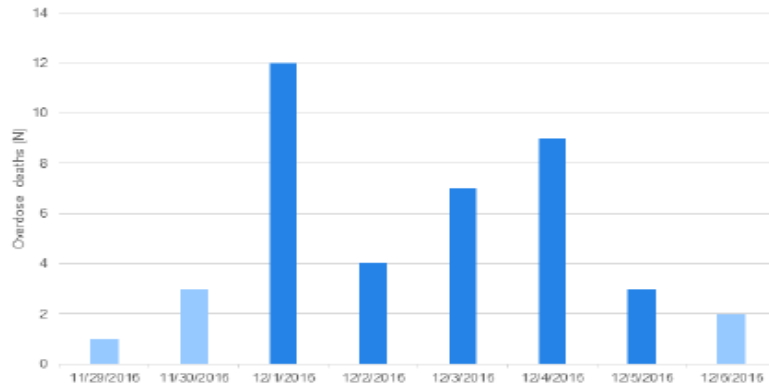
- 12% of Philadelphia adults surveyed, or 1 in 8 people, were current benzodiazepine users, having taken one in the past 7 days.
- Women (16%) were twice as likely as men (7%) to be current users of benzodiazepines.
- Benzodiazepine use was highest among people with household incomes below \$25,000.

PHILADELPHIA DEPARTMENT OF PUBLIC HEALTH  
AUGUST 2017

Source: Philadelphia Department of Public Health, Prescription Opioid and Benzodiazepine Use in Philadelphia, 2017[60]

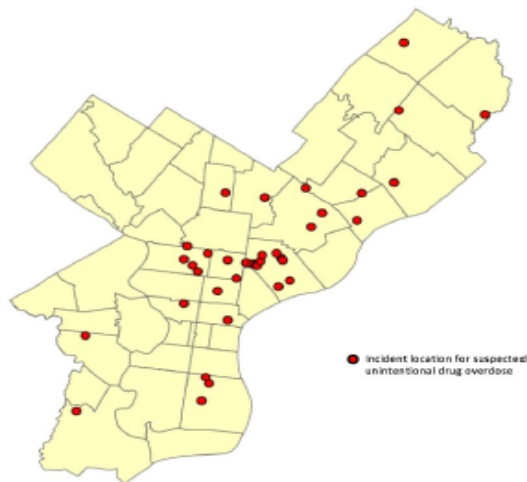
## Appendix G: Philadelphia Drug Overdose Deaths

### Drug Overdose Deaths Spiked December 1-5, 2016



- Drug overdoses cause an average of between 2 and 3 deaths per day in Philadelphia.
- The number of deaths between December 1-5, 2016 (dark blue) was significantly above this baseline. The 12 apparent unintentional drug deaths reported on December 1, 2016 were more than had ever been reported on a single day to the Medical Examiner's Office.

(Source: Philadelphia Department of Public Health, Medical Examiner's Office)



### Deaths Occurred Throughout Philadelphia

- These overdose deaths clustered in the North Philadelphia and Kensington neighborhoods, though occurred across Philadelphia.

(Source: Philadelphia Department of Public Health, Medical Examiner's Office)

Source: Philadelphia Department of Public Health, Prescription Opioid and Benzodiazepine Use in Philadelphia, 2017[60]

## Appendix H: Variable Labels and Irwin et al. (2017) Models

### KEY

$\Phi$  denotes values obtained from Philadelphia City officials

\* denotes values used in Irwin et al. (2017) for Baltimore

### HIV Predictive Models:

$I_{HIV} = iNsd [1-(1-qt)^M]$  to estimate the number of new HIV infection cases without a SCF, where:

- “i” is the percentage of HIV negative PWIDs ( $\Phi$ 94.5%)
- “N” is the total number of needles in circulation ( $\Phi$ 2,800,000)
- “s” is the percentage of injections with a shared needle (\*2.0% and  $\Phi$ 28.3%)
- “d” is the percentage of injections with an unbleached needle (\*100%)
- “q” is the percentage of HIV positive PWIDs ( $\Phi$ 5.5%)
- “t” is the chance of transmitting HIV through a single injection with a shared needle (\*0.67)
- “M” is the average number of people injecting with a previously used needle (\*1.2)

$S_{post} = S_{pre}(T-N) + (1-n)N/T$  to find new percentage of infections with a shared needle from a SCF, where:

- “S<sub>pre</sub>” is the original percentage of injections with a shared needle (\*2.0% and  $\Phi$ 28.3%)
- “T” is the total number of PWID in the city ( $\Phi$ 26,400)
- “N” is the number of SCF users (\*2,100)
- “n” is the reduction in needle sharing by SCF users (\*70%)

$I_{post} = iN(S_{post})d [1-(1-qt)^M]$  to estimate the number of new HIV infection cases with a SCF

- “i” is the percentage of HIV negative PWIDs ( $\Phi$ 94.5%)
- “N” is the total number of needles in circulation ( $\Phi$ 2,800,000)
- “S<sub>post</sub>” is the percentage of injections with a shared needle from a SCF (\*0.019 and  $\Phi$ 0.267)
- “d” is the percentage of injections with an unbleached needle (\*100%)
- “q” is the percentage of HIV positive PWIDs ( $\Phi$ 5.5%)
- “t” is the chance of transmitting HIV through a single injection with a shared needle (\*0.67)
- “M” is the average number of people injecting with a previously used needle (\*1.2)

$I_{HIV} - I_{post} =$  estimated SCF averted HIV infections annually due to implementation of one SCF  
(\*23.4 4- \*22.10) and ( $\Phi$ 331.12-  $\Phi$ 312.68)



## Appendix H: Variable Labels and Irwin et al. (2017) Models

### HCV Predictive Models:

$I_{HCV} = iNsd [1-(1-qt)^M]$  to estimate the number of new HCV infection cases without a SCF, where:

- “i” is the percentage of HCV negative PWIDs ( $\Phi$ 16%)
- “N” is the total number of needles in circulation ( $\Phi$ 2,800,000)
- “s” is the percentage of injections with a shared needle (\*2.0% and  $\Phi$ 28.3%)
- “d” is the percentage of injections with an unbleached needle (\*100%)
- “q” is the percentage of HCV positive PWIDs ( $\Phi$ 84%)
- “t” is the chance of transmitting HCV through a single injection with a shared needle (\*3%)
- “M” is the average number of people injecting with a previously used needle (\*1.2)

$S_{post} = S_{pre}(T-N) + (1-n)N/T$  to find new percentage of infections with a shared needle from a SCF, where:

- “S<sub>pre</sub>” is the original percentage of injections with a shared needle (\*2.0% and  $\Phi$ 28.3%)
- “T” is the total number of PWID in the city ( $\Phi$ 26,400)
- “N” is the number of SCF users (\*2,100)
- “n” is the reduction in needle sharing by SCF users (\*70%)

$I_{post} = iN(S_{post})d [1-(1-qt)^M]$  to estimate the number of new HCV infection cases with a SCF

- “i” is the percentage of HCV negative PWIDs ( $\Phi$ 16%)
- “N” is the total number of needles in circulation ( $\Phi$ 2,800,000)
- “S<sub>post</sub>” is the percentage of injections with a shared needle from a SCF (\*0.019 and  $\Phi$ 0.267)
- “d” is the percentage of injections with an unbleached needle (\*100%)
- “q” is the percentage of HCV positive PWIDs ( $\Phi$ 84%)
- “t” is the chance of transmitting HCV through a single injection with a shared needle (\*3%)
- “M” is the average number of people injecting with a previously used needle (\*1.2)

$I_{HCV} - I_{post} =$  estimated SCF averted HCV infections annually due to implementation of one SCF (\*270 - \*255) and ( $\Phi$ 3,824 -  $\Phi$ 3,611)

### Skin and Soft Tissue Infection Model:

$S_{SSTI} = NhLrC$  to estimate the annual savings due to SCF SSTI reduction, where:

- “N” is the total number of SCF clients (\*2,100)
- “h” is the percent of PWID hospitalized for SSTI in an average year ( $\Phi$ 2.24%)
- “L” is the average length of SSTI hospitalization ( $\Phi$ 6.36)
- “r” is the percent reduction in hospital stay length (\*67%)
- “C” is the average daily cost of a hospital stay ( $\Phi$ \$9,320)

### Value of Single Life Saved

$$V = \sum_{i=1}^N \frac{W}{(1+r)^i}$$

- “W” is the median wage for the City ( $\Phi$ \$41,233)
- “N” is the average number of years until retirement (\*30)
- “r” is the discount rate (\*3%)

## Appendix H: Variable Labels and Irwin et al. (2017) Models

### Overdose Death Model:

$SOD = rnDV$  to estimate the total value of overdose deaths averted annually, where:

- “r” is the rate of overdose death reduction expected within 500 m (\*25.7%)
- “n” is the percent share of naloxone administrations concentrated within a single 500m radius (\*5% and <sup>Φ</sup>30%)
- “D” is the total number of overdose deaths in the city (<sup>Φ</sup>1,200)
- “V” is the value of a single life saved (calculated above <sup>Φ</sup>\$808,185)

### Ambulance Call Model:

$S_a = Io(C_o - C_i)A$  to estimate the annual savings due to SCF reducing ambulance calls for overdose, where:

- “I” is the annual number of injections at the SCF (\*180,000)
- “o” is the per-injection rate of overdose (\*0.133%)
- “C<sub>o</sub>” is the rate of overdose ambulance calls outside the SCF (\*46%)
- “C<sub>i</sub>” is the rate of overdose ambulance calls inside the SCF (\*0.79%)
- “A” is the average cost of an overdose ambulance call (<sup>Φ</sup>\$1,170)

### Emergency Room Model:

$S_{er} = Io(t_o - t_i)F$  to estimate the annual savings due to SCF reducing ER visits for overdose, where:

- “I” is the annual number of injections at the SCF (\*180,000)
- “o” is the rate of nonfatal overdose (\*0.133%)
- “t<sub>o</sub>” is the rate of ER visit for overdose when overdose occurs outside SCF (\*33%)
- “t<sub>i</sub>” is the rate of ER visit for overdose when overdose occurs inside SCF (\*0.79%)
- “F” is the average cost of an overdose emergency room visit (<sup>Φ</sup>\$3,640)

### Hospitalization Model:

$S_h = Io(a_o - a_i)E$  to estimate the annual savings due to SCF reducing hospitalizations for overdose, where:

- “I” is the annual number of injections at the SCF (\*180,000)
- “o” is the rate of nonfatal overdose (\*0.133%)
- “a<sub>o</sub>” is the rate of hospitalization of overdose when the overdose occurs outside the SCF (\*12%)
- “a<sub>i</sub>” is the rate of hospitalization of overdose when the overdose occurs inside the SCF (\*0.79%)
- “E” is the average expense of an overdose hospital stay (<sup>Φ</sup>\$9,240)

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