
Prevalence and Correlates of the Use of Prefilled Syringes Among Persons Who Inject Drugs in San Diego, CA

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ABSTRACT *Persons who inject drugs (PWID) are at increased risk for blood-borne virus (BBV) infections and overdose resulting from high-risk injecting practices. Studies of prefilled syringe use (PFSU) using a syringe that already contained drug solution when it was obtained by the user, an injection practice previously described in Eastern Europe, suggest that it increases susceptibility to BBV. However, little is known about this practice in the USA. Data were obtained from an ongoing cohort study of PWID to determine the prevalence and assess correlates of PFSU in San Diego, CA. Baseline interviews assessed socio-demographics and drug use behaviors. Logistic regression was used to identify factors independently associated with ever using a prefilled syringe (yes/no). Participants (n=574) were predominately males (73.9 %) and white (50.9 %) with a mean age of 43.4 years (range 18–80); 33.3 % reported ever using prefilled syringes, although only 4.9 % reported use in the past 6 months. In multivariable analyses, PFSU was independently associated with ever having a rushed injection due to police presence [adjusted odds ratio (AOR)=2.51, 95 % CI 1.66, 3.79], ever being in prison (AOR=1.80, 95 % CI 1.23, 2.63), injecting most often in public versus private places in the past 6 months (AOR=1.66, 95 % CI 1.11, 2.48), and injecting drugs in Mexico (AOR=1.70, 95 % CI 1.16, 2.49). Results indicate that a history of PFSU is common and associated with environmental factors that may also increase risk for adverse health outcomes. Studies are needed to better understand PFSU in order to develop interventions to prevent adverse outcomes associated with their use.*

KEYWORDS *Injection drug use, HIV, Hepatitis C, Prefilled syringes, Overdose*

INTRODUCTION

Persons who inject drugs (PWID) are at increased risk for infection with blood-borne viruses (BBV) including hepatitis C virus (HCV) and human immunodeficiency virus (HIV).^{1–5} Though the prevalence of HCV is low among the general

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population, it is much higher in PWID with approximately one third of young (18–30 years old) and 50–90 % of older PWID estimated to be infected in the USA.^{6, 7} Clatts (2007) suggests “transmission associated with the ways that illegal drugs such as heroin are prepared, distributed, and self-administered have emerged as adaptive responses to opportunities and constraints in the local physical and social environments.”⁸ Thus, it is important for substance use researchers to be mindful of emerging trends in drug using practices.

Atypical injection practices and drug distribution methods might affect the spread of disease. One such practice is prefilled syringe use (PFSU), which is defined as using a syringe that already contained drug solution when it was obtained by the user. PFSU may have influenced HIV transmission among PWIDs in some Eastern European countries (e.g., Russia and Ukraine); however, drug preparation methods and time between preparation and distribution of prefilled syringes influences their infectivity and potential for the spread of disease.^{9–12} There is a dearth of information about this practice from the USA.

There are two predominant concerns associated with PFSU. First, the concentration and composition of the solution in the syringes is unknown to the user—potentially resulting in unintended overdose. Second, the source and sterility of the syringes and injection paraphernalia is unknown to the user—this could lead to BBV transmission. In many settings, a common drug container is used to fill syringes and if that container becomes contaminated then all subsequent syringes filled may become contaminated.^{13–15} While PFSU may result in increased risk of BBV infection, PWID engage in many high-risk behaviors such as using non-sterile syringes and a common drug container that are additive to risk associated with PFSU.^{11, 15, 16}

The interplay between the physical, economic, social, and political environment affects the distribution and use of drugs. Distribution and use of prefilled syringes may be associated with properties of the drug (i.e., liquid or powdered form), the need for rapid drug transactions, and individual factors of discreet drug users.^{17, 18} In Eastern Europe, younger and less experienced drug users are more likely to report PFSU.^{15, 19–21} In the USA, the use of prefilled syringes has been documented among PWID who inject ketamine (a dissociative hallucinogen commonly used in as an anesthetic in veterinary practice but also used illicitly).²²

PFSU occurs within the risk environment described by Rhodes as the social norms and physical spaces that interact to impact health behaviors and health outcomes.²³ In regards to PFSU, microenvironmental factors such as drug injection locations, income, and access to syringes, combined with macroenvironmental factors such as drug possession laws and policing practices, influence their use and interact to produce HIV risk and other drug related harms.^{24, 25} Evidence suggests that while increased police presence may lessen the visibility of drug use in public spaces, there can be negative public health consequences due to environmental changes as a result of increased monitoring of drug use.²⁶ One example of this is the increased use of shooting galleries, often cited as riskier injection sites where more syringe and paraphernalia sharing happens, as a result of police arrests for syringe possession.²⁷ Thus, with heightened monitoring of drug practices there is an increase in syringe sharing, rushed injection, and potentially PFSU, which may be an easy way to thwart arrest because drug transactions and injection of drugs can be quicker if the drugs are already prepared. Consequently, the utilization of safe sources of syringes may also decrease and participation in higher risk injection practices, such as sharing injection equipment, unsafe injection, and improper disposal of injection equipment, may increase.²⁶

Located on the US–Mexico border, San Diego, CA is adjacent to the busiest land border crossing in the world (San Ysidro/ Tijuana, Baja California, Mexico) and along major production and trafficking routes for drugs entering the USA from Mexico.²⁸ Previous studies reported that 20 % of PWID in San Diego travel to Mexico to purchase, use or inject drugs—a practice that could increase potential of disease transmission as the rates of HCV are much higher in Tijuana.²⁹ In 2011, a qualitative study among PWID from San Diego who reported injecting drugs in Tijuana referred to the finding that some PWID purchased prefilled syringes in Mexico; however, no additional information about the frequency or rationale behind this practice was collected.³⁰ The purpose of the present analysis is to determine the prevalence and correlates of PFSU in a sample of PWID recruited in San Diego, CA.

METHODS

Between June 2012 and January 2014 PWID were recruited into the Study of Tuberculosis, AIDS, and Hepatitis C Risk (STAHHR II)—an ongoing longitudinal cohort study, in San Diego, CA—to assess sociodemographic, behavioral, and contextual factors associated with HIV, HCV, and *Mycobacterium tuberculosis* (*Mtb*) infection.³¹ This study has been described in detail elsewhere.³¹ Eligibility criteria included (1) being ≥ 18 years of age, (2) having injected illicit drugs in the past 30 days, (3) reporting no plans to move from San Diego County within the next 2 years, (4) agreeing to a blood draw and serologic testing for HIV, HCV and TB, (5) ability to speak English or Spanish, and (6) the ability to provide written, informed consent.

Participants were recruited using targeted outreach methods including advertising and street outreach in areas of known high drug use prevalence and word-of-mouth. The study took place in a storefront office and on a mobile unit that parked in locations throughout San Diego County to increase representativeness of the sample. A bilingual (Spanish–English) outreach worker provided potential participants with information about the study and helped them to make appointments for the interviews. The institutional review board at the University of California, San Diego, approved the study and all participants provided written informed consent.

Data Collection

Face-to-face interviews were conducted using computer-assisted personal interviewing (CAPI), a process in which trained interviewers read questions from a computer to participants in English or Spanish and enter their responses on a laptop computer. The questionnaire included sociodemographics and behavioral factors associated with PFSU. Serologic testing was conducted to determine the prevalence of infection with HIV and HCV. Participants who tested positive for HIV or HCV were provided counseling and referrals for follow-up medical care and treatment. Participants were offered \$25 USD at baseline for time and travel to complete the interview and serologic testing.

Measures

Sociodemographics: age, sex, race/ethnicity, relationship status (single versus in a relationship), income (<\$10,000 versus \geq \$10,000 USD annually), and housing status (homeless versus not). *Substance use and injection practices*: number of years injecting, number of injecting partners in the USA, frequency of heroin use in the

past 6 months (daily versus less frequently), frequency of crack/cocaine injection in the past 6 months (weekly versus less frequently), frequency of syringe sharing in the past 6 months (any vs. none), frequency of sharing injection paraphernalia (cookers, cotton, rinse water) in the past 6 months (any vs. none). *Microenvironmental factors*: education (\geq high school vs. $<$ high school), most frequent syringe source in the past 6 months (safe [i.e., syringe exchange program, doctor/clinic/hospital, veterinary clinic/pet store, market] versus unsafe [i.e., spouse, family member, or sex partner, friend, drug dealer, "Hit doctor," shooting gallery, on the street, some other place]), primary injection location in the past 6 months (private [i.e., my/someone else's home, car] versus public location [i.e., shooting gallery, construction site, alleyway, bar/club, on the street, vacant lot, park, freeway overpass/bridge/canyon, public restroom]), use of the syringe exchange program in the last 6 months, and whether they injected drugs in Mexico in the last 6 months because injecting in Mexico may influence PFSU due to PWIDs unfamiliarity with where to obtain drugs or injection equipment. *Macroenvironmental factors*: rushed injection due to police presence, ever (yes vs. no) and whether police presence affected where PWID buy or use drugs, ever (yes vs. no). *Health care utilization*: hospitalizations and emergency room (ER) visits in the past 6 months. *Health outcomes*: HIV and HCV seropositivity were detected using HIV Unigold Recombigen rapid antibody test (Trinity Biotech PLC, Bray, Ireland) and OraQuick HCV rapid antibody test (Orasure Technologies Inc., Bethlehem, PA).

Outcome: We assessed the use of prefilled syringes as a binary variable: "Have you ever used drugs that were purchased in prefilled syringes, meaning syringes that already had drugs in them before you purchased them?" (yes/no). In addition to lifetime PFSU, we also assessed any PFSU in the past 6 months. Lifetime PFSU was used as the outcome in subsequent analyses because only 27 (4.9 %) of participants reported PFSU in the past 6 month; thus, we lacked sufficient power to use PFSU in the past 6 month as our outcome.

Statistical Methods

For this analysis, we used data from the STAHR II baseline visit. Descriptive statistics were calculated. Chi-squared and *t* test statistics were used to describe the sample and compare PWID who reported lifetime PFSU to those who did not. Bivariate logistic regression was used to determine factors associated with PFSU. Factors with a *p* value $<$ 0.20, and those considered potential confounders, were entered into a multivariable logistic regression model using forward stepwise procedures. Collinearity was tested in the final model using condition indices and variance inflation factors.³² Confounders³³ and variables significantly associated with PFSU (*p* $<$ 0.05) were retained in the final model. All analyses were completed using SAS 9.3.

RESULTS

A total of 574 participants enrolled in the study responded to the PFSU questions and were eligible for this analysis. Half of the participants were white (50.9 %), nearly three quarters (73.9 %) were male, and the mean age was 43.4 years (range 18–80). Sixty-one percent reported being homeless, most were single (88.7 %), and one third (32.1 %) reported a yearly income greater than \$10,000. Mean age of first injection was 22.6 years and mean duration of injecting was 20.8 years (Table 1).

Of the 574 participants who responded to the PFSU questions, 193 (33.5 %) reported ever using prefilled syringes and 27 (4.7 %) reported PFSU in the past 6 months. As reported in Table 1, in bivariate analysis, participants who reported lifetime PFSU at baseline were more likely to report a high school education or less compared to greater than high school (40.2 vs. 27.5 %), to be currently homeless (67.4 vs. 58.0 %) and to be younger at first injection (mean age: 21.5 vs. 23.1 years). Participants who reported lifetime PFSU were more likely to report ever rushing injection due to police presence (39.5 vs. 19.9 %) and to agree that police presence had ever affected where they purchase (47.9 vs. 36.1 %) and use drugs (48.3 vs. 33.3 %). Participants who reported lifetime PFSU were also more likely to have ever been in prison (60.5 vs. 46.7 %), to report injecting drugs most often in public compared to private places in the past 6 months (38.8 vs. 24.7 %), shared syringes more often in the past 6 months (74.9 vs. 50.9 %), shared other injection paraphernalia more often (89.2 vs. 63.3 %) and were more likely to report injecting drugs in Mexico in their lifetime (46.2 vs. 31.5 %).

In regards to health care utilization and status, in bivariate analysis participants who reported lifetime PFSU were more likely to report hospital (23.4 vs. 13.9 %) or ER (44.8 vs. 28.6 %) visits in the past 6 months, to have ever had an abscess (73.4 vs. 66.6 %) and to have tested anti-HCV positive (71.4 vs. 63.2 %).

In multivariable analysis (Table 2), reporting lifetime PFSU was associated with having ever rushed an injection due to police presence (AOR=2.50, 95 % CI 1.66, 3.80), ever being in prison (AOR=1.80, 95 % CI 1.23, 2.63), ever injecting drugs in Mexico (AOR=1.70, 95 % CI 1.16, 2.49), and injecting most often in public versus private places in the past 6 months (AOR=1.66, 95 % CI 1.11, 2.48).

Among those who reported lifetime PFSU, 27 (13 %) reported PFSU in the past 6 months. The majority (92.6 %) reported purchasing prefilled syringes in the past 6 months in the USA, while only one participant purchased them in Mexico and one participant reported purchasing them in both the USA and Mexico. Most participants reported purchasing prefilled syringes from their injection partners or friends (88.4 %) or drug dealers (42.3 %), while other places such as shooting galleries, bars/clubs, the casino, and in jail were also reported infrequently (data not shown).

DISCUSSION

In this study of the prevalence and correlates of PFSU among PWID in San Diego, CA, we uncovered several factors suggesting that those who have engaged in this practice are more vulnerable and take higher risks as a result of both micro and macroenvironmental factors. Specifically, we found that lifetime PFSU was independently associated with ever having rushed injection due to police presence, having been in prison, injecting most often in public versus private locations, and ever injecting drugs in Mexico.

Our finding that PFSU is associated with both rushed injection due to police presence and injecting in mostly public spaces is consistent with other research that suggests that environmental factors may lead to risky injection behaviors.² While the purchase of syringes at pharmacies and use of the SEP is legal in San Diego, micro-level enforcement of laws, such as syringe access and possession laws, shape drug injection practices by discouraging the possession of syringes and injection paraphernalia, which may necessitate sharing or PFSU. The SEP in San Diego is also limited to 2 days per week and does not provide an adequate number of

TABLE 1 Sociodemographic and behavioral factors associated with lifetime prefilled syringe use (PFSU) among persons who inject drugs in San Diego, CA (n=574)

	Total	PFSU ever	PFSU never	OR	95 % CI	p value
Demographics						
Mean age, years (mean, sd)	43.4 (11.7)	193 (33.5 %) 43.4 (11.8)	383 (66.5 %) 43.3 (11.7)	1.00	0.99, 1.02	0.92
Male gender	420 (73.9 %)	147 (77.0 %)	273 (72.4 %)	0.83	0.57, 1.20	0.32
Race/Ethnicity						
White, Non-Hispanic	293 (50.9 %)	101 (52.3 %)	192 (50.1 %)	-	-	0.12
Hispanic	178 (30.9 %)	67 (34.7 %)	111 (29.0 %)	1.15	0.78, 1.69	
Black, Non-Hispanic	51 (8.9 %)	12 (6.2 %)	39 (10.2 %)	0.59	0.29, 1.17	
Other	54 (9.4 %)	13 (6.7 %)	41 (10.7 %)	0.60	0.31, 1.18	
Yearly income (\geq \$10,000 vs. <\$10,000)	184 (32.1 %)	62 (32.3 %)	122 (31.9 %)	0.98	0.69, 1.43	0.93
Marital status (Single vs. Married)	511 (88.7 %)	172 (89.1 %)	339 (88.5 %)	1.06	0.61, 1.84	0.83
Education level (<=High School vs. >High School)	207 (35.9 %)	53 (27.5 %)	154 (40.2 %)	1.78	1.22, 2.59	<0.01
Homeless (yes vs. no)	352 (61.1 %)	130 (67.4 %)	222 (58.0 %)	1.50	1.04, 2.15	0.03
Mean years injecting (mean, sd)	20.8 (13.5)	21.9 (13.4)	20.3 (13.5)	1.00	1.00, 1.02	0.17
Mean age first injection, years (mean, sd)	22.6 (8.2)	21.5 (7.3)	23.1 (8.6)	0.98	0.95, 1.00	0.06
Substance abuse related factors						
Injected crack weekly, last 6 months (yes vs. no; n=552)	19 (3.4 %)	10 (5.3 %)	9 (2.4 %)	2.23	1.01, 6.07	0.05
Injected heroin weekly, last 6 months (yes vs. no)	310 (56.2 %)	114 (60.3 %)	196 (54.0 %)	1.30	0.91, 1.85	0.16
Injected heroin more than daily, last 6 months (yes vs. no)	170 (30.8 %)	73 (38.6 %)	97 (26.7 %)	1.73	1.19, 2.51	<0.01
Used two or more drugs per week, last 6 months (yes vs. no)	317 (55.0 %)	118 (61.1 %)	198 (52.0 %)	1.61	1.13, 2.29	0.04
Ever rushed injection due to police presence (yes vs. no)	151 (26.4 %)	75 (39.5 %)	76 (19.9 %)	2.63	1.79, 3.86	<0.001
Police presence affected where buy drugs (yes vs. no)	229 (40.3 %)	91 (47.9 %)	138 (36.1 %)	1.61	1.13, 2.29	<0.01
Police presence affected where use drugs (yes vs. no)	219 (38.3 %)	92 (48.4 %)	127 (33.3 %)	1.86	1.31, 2.66	<0.001
Ever been in jail (yes vs. no)	516 (90.7 %)	176 (92.6 %)	340 (89.7 %)	1.44	0.76, 2.73	0.26
Ever been in prison (yes vs. no)	292 (51.3 %)	115 (60.5 %)	177 (46.7 %)	1.75	1.23, 2.49	0.002
Number of people know who inject (mean, sd)	28.0 (37.1)	31.3 (37.7)	26.4 (36.7)	1.003	1.00, 1.01	0.14
Number of people know who inject who are friends (mean, sd)	5.2 (10.6)	6.7 (12.4)	4.5 (9.6)	1.02	1.00, 1.04	0.03
Obtained syringes most often from safe vs. unsafe source, last 6 months	354 (62.7 %)	108 (57.1 %)	246 (65.4 %)	1.42	0.99, 2.03	0.05

Injected most often in public vs. private place, last 6 months	166 (29.4 %)	73 (38.8 %)	93 (24.7 %)	1.93	1.33, 2.81	0.001
Used syringe exchange, last 6 months (yes vs. no)	238 (41.3 %)	81 (42.0 %)	157 (41.0 %)	1.04	0.73, 1.48	0.82
Shared syringes, last 6 months (yes vs. no)	289 (59.3 %)	128 (74.9 %)	161 (50.9 %)	2.88	1.92, 4.35	<0.001
Shared any injection paraphernalia, last 6 months (yes vs. no)	394 (72.0 %)	165 (89.2 %)	229 (63.3 %)	4.83	2.90, 8.04	<0.001
Ever bought drugs in Mexico (yes vs. no)	267 (47.7 %)	106 (56.7 %)	161 (43.2 %)	1.72	1.21, 2.46	<0.01
Ever used drugs in Mexico (yes vs. no)	215 (38.5 %)	83 (44.4 %)	132 (35.5 %)	1.45	1.01, 2.08	0.04
Ever injected drugs in Mexico (yes vs. no)	203 (36.4 %)	86 (46.2 %)	117 (31.5 %)	1.87	1.31, 2.69	<0.001
Health care utilization and health status						
Any ER visit, last 6 months (yes vs. no)	195 (34.0 %)	86 (44.8 %)	109 (28.6 %)	2.03	1.41, 2.90	<0.001
Any hospitalization, last 6 months (yes vs. no)	98 (17.1 %)	45 (23.4 %)	53 (13.9 %)	1.90	1.22, 2.95	<0.01
Ever had an abscess (yes vs. no)	394 (68.9 %)	141 (73.4 %)	253 (66.6 %)	1.39	0.94, 2.04	0.10
HIV positive (seroconfirmed; <i>n</i> = 553)	52 (9.4 %)	18 (9.7 %)	34 (9.2 %)	1.06	0.58, 1.93	0.85
HCV positive (seroconfirmed; <i>n</i> = 552)	364 (65.9 %)	132 (71.4 %)	232 (63.2 %)	1.45	0.99, 2.13	0.05
Likelihood of getting infected with HIV (more vs. same or less likely; <i>n</i> = 529)	146 (27.6 %)	57 (32.4 %)	89 (25.2 %)	1.42	0.96, 2.11	0.08
Ever smoke cigarettes (yes vs. no; <i>n</i> = 522)	488 (93.5 %)	163 (92.1 %)	325 (94.2 %)	0.72	0.35, 1.45	0.36

TABLE 2 Multivariable analysis of factors associated with lifetime prefilled syringe use among persons who inject drugs in San Diego, CA (*n*=543)

Variable	Adjusted odds ratio	95 % confidence interval	<i>p</i> value
Ever rushed injection due to police presence (yes vs. no)	2.51	1.66, 3.80	<0.001
Ever been in prison (yes vs. no)	1.80	1.23, 2.63	<0.01
Injected most often in public vs. private place, last 6 months	1.66	1.11, 2.48	0.01
Ever injected drugs in Mexico (yes vs. no)	1.70	1.16, 2.49	<0.01

syringes to sustain most PWIDs safe injection between SEP visits.³⁴ PWID also often report getting stopped for possession regardless of the law.³⁵ As such, PFSU could have emerged as a mechanism to get a “quick” high when no other options, namely safer places to inject drugs or time to prepare their own solution were available, or due to fear of enforcement of paraphernalia laws.^{23, 36, 37} Those with a prison record have even greater reason to fear police and thus, may be more likely to use prefilled syringes to avoid being apprehended by the police with syringes or other injection paraphernalia.

Our finding that PWID who have ever used prefilled syringes are more likely to report ever injecting drugs in Mexico highlights the importance of cross-border surveillance of trends. Previous studies indicate that 27 % of PWID in San Diego report traveling to Mexico to inject drugs and an even higher number report traveling for other reasons.²⁹ Macroenvironmental factors such as the spillover from drug trafficking and population mixing, and microenvironmental factors such as arrest for possession of injection paraphernalia in Mexico may lead to the altering of behaviors among PWID from San Diego, though we could not assess the temporality of these behaviors. Others have found that sharing of syringes and other injection paraphernalia is also influenced by the availability of syringes and other equipment and social norms, which may be different in Mexico than in the USA.^{21, 38–40} Thus, PWID who travel to Mexico may be influenced by a number of factors that could increase their risk BBV infection.

Physical microenvironmental factors (e.g., drug injection locations) and social microenvironmental factors (e.g., local policing practices, injection locations, and social norms) that may influence PFSU and increase overdose risk may also increase likelihood of disease transmission.^{41, 42} While we did not find an association between PFSU and HIV or HCV infection, PFSU could increase the likelihood of BBV infection if the syringe is not sterile or the drugs are drawn from a common container that becomes infected.¹² Further, others report that prefilled syringes are often shared.¹⁶ Thus, it is important that education messages address PFSU as well as related high-risk behaviors for HIV infection. Studies have found that HCV and HIV transmission are often a result of the setting in which drugs are injected, highlighting the importance of developing structural interventions to address policing practices and the availability of sterile syringes.^{10, 43, 44}

The results of this study must be interpreted in light of certain limitations. Cross-sectional data were utilized and the outcome was measured as any lifetime use. Thus, we were unable to assess temporal associations between PFSU and the independent variables, which were measured using both lifetime and proximal timeframes. Future studies that assess PFSU over time and incident disease status are

needed to better understand the risks associated with PFSU and to determine whether there are any changes in the prevalence of this behavior over time. Our reliance on self-report data may introduce bias into our study. However, we would expect underreporting of risky behaviors, which would bias our results towards the null. It is also possible that PFSU may include both syringes that were purchased already filled and those that were prepared and filled by an injection partner with whom they were injected. Though these are separate behaviors, they are similar in that the person injecting has less control over preparation methods.

High-risk behaviors among PWID constantly evolve in response to changes in environmental, social, and structural factors that impact the ways in which drugs are distributed and used. While research has described how different drug preparation (e.g., sharing cookers, cotton, water, and using common drug containers) and distribution methods (e.g., backloading/frontloading, prefilled syringes) influence BBV transmission individually, further research is needed to understand how a previously unrecognized behavior, PFSU, influences HIV and HCV transmission in our setting, if at all. Our findings suggest that PFSU is shaped by environmental factors that produce risk among PWID. Namely, vulnerability to policing practice, unavailability of safe injection sites, and restricted access to syringes might create environments that prevent PWID from practicing harm reduction strategies. While individual factors such as knowledge of risk behaviors are often identified in intervention programs, they fail to recognize circumstances over which PWID have little control.⁴⁵ Qualitative and longitudinal studies that contextualize the use of prefilled syringes are needed to understand why PWID choose to use prefilled syringes and to better understand situations in which they are used.

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