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RESEARCH REPORT

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Drug consumption rooms are effective to reduce at-risk practices associated with HIV/HCV infections among people who inject drugs: Results from the COSINUS cohort study

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Abstract

Aims: The primary aim of this study was to evaluate the impact of drug consumption rooms (DCRs) in France on injection equipment-sharing, while the secondary aims focused upon their impact on access to hepatitis C virus (HCV) testing and opioid agonist treatment (OAT).

Design: The COhort to identify Structural and INdividual factors associated with drug USe (COSINUS cohort) was a 12-month longitudinal study of 665 people who inject drugs (PWID), conducted in Bordeaux, Marseille, Paris and Strasbourg. We used data from face-to-face interviews at enrolment and at 6-month and 12-month visits.

Setting and participants: The participants were recruited in harm reduction programmes in Bordeaux and Marseille and in DCRs in Strasbourg and Paris. Participants were aged more than 18 years, French-speaking and had injected substances the month before enrolment.

Measurements: We measured the impact of DCR exposure on injection equipment sharing, HCV testing and the use of medications for opioid use disorder, after adjustment for significant correlates. We used a two-step Heckman mixed-effects probit model, which allowed us to take into account the correlation of repeated measures and to control for potential bias due to non-randomization between the two groups (DCR-exposed versus DCR-unexposed participants).

Findings: The difference of declared injection equipment sharing between PWID exposed to DCRs versus non-exposed was 10% (1% for those exposed versus 11% for those non-exposed, marginal effect = −0.10; 95% confidence interval = −0.18, −0.03); there was no impact of DCRs on HCV testing and OAT.

Laurence Lalanne, Perrine Roux, Marc Auriacombe, and Marie Jauffret-Roustide contributed equally to this study.

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Conclusions: In the French context, drug consumption rooms appear to have a positive impact on at-risk practices for infectious diseases such as human immunodeficiency virus (HIV) and hepatitis C virus.

KEYWORDS
At-risk practices, cohort studies, drug consumption rooms, drug policy, evaluation, harm reduction, HCV, HIV

BACKGROUND

Sharing injecting equipment, mainly needles and syringes but also other paraphernalia, is one of the main risk factors for the transmission of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) [1]. Harm reduction models have indicated the efficiency of reducing injection sharing practices based on access to needle and syringe programmes (NSP) and opioid agonist treatment (OAT). In France, the extensive dissemination of OAT [2, 3], NSPs and antiretroviral therapy for HIV-infected individuals [4] has largely contributed to a decrease in HIV prevalence among people who inject drugs (PWID) from 40 to 20% from 1988 to 2002 [5]. At the same time, the HCV epidemic remains high and uncontrolled in France, with a high HCV infection prevalence among PWID that reached 64% in 2011 compared to 74% in 2004 [6]. Previous studies conducted in 2011 also show that HCV incidence is very high (20%) among PWID [7]: much higher compared to the general population (estimated among blood donors at one in 34 million donations) [8]. Indeed, France was late in implementing a national harm reduction policy compared to other countries such as the Netherlands and Switzerland, that were able to rapidly control HCV infections among PWID [9–11]. Moreover, in these countries, drug consumption rooms (DCRs) were implemented earlier. DCRs are places where people can inject or smoke substances in secure environments under the supervision of trained staff. DCRs aim to reduce the acute risks of infectious transmission (HCV/HIV), prevent overdose deaths and refer PWID to social and health services and addiction treatment [12].

Previous studies in different countries have demonstrated that DCRs are an effective way to reduce at-risk practices associated with disease transmission among PWID by avoiding the sharing of injecting equipment [13–15]. However, several modelling studies have also indicated that addressing the HCV epidemic calls for a combined approach of diverse harm reduction tools [16]. It is also recognized that treatment as prevention may be an interesting strategy for HCV elimination [17]. Globally, DCRs often offer HCV testing on-site, which contributes to a decrease in the risk of transmission to other PWID, and refer PWID for HCV treatment [18]. Finally, DCRs have already demonstrated their effectiveness in improving access to OAT [19], which might also be considered a strategy to decrease the risk of HCV transmission by reducing injecting practices and associated risks [18–21]. By offering multiple services, including the provision of sterile injecting equipment immediately before injecting and facilitating access to HCV testing and OAT, DCRs may be an additional harm reduction tool to facilitate HCV prevention.

To provide an effective response to HCV infection prevalence in PWID, in October 2016 the French government decided to introduce two DCRs (taking into account political hesitation, 30 years after they were introduced in Switzerland [22, 23]) over a 6-year experimental outcome evaluation frame [24]. The French DCRs are open to PWID 18 years or older at two French hospitals, one in Paris and the other in Strasbourg. These DCRs provide a medical environment to administer substances by injection or inhalation, in addition to access to social, medical and psychiatric services and related information. As in harm reduction facilities, access to HCV testing is available in DCRs in both Paris and Strasbourg, especially thanks to rapid diagnostic tests.

There is an extensive literature regarding the evaluation of DCRs, particularly from Insite in Vancouver [25]. However, whereas previous studies lacked control groups [18, 25] and evaluated the impact of DCRs based on the frequency of their use by comparing those who frequently attended with those who attended less frequently, our controlled study design allowed the comparison of PWID exposed to the DCRs with a control group with no access to DCRs. The group non-exposed to DCR is exposed to French harm reduction facilities that provide harm reduction tools for people who use drugs such as NSPs, support and education on injection-related risks, crack pipes and a place to rest during the day, as well as an opportunity to meet harm reduction providers for improving access to social and medical care. All the non-DCR harm reduction facilities were fixed sites that operate during the day, as well as the DCRs. Recruitment sites were mainly managed by non-governmental organizations (NGOs) and all were publicly funded. The French evaluation of DCRs was partially based on the COSINUS survey (COhort to identify Structural and INdividual factors associated with drug USe), conducted from 2016 to 2019. The primary objective of this cohort was to evaluate the impact of DCRs on exposure to the risk of bloodborne viruses (HIV/HCV) transmission measured through sharing injecting equipment. The secondary objectives were to assess DCR impact on access to HCV testing and OAT.

METHODS

Study

This prospective, multi-site cohort study enrolled 665 PWID in four cities, namely Bordeaux, Marseille, Paris and Strasbourg, from November 2016 to May 2018. The final 1-year follow-up was collected in May 2019. In two of these cities, Paris and Strasbourg, DCRs opened at the beginning of the study, while this was not the case in Bordeaux and Marseille. The two groups of PWID (exposed versus non-exposed) were recruited over 18 months and followed for 12 months. The PWID were interviewed face-to-face by trained interviewers at baseline and at 3-, 6- and 12-month follow-ups. The detailed study design was described previously [24].

Population

Participants were eligible if they reported having injected illegal substances or prescription medications (e.g. methadone, buprenorphine, benzodiazepines, morphine-sulphate, oxycodone) at least once during the previous month. They were recruited either in DCR or non-DCR harm reduction facilities. Each participant provided informed consent. An additional inclusion criterion was that they had to be aged 18 years or older. Participants were compensated for their time with €10-worth of service vouchers after each interview.

Data collection

The questionnaire collected information regarding socio-demographic characteristics, substance use history, current drug use, DCR attendance, drug-use-related risk practices and self-reported HIV and HCV serostatus at each follow-up. The data collection tools were partly inspired by an evaluation of the Vancouver Downtown Eastside DCR (Insite) and the Vancouver Injection Drug User Study. We used the blood-borne virus transmission risk assessment to collect information regarding risk practices [26]. The main variables are described in the Supporting information.

Statistical analysis

We first described the sample at baseline by comparing the two groups in terms of their exposure to DCRs. We used the χ^2 test to compare categorical variables between the groups and Student's *t*-test or Wilcoxon's rank sum test to compare ages between the groups.

In order to investigate the impact of DCR use on the three outcomes (injection equipment sharing, HCV testing and being on OAT) we conducted a random-effect model, which is relevant for samples with repeated measures [27]. A two-step Heckman model was applied to control for selection bias induced by non-randomized allocation to the DCR group [28].

We described this Heckman procedure as follows. The three main outcomes and the DCR-exposure variable were defined as time-varying variables, measured at each visit during the 12-month follow-up, reflecting a longitudinal design. To study the association between DCR exposure and the three outcomes (HIV/HCV risk practices, HCV testing and being on OAT) a longitudinal analysis was performed for each of the three outcomes, using all available data at months 0, 6 and 12 visits. Data from the month 3 questionnaire were not taken into account in the analysis in order to have the same 6-month time-frame for all questions.

We used the two-step Heckman method to take into account the potential non-randomization bias due to differences between DCR-exposed and DCR-unexposed participants, based on mixed probit models in each of the two steps.

In the first step of the Heckman method, we identified the factors associated with DCR exposure and then used the residuals of this mixed probit model to calculate the inverse Mills ratio (IMR). In the second step, we built a mixed probit model for each of the three secondary outcomes of the study, adjusting for associated factors with a *P*-value < 0.05, the 'exposure to DCR' variable and the IMR variable (irrespective of the *P*-value of the two latter variables). We estimated univariable Heckman mixed probit models for associations between the explanatory variables and each outcome (HIV/HCV risk practices, HCV testing and use of OAT). Variables associated with the outcome with a *P*-value < 0.25 were eligible to enter the multivariable models. Finally, a backward selection procedure was used to build each final multivariable model, with a significance level of 0.05. Bias-corrected confidence intervals and *P*-values, based on 500 bootstrap replicates, were used in the second step. To assess the robustness of the multivariable models, we performed a sensitivity analysis based on a forward selection procedure in the second step of the Heckman method.

If the IMR variable was significant (*P*-value < 0.05) in the multivariable model, the Heckman method was used to correct for non-randomization bias; otherwise, a standard mixed probit regression method was used with a similar selection procedure for the explanatory variables, as presented previously.

For the present analyses, we used data from the baseline (month 0) and months 6 and 12. Data from the month 3 questionnaire were not taken into account in the analysis, because the covariates were not the same as in the months 6 and 12 questionnaires. We also described attrition rates at months 6 and 12 and compared the baseline characteristics, including the three main outcomes, between participants who were lost to follow-up at month 12 and those who were not.

We used a specific sample selection in order to select only participants and observations eligible or relevant for each analysis, as follows.

1. For the 'injection equipment sharing' analyses we considered that all observations collected were eligible for the analyses, so 665 participants at month 0, 406 participants at month 6 and 395 participants at month 12 were used (see Flow-chart 1).
2. For the 'recent HCV testing' analyses, we included eligible participants and observations. First, we excluded participants who presented discrepancies between answers among follow-ups

regarding links between testing and HCV status; in other words, (1) participants not positive for HCV, who declared being positive at the next follow-up but with a test ≥ 6 months compared with the duration between the two questionnaires and (2) participants with a recent test and positive with HCV at a follow-up visit, who already declared a positive status with no recent HCV testing previously. Secondly, we determined eligible visits for HCV testing: (1) visits where participants were HCV-positive and not recently tested (> 6 months) were excluded from our analysis and (2) visits where participants declared being positive and tested recently (i.e. tested positive) were kept. After this type of visit: (1) if participants declared not being seropositive (seronegative, cured or not knowing their status) we kept these visits, as we assessed participants who became newly eligible for a test; (2) if participants were still seropositive at the next visit, we removed those visits. Finally, we analyzed 569 participants at month 0, 308 participants at month 6 and 302 participants at month 12 (80% of the initial sample) (see Flow-chart 2).

3. For the OAT analyses: at each follow-up (see Flow-chart 3), we selected participants who were eligible for treatment for opioid use disorder; in other words, participants who used at least one unprescribed opioid daily (heroin, buprenorphine, methadone or other) or participants who were already on OAT. This comprised 547 participants at month 0, 348 participants at month 6 and 338 participants at month 12 (85% of the initial sample).

As all three analyses were conducted with different sample sizes, we had to calculate a new Heckman first-step equation each time. For the 'injection equipment sharing' and 'recent HCV testing' second-step analyses the IMR was significant at 5%, so we introduced it in the second step. For the OAT model, the IMR was not significant ($P = 0.471$), so we decided to conduct a simple mixed probit regression method (with a similar method of selection of explanatory variables as presented previously).

As probit model estimates are only coefficients, we calculated the predicted probabilities and the marginal effects of the 'exposure to DCR' variable for the multivariable 'injection equipment sharing' model and the multivariable 'recent HCV testing' model, in order to facilitate the interpretation of the effect of DCR use on different outcomes. A marginal effect represents the difference between the predicted probabilities of the event in a chosen group and the reference group. We presented the marginal effect of DCR use with all other co-factors being held at their mean and random effect equal to 0.

To assess the robustness of the multivariable models, we performed a sensitivity analysis based on a forward selection procedure in the second step of the Heckman method.

RESULTS

Baseline sample description

Table 1 presents the baseline characteristics of the DCR-unexposed group versus the DCR-exposed group. The table includes a total of 662 enrolled participants, 238 in the DCR-exposed group (36%) and 424 in the DCR-unexposed group (64%). Three participants were excluded because they had missing responses regarding DCR use at baseline. Overall, the median age was 38 years, and 20% of the participants were female. Regarding socio-economic status, 25% lived as a couple, more than 43% lived in extremely unstable housing and fewer than 20% of the participants were employed. In terms of substance use, almost 60% of the participants had injected at least once every day in the previous month. One in four participants reported daily use of unprescribed morphine, 22% used crack cocaine daily, 11% used cocaine daily and 59% had engaged in harmful alcohol use. Finally, 65% of the PWID had been incarcerated in their life-time, and more than 25% of the participants self-reported being infected with the hepatitis C virus. Eighteen per cent of participants were more likely to report injection equipment sharing, 65% had a recent HCV screening (among the eligible participants) and 77% were receiving OAT (among the participants eligible for such treatment).

The DCR-exposed group was different from the DCR-unexposed group in terms of housing (more had extremely unstable housing), employment (more were unemployed), public allowance (less likely), substance use (more daily morphine and daily crack cocaine or free-base use, more daily injection and less daily cocaine and harmful alcohol use) and HCV status (more self-reported seropositive status). Visits to a physician in the past 6 months were less frequent in the DCR-exposed group. There were no significant differences regarding injecting equipment sharing and HCV screening between the two groups, and DCR users were less likely to be receiving OAT. According to the sensitivity analysis, the association between DCR exposure and the main outcome, 'HIV/HCV risk practices', becomes significant in the Heckman multivariable model when adjusting by the 'crack cocaine use' variable. This was not surprising as the participants enrolled in Paris, who represent an important part of the DCR-exposed participants, are more likely to be crack cocaine users.

As estimated in the protocol article [24], the attrition rate was 39 and 41% at the 6- and 12-month follow-up visits, respectively. Participants who were lost to follow-up at month 12 were younger, more likely to use cannabis daily and to be interviewed in Bordeaux or Strasbourg (results not shown). Regarding the three outcomes, no association was found between attrition status at month 12 and injection equipment sharing ($P = 0.61$), while participants lost to follow-up at month 12 were more likely to have been tested for HCV ($P = 0.072$) and less likely to receive OAT ($P = 0.067$).

Factors associated with exposure to DCRs (first stage of Heckman model)

Table 2 presents the analysis of factors associated with exposure to DCRs used to calculate the IMR term in the 'injecting equipment sharing' model, on one hand, and the 'recent HCV testing' on the other hand. In the first model (all participants included), the adjusted results indicate that the DCR-exposed group was significantly different from the DCR-unexposed group in terms of education level, extremely

TABLE 1 Baseline characteristics by groups of exposure [*n* (%) or median (IQR)], COSINUS study (*n* = 662).

	DCR-unexposed group *n* = 424 (64%)	DCR-exposed group *n* = 238 (36%)	Total *n* = 662 (100%)	*P*-value
City of interview				< 0.001
Bordeaux	145 (34.2)	0 (0.0)	145 (21.9)	
Marseille	197 (46.5)	2 (0.8)	199 (30.1)	
Paris	48 (11.3)	190 (79.8)	238 (36.0)	
Strasbourg	34 (8.0)	46 (19.3)	80 (12.1)	
Age (years, median, IQR)	38 (31–46)	37 (32–44)	38 (31–46)	0.523
Time since first injection (years)[a]				0.109
< 10 years	128 (30.3)	86 (36.4)	214 (32.5)	
≥ 10 years	294 (69.7)	150 (63.6)	444 (67.5)	
Gender[a]				0.441
Male or trangender male	335 (79.0)	194 (81.5)	529 (79.9)	
Female or trangender female	89 (21.0)	44 (18.5)	133 (20.1)	
Education level[a]				0.114
Below high school certificate	308 (72.6)	159 (66.8)	467 (70.5)	
High school or university certificate	116 (27.4)	79 (33.2)	195 (29.5)	
Country of birth[a]				0.053
Born in France	360 (84.9)	188 (79.0)	548 (82.8)	
Born abroad	64 (15.1)	50 (21.0)	114 (17.2)	
In a couple				0.302
No	312 (73.6)	183 (77.2)	495 (74.9)	
Yes	112 (26.4)	54 (22.8)	166 (25.1)	
Housing				0.001
Very stable housing	164 (38.7)	67 (28.2)	231 (34.9)	
Precarious or unstable	102 (24.1)	47 (19.7)	149 (22.5)	
Extremely precarious	158 (37.3)	124 (52.1)	282 (42.6)	
Employment (paid activity)				0.028
No	332 (78.3)	203 (85.3)	535 (80.8)	
Yes	92 (21.7)	35 (14.7)	127 (19.2)	
Public allowance				< 0.001
No	127 (30)	125 (52.5)	252 (38.1)	
Yes	297 (70)	113 (47.5)	410 (61.9)	
Food aid at least once[b]				0.093
No	310 (73.1)	188 (79.0)	498 (75.2)	
Yes	114 (26.9)	50 (21.0)	164 (24.8)	
Health insurance				< 0.001
No	86 (20.3)	86 (36.1)	172 (26.0)	
Yes	338 (79.7)	152 (63.9)	490 (74.0)	
Daily heroin use[b]				0.161
No	412 (97.4)	226 (95.4)	638 (96.7)	
Yes	11 (2.6)	11 (4.6)	22 (3.3)	
Daily unprescribed buprenorphine use[b]				0.268
No	385 (90.8)	222 (93.3)	607 (91.7)	
Yes	39 (9.2)	16 (6.7)	55 (8.3)	

(Continues)

TABLE 1 (Continued)

	DCR-unexposed group *n* = 424 (64%)	DCR-exposed group *n* = 238 (36%)	Total *n* = 662 (100%)	*P*-value
Daily unprescribed methadone use[b]				0.393
No	410 (96.7)	227 (95.4)	637 (96.2)	
Yes	14 (3.3)	11 (4.6)	25 (3.8)	
Daily unprescribed morphine use[b]				< 0.001
No	379 (89.4)	125 (52.5)	504 (76.1)	
Yes	45 (10.6)	113 (47.5)	158 (23.9)	
Daily cocaine use[b]				< 0.001
No	364 (85.8)	226 (95.4)	590 (89.3)	
Yes	60 (14.2)	11 (4.6)	71 (10.7)	
Daily crack cocaine/freebase use[b]				< 0.001
No	402 (94.8)	113 (47.5)	515 (77.8)	
Yes	22 (5.2)	125 (52.5)	147 (22.2)	
Daily cannabis use[b]				0.147
No	266 (62.9)	163 (68.5)	429 (64.9)	
Yes	157 (37.1)	75 (31.5)	232 (35.1)	
Daily injection[b]				< 0.001
No	197 (46.7)	74 (31.1)	271 (41.1)	
Yes	225 (53.3)	164 (68.9)	389 (58.9)	
Harmful alcohol consumption[c]				0.012
No	159 (37.5)	113 (47.5)	272 (41.1)	
Yes	265 (62.5)	125 (52.5)	390 (58.9)	
Life-time experience of prison				0.542
No	150 (35.5)	79 (33.2)	229 (34.7)	
Yes	272 (64.5)	159 (66.8)	431 (65.3)	
Life-time suicide attempt				0.346
No	249 (58.7)	153 (64.3)	402 (60.7)	
Yes	167 (39.4)	82 (34.5)	249 (37.6)	
Missing	8 (1.9)	3 (1.3)	11 (1.7)	
Self-reported HIV status				0.761
Seronegative	389 (91.8)	215 (90.3)	604 (91.2)	
Seropositive	21 (5.0)	15 (6.3)	36 (5.4)	
Not tested	14 (3.3)	8 (3.4)	22 (3.3)	
Self-reported HCV status				0.005
Seronegative	206 (48.6)	116 (48.7)	322 (48.6)	
Previously seropositive but cured	94 (22.2)	30 (12.6)	124 (18.7)	
Seropositive	98 (23.1)	78 (32.8)	176 (26.6)	
Not tested	26 (6.1)	14 (5.9)	40 (6.0)	
Harm reduction facilities use[d]				0.062
Less than often	133 (31.7)	59 (24.8)	192 (29.2)	
Often or always	287 (68.3)	179 (75.2)	466 (70.8)	
At least one visit to a general or specialist physician[d]				< 0.001
No	121 (28.5)	129 (54.2)	250 (37.8)	
Yes	303 (71.5)	109 (45.8)	412 (62.2)	

TABLE 1 (Continued)

	DCR-unexposed group *n* = 424 (64%)	DCR-exposed group *n* = 238 (36%)	Total *n* = 662 (100%)	*P*-value
At least one injecting equipment sharing[b]				0.753
No	346 (81.8)	197 (82.8)	543 (82.1)	
Yes	77 (18.2)	41 (17.2)	118 (17.9)	
Recent HCV testing[d,e]				0.784
No	132 (35.7)	68 (34.5)	200 (35.3)	
Yes	238 (64.3)	129 (65.5)	367 (64.7)	
Opioid agonist treatment[f]				< 0.001
No	44 (13.1)	82 (39.2)	126 (23.1)	
Yes	292 (86.9)	127 (60.8)	419 (76.9)	

Abbreviations: DCR = drug consumption room; IQR = interquartile range.
[a]Times invariant factor.
[b]In the previous month.
[c]Alcohol Use Disorders Identification Test (AUDIT)-C score ≥ 3 for women and ≥ 4 for men.
[d]In the past 6 months.
[e]Among the 567 participants eligible for HCV testing and having no missing data on the 'DCR exposure' variable.
[f]Among the 454 participants eligible for medications for opioid use disorder and having no missing data on the 'DCR exposure' variable.

unstable housing and public allowance. Regarding substance use, they were more likely to use unprescribed morphine daily and crack cocaine or freebase daily and less likely to use cocaine daily. The DCR-exposed group was more likely to report being HCV positive than the non-exposed group. Similar associated factors were found in the second model, with the exception of country of birth (Table 3). HCV status was not chosen to be an adjustment variable, because it was correlated with the second-step outcome (in our selection, all participants who were HCV-positive had been tested in the past 6 months).

Impact of DCR use on sharing injection equipment, recent HCV testing and OAT

The adjusted results of the DCR effect on the three outcomes are presented in Table 3. Complete univariable and multivariable tables are presented in Tables 4 and 5 (see Supporting information, Appendix). The IMR was statistically significant at 5% in the 'injecting equipment sharing' model ($P = 0.012$) and in the 'recent HCV testing' model ($P = 0.019$), suggesting that there was a selection bias induced by the non-randomization of the exposure groups regarding those outcomes. After correction for the selection bias and adjustment for significant factors, being exposed to DCRs was significantly associated with a lower risk of injection equipment sharing [adjusted coefficient (aCoeff) = −1.14; 95% confidence interval (95% CI) = −1.91, −0.36]. Analysis of the predicted probabilities indicated that being in the exposed group decreased the probability of at-risk practices by 10 percentage points compared to the unexposed group (marginal effect = −0.10; 95% CI = −0.18, −0.03), with a probability outcome of 1% in the DCR group versus 11% in the unexposed group.

However, there was no significant difference between the two groups regarding HCV testing after multiple adjustments (aCoeff = −0.18; 95% CI = −0.44, 0.09). Furthermore, the last multivariable probit model indicates that access to OAT was not statistically different between the two groups, even if it was lower in the 'DCR-exposed' group (aOR = −0.17; 95% CI = −0.67, 0.33) (Table 3).

Other factors positively associated with injection equipment sharing were having received food aid, using crack cocaine or freebase daily, daily injection, harmful alcohol consumption and a seropositive self-declared HCV status. Inversely, older people were less likely to share their injection equipment (Table 4).

Being younger, being born outside France, being unemployed, having a public allowance and regularly using harm reduction facilities were factors increasing the probability of access to recent HCV testing (Table 4).

Finally, some correlates were found to be associated with engagement in OAT: having a public allowance, benefiting from health insurance and having visited a general or specialist physician at least once. Conversely, being in extremely unstable housing, using heroin regularly, using unprescribed morphine regularly and injecting psychoactive substances daily were associated with not being on OAT (Table 5).

DISCUSSION

The COSINUS cohort was designed as a controlled cohort study to determine the impact of attending a DCR on the risk of HIV and HCV transmission by measuring at-risk practices among PWID with a high level of precariousness. The main finding is that PWID exposed to DCRs in the French health-care context are less likely to report sharing injecting equipment, the main route for HIV and HCV transmission, compared to those not exposed to DCRs. Indeed, the rate of

TABLE 2 Factors associated with the exposure to DCR, mixed probit models, univariable and multivariable analyses: COSINUS study.

	Factors associated with exposure to DCR[b] For 'injection equipment sharing' model				Factors associated with exposure to DCR[b] For 'recent HCV testing' model			
	Univariable analyses *N* = 1463 visits, *n* = 664		Multivariable analysis *N* = 1459 visits, *n* = 664		Univariable analyses *N* = 1177 visits, *n* = 576		Multivariable analysis *N* = 1175 visits, *n* = 576	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Age (years)[a]	−0.02 (−0.05,0.02)	0.322			0.00 (−0.04,0.03)	0.792		
Time since first injection (years)[a]								
< 10 years	0				0			
≥ 10years	−0.62 (−1.33, 0.10)	0.09			−0.31 (−1.02, 0.4)	0.399		
Gender[a]								
Male or trangender male	0				0			
Female or trangender female	−0.39 (−1.14, 0.37)	0.313			−0.26 (−1.04, 0.53)	0.521		
Education level[a]								
Below high school certificate	0		0		0			
High school or university certificate	0.78 (0.03, 1.53)	0.04	0.52 (0.05, 0.99)	0.03	1.14 (0.31, 1.97)	0.007	0.79 (0.27, 1.31)	0.003
Country of birth[a]								
Born in France	0		0		0			
Born abroad	1.07 (0.06, 2.07)	0.038	0.52 (−0.03, 1.08)	0.065	1.20 (0.12, 2.27)	0.029		
In a couple								
No	0				0			
Yes	−0.21 (−0.70, 0.27)	0.39			−0.25 (−0.79, 0.29)	0.371		
Housing								
Very stable housing	0		0		0			
Precarious or unstable	0.57 (−0.00, 1.14)	0.052	0.40 (−0.05, 0.84)	0.08	0.91 (0.24, 1.58)	0.008	0.73 (0.22, 1.25)	0.005
Extremely precarious	1.4 (0.83, 1.96)	< 0.001	0.56 (0.13, 0.99)	0.011	1.51 (0.88, 2.14)	< 0.001	0.73 (0.24, 1.23)	0.003
Employment (paid activity)								
No	0				0			
Yes	−0.54 (−1.06, −0.02)	0.041			−0.36 (−0.92, 0.20)	0.21		
Public allowance								
No	0		0		0			
Yes	−0.96 (−1.42, −0.51)	< 0.001	−0.46 (−0.82, −0.1)	0.013	−0.97 (−1.48, −0.46)	< 0.001	−0.52 (−0.92, −0.12)	0.01
Food aid at least once[b]								
No	0				0			
Yes	0.06 (−0.38, 0.49)	0.793			−0.05 (−0.53, 0.44)	0.845		

TABLE 2 (Continued)

	Factors associated with exposure to DCR[b] For 'injection equipment sharing' model				Factors associated with exposure to DCR[b] For 'recent HCV testing' model			
	Univariable analyses *N* = 1463 visits, *n* = 664		Multivariable analysis *N* = 1459 visits, *n* = 664		Univariable analyses *N* = 1177 visits, *n* = 576		Multivariable analysis *N* = 1175 visits, *n* = 576	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Health insurance								
No	0				0			
Yes	−0.86 (−1.33, −0.39)	< 0.001			−0.86 (−1.41, −0.31)	0.002		
Daily heroin use[b]								
No	0				0			
Yes	−0.36 (−1.34, 0.62)	0.476			−0.29 (−1.35, 0.77)	0.595		
Daily unprescribed buprenorphine use[b]								
No	0				0			
Yes	0.09 (−0.66, 0.85)	0.807			0.27 (−0.57, 1.11)	0.525		
Daily unprescribed methadone use[b]								
No	0				0			
Yes	1.59 (0.13, 3.05)	0.033			1.11 (−0.6, 2.83)	0.203		
Daily unprescribed morphine use[b]								
No	0		0		0			
Yes	1.90 (1.42, 2.38)	< 0.001	1.17 (0.74, 1.6)	< 0.001	1.87 (1.35, 2.38)	< 0.001	1.1 (0.63, 1.56)	< 0.001
Daily cocaine use[b]								
No	0		0		0			
Yes	−0.68 (−1.35, −0.00)	0.049	−0.66 (−1.21, −0.11)	0.019	−0.86 (−1.64, −0.08)	0.031	−0.88 (−1.51, −0.25)	0.006
Daily crack cocaine/freebase use[b]								
No	0		0		0			
Yes	3.43 (2.83, 4.04)	< 0.001	2.75 (2.19, 3.31)	< 0.001	3.26 (2.61, 3.90)	< 0.001	2.66 (2.05, 3.27)	< 0.001
Daily cannabis use[b]								
No	0				0			
Yes	−0.41 (−0.80, −0.02)	0.037			−0.27 (−0.7, 0.16)	0.217		
Opioid agonist treatment								
No	0				0			
Yes	−1.24 (−1.78, −0.70)	< 0.001			−1.19 (−1.79, 0.59)	< 0.001		

(Continues)

TABLE 2 (Continued)

	Factors associated with exposure to DCR[b] For 'injection equipment sharing' model				Factors associated with exposure to DCR[b] For 'recent HCV testing' model			
	Univariable analyses *N* = 1463 visits, *n* = 664		Multivariable analysis *N* = 1459 visits, *n* = 664		Univariable analyses *N* = 1177 visits, *n* = 576		Multivariable analysis *N* = 1175 visits, *n* = 576	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Daily injection[b]								
No	0				0			
Yes	0.63 (0.22, 1.03)	0.002			0.57 (0.12, 1.02)	0.013		
Harmful alcohol consumption[c]								
No	0				0			
Yes	−0.67 (−1.16, −0.19)	0.006			−0.64 (−1.18, −0.1)	0.02		
Life-time experience of prison								
No	0				0			
Yes	0.11 (−0.54, 0.77)	0.733			0.12 (−0.55, 0.79)	0.722		
Life-time suicide attempt								
No	0				0			
Yes	−0.43 (−1.07, 0.21)	0.189			−0.17 (−0.84, 0.49)	0.607		
Missing	−1.01 (−3.24, 1.22)	0.373			−0.68 (−2.97, 1.62)	0.563		
Self-reported HIV status								
Seronegative	0				0			
Seropositive	0.81 (−0.52, 2.14)	0.233			0.47 (−0.99, 1.94)	0.525		
Not tested	0.66 (−0.54, 1.85)	0.281			0.46 (−0.96, 1.87)	0.527		
Self-reported HCV status								
Seronegative	0							
Previously seropositive but cured	−0.60 (−1.15, −0.04)	0.035	−0.37 (−0.85, 0.11)	0.133				
Seropositive	0.14 (−0.38, 0.65)	0.596	0.42 (0.01, 0.83)	0.046				
Not tested	0.19 (−0.62, 1.00)	0.645	−0.05 (−0.77, 0.66)	0.881				
Harm reduction facilities use[d]								
Less than often	0				0			
Often or always	0.51 (0.09, 0.92)	0.017			0.54 (0.07, 1.00)	0.025		

Abbreviations: DCR = drug consumption room; CI = confidence interval.

[a]Time-invariant factors.

[b]In the previous month.

[c]Alcohol Use Disorders Identification Test (AUDIT)-C score ≥ 3 for women and ≥ 4 for men.

[d]In the past 6 months.

TABLE 3 Factors associated with injection equipment sharing, recent HCV testing and opioid agonist treatment: Heckman mixed probit models with bootstrapped CIs (250 replicates) and mixed probit model, multivariable analyses, COSINUS study.

	Model 1: Injection equipment sharing[a] model[c] (mixed probit model)				Model 2: Recent HCV testing[b] model[d] (mixed probit model)				Model 3: Opioid agonist treatment model[e] (mixed probit model)	
	Multivariable analysis *N* = 1450 visits, *n* = 664				Multivariable analysis *N* = 1170 visits, *n* = 575				Multivariable analysis *N* = 1220, *n* = 582	
	aCoeff (95% CI)	*P*-value			aCoeff (95% CI)	*P*-value			aCoeff (95% CI)	*P*-value
Exposure to DCR[a]										
No	0				0				0	
Yes	−1.14 (−1.91, −0.36)	0.004			−0.18 (−0.44, 0.09)	0.185			−0.17 (−0.67, 0.33)	0.509
IMR	0.49 (0.11, 0.87)	0.012			0.18 (0.03, 0.33)	0.019				
	Post-estimations (multivariable model)				Post-estimations (multivariable model)					
	N = 1450 visits, *n* = 664				*N* = 1170 visits, *n* = 575					
	Prob. (95% CI)	*P*-value	Marg. effect (95% CI)	*P*-value	Prob. (95% CI)	*P*-value	Marg. effect (95% CI)	*P*-value		
Exposure to DCR[a]										
No	0.11 (0.04, 0.18)	0.001			0.69 (0.65, 0.74)	< 0.001				
Yes	0.01 (−0.00, 0.02)	0.2	−0.10 (−0.18, −0.03)	0.007	0.63 (0.55, 0.71)	< 0.001	−0.07 (−0.16, 0.03)	0.19		

Abbreviations: DCR = drug consumption room; CI = confidence interval; IMR = inverse Mills ratio.

[a]In the previous month.

[b]In the past 6 months.

[c]Adjusted with age, food aid, crack cocaine daily use, daily injection, harmful alcohol consumption and self-reported HCV status.

[d]Adjusted with age, country of birth, employment status, public allowance and harm reduction facilities use.

[e]Adjusted with type of housing, public allowance, health insurance, daily heroin use, daily unprescribed morphine use, daily injection and at having visited at least once a general or specialist physician.

TABLE 4 Factors associated with injection equipment sharing and recent HCV testing: Heckman mixed probit models with bootstrapped CIs (250 replicates), univariable and multivariable analyses, COSINUS study.

	Injection equipment sharing (Heckman mixed probit model)				Recent HCV testing (Heckman mixed probit model)			
	Univariable analyses *N* = 1454 visits, *n* = 664		Multivariable analysis *N* = 1450 visits, *n* = 664		Univariable analyses *N* = 1175, *n* = 576		Multivariable analysis *N* = 1170, *n* = 575	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Exposure to DCR[b]								
No	0		0		0		0	
Yes	0.15 (−0.22, 0.52)	0.433	−1.14 (−1.91, −0.36)	0.004	−0.12 (−0.4, 0.16)	0.385	−0.18 (−0.44, 0.09)	0.185
IMR			0.49 (0.11, 0.87)	0.012			0.18 (0.03, 0.33)	0.019
Age (years)[a]	−0.02 (−0.04, 0.00)	0.025	−0.02 (−0.04, 0.00)	0.013	−0.01 (−0.02, 0.00)	0.019	−0.02 (−0.03, −0.01)	0.001
Time since first injection (years)[a]								
< 10 years	0				0			
≥ 10 years	0.01 (−0.31, 0.32)	0.968			−0.17 (−0.4, 0.05)	0.13		
Gender[a]								
Male or trangender male	0				0			
Female or transgender female	0.31 (−0.04, 0.66)	0.084			0.19 (−0.12, 0.51)	0.223		
Education level[a]								
Below high school certificate	0				0			
High school or university certificate	−0.01 (−0.29, 0.27)	0.933			−0.04 (−0.28, 0.2)	0.742		
Country of birth[a]								
Born in France	0				0		0	
Born abroad	0.16 (−0.26, 0.57)	0.459			0.30 (−0.01, 0.61)	0.061	0.39 (0.12, 0.67)	0.005
In a couple								
No	0				0			
Yes	0.04 (−0.27, 0.35)	0.81			0 (−0.22, 0.21)	0.989		
Housing								
Very stable housing	0				0			
Precarious or unstable	0.12 (−0.26, 0.51)	0.529			0.25 (−0.01, 0.52)	0.058		
Extremely precarious	0.21 (−0.1, 0.53)	0.19			0.19 (−0.05, 0.43)	0.116		
Employment (paid activity)								
No	0				0		0	
Yes	−0.17 (−0.54, 0.21)	0.385			−0.37 (−0.6, −0.15)	0.001	−0.37 (−0.65, −0.09)	0.009

TABLE 4 (Continued)

	Injection equipment sharing (Heckman mixed probit model)				Recent HCV testing (Heckman mixed probit model)			
	Univariable analyses *N* = 1454 visits, *n* = 664		Multivariable analysis *N* = 1450 visits, *n* = 664		Univariable analyses *N* = 1175, *n* = 576		Multivariable analysis *N* = 1170, *n* = 575	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Public allowance								
No	0				0		0	
Yes	0.01 (−0.24, 0.27)	0.917			0.19 (−0.02, 0.4)	0.082	0.23 (0.02, 0.44)	0.033
Food aid at least once[b]								
No	0		0		0			
Yes	0.45 (0.18, 0.73)	0.001	0.47 (0.18, 0.77)	0.002	0.13 (−0.12, 0.38)	0.296		
Health insurance								
No	0				0			
Yes	−0.11 (−0.41, 0.19)	0.46			0 (−0.25, 0.24)	0.98		
Daily unprescribed upioid use[b]								
No	0							
Yes	0.08 (−0.19, 0.35)	0.571						
Daily heroin use[b]								
No					0			
Yes					0.41 (−0.26, 1.07)	0.228		
Daily unprescribed buprenorphine use[b]								
No					0			
Yes					−0.14 (−0.53, 0.26)	0.489		
Daily unprescribed methadone use[b]								
No					0			
Yes					−0.1 (−0.72, 0.52)	0.753		
Daily unprescribed morphine use[b]								
No					0			
Yes					−0.16 (−0.38, 0.07)	0.174		
Daily cocaine use[b]								
No	0				0			
Yes	0.67 (0.27, 1.07)	0.001			0.26 (−0.08, 0.6)	0.139		

(Continues)

TABLE 4 (Continued)

	Injection equipment sharing (Heckman mixed probit model)				Recent HCV testing (Heckman mixed probit model)			
	Univariable analyses *N* = 1454 visits, *n* = 664		Multivariable analysis *N* = 1450 visits, *n* = 664		Univariable analyses *N* = 1175, *n* = 576		Multivariable analysis *N* = 1170, *n* = 575	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Daily crack cocaine/freebase use[b]								
No	0		0		0			
Yes	0.27 (−0.08, 0.61)	0.133	1.03 (0.30, 1.75)	0.005	−0.05 (−0.31, 0.2)	0.682		
Daily cannabis use[b]								
No	0				0			
Yes	−0.11 (−0.4, 0.18)	0.471			−0.07 (−0.28, 0.14)	0.505		
Opioid agonist treatment								
No	0				0			
Yes	0.11 (−0.16, 0.38)	0.417			0.2 (−0.01, 0.42)	0.057		
Daily injection[b]								
No	0		0		0			
Yes	0.53 (0.25, 0.81)	< 0.001	0.57 (0.28, 0.86)	< 0.001	−0.1 (−0.31, 0.1)	0.317		
Harmful alcohol consumption[c]								
No	0		0		0			
Yes	0.39 (0.12, 0.65)	0.004	0.43 (0.16, 0.7)	0.002	0.03 (−0.17, 0.23)	0.753		
Life-time experience of prison								
No	0				0			
Yes	−0.05 (−0.36, 0.27)	0.781			0.15 (−0.07, 0.36)	0.191		
Self-reported HCV status								
Seronegative	0		0					
Previously seropositive but cured	0.09 (−0.27, 0.45)	0.617	0.29 (−0.07, 0.65)	0.119				
Seropositive	0.44 (0.13, 0.74)	0.005	0.65 (0.33, 0.96)	< 0.001				
Not tested	0.18 (−0.49, 0.85)	0.593	0.14 (−0.54, 0.82)	0.687				
Harm reduction facilities use[d]								
Less than often					0		0	
Often or always					0.28 (0.08, 0.47)	0.006	0.31 (0.1, 0.51)	0.003

Abbreviations: DCR = drug consumption room; CI = confidence interval; IMR = inverse Mills ratio.
[a]Time-invariant factors.
[b]In the previous month.
[c]Alcohol Use Disorders Identification Test (AUDIT)-C score ≥ 3 for women and ≥ 4 for men.
[d]In the past 6 months.

TABLE 5 Factors associated with opioid agonist treatment: mixed probit models, univariable and multivariable analyses, COSINUS study.

	Opioid agonist treatment (mixed probit model)			
	Univariable analyses *N* = 1231 visits, *n* = 583		Multivariable analysis *N* = 1220 visits, *n* = 582	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Exposure to DCR[b]				
No	1		1	
Yes	−1.57 (−2.07, −1.07)	< 0.001	−0.17 (−0.67, 0.33)	0.509
Age (years)[a]	0.05 (0.01,0.08)	0.004		
Time since first injection (years)[a]				
< 10 years	1			
≥ 10 years	0.79 (0.17, 1.42)	0.012		
Gender[a]				
Male or trangender male	1			
Female or trangender female	0.35 (−0.34, 1.05)	0.315		
Education level[a]				
Below high school certificate	1			
High school or university certificate	−0.04 (−0.67, 0.58)	0.886		
Country of birth[a]				
Born in France	1			
Born abroad	−0.28 (−1.03, 0.48)	0.471		
In a couple				
No	1			
Yes	0.50 (−0.03, 1.03)	0.066		
Housing				
Very stable housing	1		1	
Precarious or unstable	−0.70 (−1.25, −0.15)	0.013	−0.42 (−1.01,0.17)	0.159
Extremely precarious	−1.39 (−1.89, −0.89)	< 0.001	−0.64 (−1.18,-0.11)	0.018
Employment (paid activity)				
No	1			
Yes	0.28 (−0.27, 0.83)	0.324		
Public allowance				
No	1		1	
Yes	1.61 (1.14, 2.07)	< 0.001	0.76 (0.29, 1.23)	0.002
Food aid at least once[b]				
No	1			
Yes	−0.25 (−0.71, 0.21)	0.284		
Health insurance				
No	1		1	
Yes	1.70 (1.22, 2.18)	< 0.001	0.71 (0.21, 1.20)	0.005
Daily heroin use[b]				
No	1		1	
Yes	−2.23 (−3.32, −1.14)	< 0.001	−2.39 (−3.39, −1.39)	< 0.001
Daily unprescribed morphine use[b]				
No	1			
Yes	−2.86 (−3.43, −2.29)	< 0.001	−2.03 (−2.67, −1.40)	< 0.001

(Continues)

TABLE 5 (Continued)

	Opioid agonist treatment (mixed probit model)			
	Univariable analyses *N* = 1231 visits, *n* = 583		Multivariable analysis *N* = 1220 visits, *n* = 582	
	Coeff (95% CI)	*P*-value	aCoeff (95% CI)	*P*-value
Daily cocaine use[b]				
No	1			
Yes	0.28 (−0.46, 1.02)	0.457		
Daily crack cocaine/freebase use[b]				
No	1			
Yes	−1.52 (−2.02, −1.02)	< 0.001		
Daily cannabis use[b]				
No	1			
Yes	0.09 (−0.33, 0.52)	0.662		
Daily injection				
No	1			
Yes	1.54 (1.11, 1.98)	< 0.001	−0.91 (−1.49, −0.34)	0.002
Harmful alcohol consumption[c]				
No	1			
Yes	0.64 (0.18, 1.10)	0.006		
Life-time experience of prison				
No	1			
Yes	−0.28 (−0.87, 0.31)	0.35		
At least one visit at a general or specialist physician[d]				
No	1			
Yes	1.54 (1.11, 1.98)	< 0.001	0.84 (0.38,1.30)	< 0.001

Abbreviations: DCR = drug consumption room; CI = confidence interval.
[a]Time-invariant factors.
[b]In the previous month.
[c]Alcohol Use Disorders Identification Test (AUDIT)-C score ≥ 3 for women and ≥ 4 for men.
[d]In the past 6 months.

sharing injecting equipment was 11% in the control group versus 1% in the group that regularly attended a DCR. This represents a decrease of 90% of injection equipment sharing between the non-exposed group and the group exposed to DCRs.

It is noteworthy that these analyses have taken into account the correction of selection bias induced by the non-randomization of the two groups. These results support our hypothesis, which postulated that access to DCR-related services may have a positive impact by reducing high-risk practices. Indeed, in a DCR, PWID are encouraged to inject safely with facilitated access to sterile equipment, and they may receive advice from a nurse/harm reduction provider to adopt more effective practices to decrease the risk of infections exposure. These results are coherent with the evaluation of AERLI (accompaniment and education on injection-related risks), an intervention which provides training, support and education regarding safer injection practices, that has been shown to be effective in increasing safer injecting practices [29]. Moreover, DCRs promote better access to social, medical and psychiatric care that also helps PWID to reduce their at-risk practices and, more widely, to improve their quality of life. This result confirms the impact of DCRs on reducing the sharing of injecting equipment and playing a key role in reducing HIV and HCV transmission, the prevalence in this group being much higher compared to the general population [20, 30].

Moreover, our study indicates that social precarity, stimulants use and daily injection are factors associated with at-risk practices for HIV/HCV infections. These results all corroborate the findings of other studies on precarity [31] and daily injection [32, 33]. Stimulants use [34] especially crack cocaine use, are associated with an increase of HCV prevalence; that is, a threefold prevalence in Brazil compared to the general population [35, 36] and higher prevalence among crack cocaine users to opioid users among vulnerable groups in other settings, including France [37, 38]. More surprisingly, in our cohort declaring to be HCV-positive is also associated with sharing injection equipment. Similar results have been reported for HIV among a cohort of PWID randomly recruited in Vancouver. Attending a DCR is associated with a reduced likelihood of borrowing needles only among

HIV-negative people, but this effect was not found for HIV-positive people [33]. We found that PWID who reported being HCV-positive had more at-risk injecting practices. This result might reflect the relationship between their HCV status as a consequence of sharing injection equipment or less access to direct-acting antivirals (DAAs) that are approved for HCV and whose tolerance is high.

Two other findings are important to discuss. The first is that, although DCR provide on-site HCV testing, we found no impact of DCRs on HCV testing in the exposed group compared to the non-exposed group. However, this can be explained, as the control group was recruited in harm reduction facilities that promote systematic HCV testing. Indeed, in recent years, as universal access to direct-acting antivirals for HCV, rapid and on-site HCV testing has been largely distributed in harm reduction facilities in France [39]. For this reason, the impact of DCRs on HCV testing might be difficult to highlight and is not different compared to these other programmes. Indeed, HCV testing among PWID who attend harm reduction facilities and addiction care centres is extremely high in France (more than 90%) [6].

Access to OAT was also not significantly different between the two groups. This might be explained because access to OAT (buprenorphine and methadone) is very high in France; in another survey conducted in the same cities (the ANRS-Coquelicot survey), more than 86% of PWID who attend harm reduction facilities and addiction care centres were on OAT [40]. In addition, a large proportion of the PWID who use the DCR in Paris use non-prescribed morphine-sulphate which, until the present, has not been registered as an official OAT. That might have resulted in an underestimation of the proportion of PWID receiving OAT within the DCR compared to other sites of recruitment.

Globally, our results confirm data from other surveys conducted in DCRs in other settings, while providing a much more valid comparison through the presence of a control group. Indeed, compared to other large cohort surveys that only recruited PWID in DCRs, the novelty of our research design was to enrol the PWID in cities with and without DCRs. In Vancouver, Canada, a cohort study (with a follow-up every 6 months) indicated that regular use of DCRs was associated with a decrease in needle sharing [13]. In addition, the design of this Vancouver cohort allowed for an evaluation before and after attending a DCR for the same group of PWID: the reduction in needle sharing among the PWID coincided with the opening of the DCR. A meta-analysis combined the results of four studies and found that attending a DCR was associated with a 69% reduction in needle sharing [41].

In Europe, the impact of DCRs in reducing at-risk practices was reported in Denmark and Spain. In Denmark, a cross-sectional survey among PWID attending the Copenhagen DCR indicated that half of the PWID declared having stopped syringe sharing [42]. In Spain, a cohort study (12-month follow-up, recruitment in two cities) of young PWID indicated that attending a DCR was independently associated with a decrease in borrowing used needles [43]. A more recent cross-sectional study conducted at harm reduction facilities in Catalonia indicated the positive impact of regular attendance of DCRs in terms of sharing used injecting equipment [15].

Policy implications

Finally, our findings underline policy implications. First, they indicate the need for more innovative and tailored interventions combined with existing services. For example, educational interventions for injecting practices that are effective in improving access to HCV testing [44] might be implemented in harm reduction facilities. Access to a diversity of treatment options for opioid use disorders [44] could have an impact for the retention in harm reduction facilities for opioid users who have not responded to standard treatments such as oral methadone maintenance treatment (MMT) or buprenorphine. For example, supervised injectable heroin treatment has emerged over the past 15 years as an effective treatment for people who have opioid use disorders and who do not respond to standard treatments [45–47]. Secondly, our findings showed that people who attended DCRs were less likely to have attended a physician. Because, in France, psychiatric and somatic care are also delivered in DCRs within a harm reduction framework (with no judgement on injecting practices), people can favour consultations in DCRs compared to consultations in a physician's office. Thirdly, financial burdens of care, logistical difficulties in accessing care and low social support were common challenges among the most vulnerable PWID [48]. In France, the two DCR are implemented in hospital that provide free specialized health-care by agreements between DCRs and the hospital services facilitating access to care for PWID. Our COSINUS survey also demonstrates that DCRs have no impact on HCV testing in the exposed group compared to the non-exposed group. This result might be explained by the high and systematic HCV testing in harm reduction facilities where the non-exposed group was recruited.

Limitations

Overall, the DCRs that have been introduced in France show a positive impact upon at-risk practices for infectious diseases such as HIV and HCV. However, we must acknowledge some limitations to our study. First, at-risk practices were evaluated with a standardized questionnaire conducted by different interviewers in the different cities, which might have led to interviewer bias. Interviewer bias means that the interviewee tends to adapt his/her answers to the expectations or opinions of the interviewer. This bias might have an impact on underestimating the declaration of at-risk practices. Nonetheless, we can make the hypothesis that this bias is equal between our two populations (the group of PWID who attend a DCR and the control group who do not attend DCRs). Moreover, the interviewer bias was limited thanks to the same written guidelines provided to all interviewers conducting the study. Secondly, as HIV and HCV status were self-reported and were not confirmed by biological measures of antibodies, the proportion of infection might be under-evaluated related to an unawareness of infection. Moreover, even if we statistically controlled the results for the attrition rate, the proportion of participants lost to follow-up might impact the results. Continuous follow-up of

the PWID might allow us to confirm the positive impact of DCRs on at-risk practices.

CONCLUSION

In conclusion, our COSINUS cohort shows that PWID exposed to French DCRs are less likely to report sharing injecting equipment compared to those not exposed to DCRs. Social precarity, stimulants use and daily injection are factors associated with at-risk practices for HIV/HCV infections. All in all, these results demonstrate that DCR are an effective harm reduction tool for reducing high-risk practices related to HCV/HIV infections that contributes to the elimination of HIV and HCV among PWID.

The goal of the COSINUS study was to evaluate DCR within an experimental framework. The French government requests this scientific evaluation in order to make an evidence-based decision on the continuation and dissemination of DCRs in France. After our evaluation, the French government announced that they will create drop-in centres for addiction (*Haltes Soins Addictions*) that will combine spaces for harm reduction through supervised injecting practices with a stronger focus upon improving access to care, including somatic and psychiatric care within a holistic approach of harm reduction.

COSINUS study group

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AUTHOR CONTRIBUTIONS

Laurence Lalanne: Conceptualization (lead); funding acquisition (lead); investigation (lead); supervision (lead); writing—original draft (lead); writing—review and editing (lead). **Perrine Roux:** Conceptualization (lead); funding acquisition (lead); investigation (lead); writing—review and editing (supporting). **Cécile Donadille:** Formal analysis (supporting); methodology (supporting); writing—review and editing (supporting). **Laélia Briand-Madrid:** Project administration (equal); writing—review and editing (equal). **Isabelle Célérier:** Investigation (supporting). **Carole Chauvin:** Investigation (supporting). **Naomi Hamelin:** Investigation (equal). **Charlotte Kervran:** Data curation (equal); writing—review and editing (equal). **Gwenaelle Maradan:** Investigation (supporting); project administration (supporting). **Marc Auriacombe:** Conceptualization (lead); funding acquisition (lead) investigation (lead); supervision (lead); writing—review and editing (supporting). **Marie Jauffret-Roustide:** Conceptualization (lead); funding acquisition (lead); investigation (lead); supervision (lead); writing—original draft (lead); writing—review and editing (lead).

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DECLARATION OF INTERESTS

All authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The Cosinus data are not available due to ethical requirements.

STUDY REGISTRATION

The study protocol was approved by the Institutional Review Board (IRB00003888) of the French Institute of Health and Medical Research (opinion number: 14-166).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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