

# Innovative community-based educational face-to-face intervention to reduce HIV, hepatitis C virus and other blood-borne infectious risks in difficult-to-reach people who inject drugs: results from the ANRS–AERLI intervention study

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## ABSTRACT

**Aims** To study the effectiveness of an educational intervention on risks associated with drug injection, comparing primary [unsafe HIV–hepatitis C virus (HCV) practices] and secondary (local complications at injecting site) end-points in harm reduction (HR) programmes offering this intervention versus HR programmes not offering it. **Design** This non-random clustered intervention study was conducted in nine intervention groups (programmes offering the intervention) and eight control groups (programmes not offering it). Each participant was followed-up through a telephone interview at enrolment and at 6 and 12 months. **Setting** The study took place in 17 cities throughout France. **Participants** Of the 271 participants, 144 were enrolled into the intervention group and 127 in the control group. Of the latter, 113 received at least one educational session. **Intervention** A series of participant-centred face-to-face educational sessions. Each session included direct observation by trained non-governmental organization (NGO) staff or volunteers of participants' self-injecting the psychoactive product they used habitually; analysis by the trained NGO staff or volunteers of the participant's injecting practices, identification of injection-related risks and explanation of safer injecting practices; and an educational exchange on the individual participant's injection practices and the questions he or she asked. **Measurements** Primary and secondary outcomes were 'at least one unsafe HIV–HCV practice' and at least one injection-related complication (derived from a checklist). **Findings** The proportion of participants with at least one unsafe HIV–HCV practice in the intervention group decreased significantly, from 44% at M0 to 25% at M6, as well as complications at the injection site (from 66 to 39% at M12), while in the control group it remained mainly stable. Multivariate probit analyses showed that the intervention group experienced a significant reduction in unsafe HIV–HCV practices at M6 [coefficient, 95% confidence interval (CI) =  $-0.73$  ( $-1.47$  to  $0.01$ )] and in injection-related complications at M12 [coefficient, 95% CI =  $-1.01$  ( $-1.77$  to  $-0.24$ )], compared with the control group. **Conclusions** An inexpensive and easily implemented educational intervention on risks associated with drug injection reduces significantly unsafe HIV–HCV transmission practices and injection-related complications.

**Keywords** Education, HCV, HIV, injecting drug user, intervention, local complications.

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## INTRODUCTION

Opioid substitution treatment (OST) and needle syringe programmes (NSP) can greatly reduce HIV transmission

in people who inject drugs (PWID) [1,2]. In France in the mid-1990s, when the HIV epidemic in injecting drug users (IDU) gave serious cause for alarm, the first harm reduction (HR) services comprised needle exchange programmes

(NEP) which provided sterile equipment to this population. These services extended their activities to include the distribution of condoms and food and the provision of social services for people who use drugs (injecting, snorting and smoking drug users). Since 2004, these HR services have been institutionalized and are funded mainly by regional health agencies. Thanks to the implementation of this national harm reduction policy in France, HIV prevalence decreased from 40% in 1988 to 11% in 2011 [3,4]. However, the burden of hepatitis C virus (HCV) infection remains an important public health issue among drug users, and more particularly in PWID [5,6]. This is because injecting drug use—in particular the sharing of needles and syringes [7] and other drug-injecting paraphernalia [8]—is recognized as the major source of HCV contamination. The average prevalence of hepatitis C in PWID is 60% (prevalence can reach > 80%), even in countries where harm reduction programmes are accessible [9]. In France, where such programmes exist throughout the country, HCV prevalence was 44% in 2011 [4]. As well as HIV and HCV transmission, other complications related to drug injection have been reported widely [10,11]. One study conducted on 883 PWID in Vancouver showed that the majority of emergency room (ER) admissions were due to abscesses, cellulitis and other injecting-related skin infections [12]. Despite being documented since the 1970s [13], these complications still remain a significant problem among PWID. Moreover, the injection of pills not intended for intravenous use, such as morphine sulphate [14] and buprenorphine [15], constitutes a growing problem. These unsafe practices lead to several health problems beyond local lesions, such as cardiovascular and pulmonary complications [16,17].

Many positive social and health outcomes have been associated with the work of safe injection facilities (SIF). For example, in Vancouver, the Insite SIF has led to a reduction in HIV mortality and overdoses [18]. However, a recent study showed that harmful injecting practices still exist among the attendees of Insite [19].

These phenomena reflect the existence of persisting unsafe behaviours in PWID. Indeed, it is worth noting that some PWID never or only rarely use HR services, either because services are absent in certain geographic areas or because they do not meet some specific needs, such as increased knowledge and skill about injection practices which PWID often demand. This suggests that current harm reduction services do not cover some demand and are not sufficient to reduce the harm caused by globally at-risk injecting practices. Therefore, it is imperative to experiment with, evaluate and implement innovative strategies in HR services for drug users as soon as possible to improve PWID health effectively. Among the various approaches already investigated to improve HIV and HCV risk reduction in PWID, educational interventions have proved

effective [20,21]. To date, however, few studies have demonstrated the effectiveness of innovative interventions on the direct consequences of drug injection, such as the reduction of local cutaneous complications. In the present study, we aimed to evaluate the effectiveness of an alternative and innovative community-based face-to-face intervention providing training and education about injection (Accompagnement et Education aux Risques Liés à l'Injection: AERLI) on HIV and HCV infectious risk reduction, and also on the reduction of local complications at the injection site.

## METHODS

### Study design

This national, clustered, multi-site intervention study was conducted in 17 low-threshold drug users' services in France between 2011 and 2013. It enrolled 271 PWID seeking support for their injection practices, including 144 people recruited in eight units implementing the intervention (hereafter 'intervention group units') and 127 people in nine units not providing the intervention (hereafter 'control group units'). Control group centres operated according to their current guidelines, while intervention group units proposed the intervention to PWID. We did not perform a random assignment of services to the intervention and control groups because it was not feasible to implement the intervention in all HR services. More specifically, this intervention required HR services to have a dedicated space and trained workers. Therefore, to avoid the bias related to non-random assignment, a two-step Heckman model was used in the analysis. All PWID who agreed to participate in the study provided written informed consent. This research project is a partnership between the non-governmental organizations (NGOs), AIDES and Médecins du Monde (MdM), with the INSERM UMR 912 SESSTIM-ORS PACA research laboratory. AIDES and MdM staff members and volunteers were involved in the study design, training of peers and implementation of the intervention, as well as data collection and analysis. The study was approved by the National Scientific Research Ethics Committee in Paris (CEEI/IRB).

The main aim of this research was to study the impact of an educative intervention for PWID focusing on unsafe injecting practices, especially in terms of infectious diseases and venous damage.

### Description of the intervention

The intervention consisted of providing training and education about HIV and HCV transmission risk reduction in terms of drug injecting practices, and also about how to reduce other injection-related complications.

This intervention was based on ‘self-determination theory’, developed by Edward L. Deci & Richard M. Ryan [22]. It comprised taking into account three psychological needs: autonomy, competence and relatedness to improve motivation and wellbeing. It was organized as a series of participant-centred face-to-face educational sessions, taking place in a dedicated room in each intervention group unit. Each session included:

- Direct observation by trained NGO staff or volunteers of participants’ self-injecting the psychoactive product they used habitually;
- Analysis by the trained NGO staff or volunteers of the participant’s injecting practices, identification of injection-related risks and explanation of safer injecting practices; and
- An educational exchange on the individual participant’s injection practices and the questions they asked.

Participants had to receive at least one educational session over the first 6 months. Participants enrolled into the control group were followed by the relevant service (according to the latter’s guidelines) for 1 year.

### Participants and recruitment

Eligibility criteria of participants were as follows: aged 18 years or over, having injected drugs at least once during the previous week, willing to be contacted for a telephone interview and able to provide written, informed consent. The inclusion criteria stipulated inclusion of PWID who asked spontaneously for help or information related to injection and who could be reached by telephone. Exclusion criteria stipulated the exclusion of all pregnant women and all individuals who had benefited from the educational intervention at least once during the previous year.

### Sample size

The ABRIDUS study (Australian Blood-borne Virus Risk and Injecting Drug Use Study), using the same questionnaire, showed that 75% of participants reported at least one unsafe HIV–HCV practice during the previous month [17]. The hypothesis for our study was that after 6 months the percentage of participants in the intervention group who reported at least one unsafe HIV–HCV practice would decrease to 50%. With an alpha of 5%, a power of 80% and an attrition rate of 25% at 6 months in both groups, 118 participants needed to be enrolled into each group.

### Data collection

To limit desirability bias, data were collected using computer-assisted telephone interview (CATI) conducted

by a trained, external, non-judgemental interviewer not involved in the educational sessions. These interviews were scheduled at inclusion (M0), 6 months (M6) and 12 months (M12). The 6- and 12-month follow-ups were implemented 6 and 12 months after study enrolment, respectively. Interviews collected socio-demographic information (gender, age, education level, living in a couple or not, employment status, housing situation), history of drug use (age at first drug injection), drug use in the previous month (frequency of drug sniffing and/or drug injection using the Opiate Treatment Index) and alcohol use using the Alcohol Use Disorders Identification Test (AUDIT)-C questionnaire. We also collected information about access to care, HIV and HCV testing and diagnosis, and whether or not they were on opiate substitution treatment (OST). Behavioural data related to the risk of HIV and HCV transmission during the previous month were collected using the validated Blood-Borne Virus Transmission Risk Assessment Questionnaire – Short Version (BBV-TRAQ-SV) [23] during the telephone interview.

A variable ‘region’ was created by gathering centres with small population sizes from the same geographic region. We then tested a random effect on the region using double clustering (over time and within region) in the probit mixed models for both outcomes.

### Outcomes

The primary outcome measured to assess programme effectiveness was unsafe HIV–HCV practices, and was called ‘Unsafe HIV–HCV transmission practices’—defined as reporting at least one unsafe HIV and HCV transmission practice during the previous 4 weeks, such as: sharing of syringes/needles, sharing of other injecting paraphernalia (filter, swab, water, cup, etc.).

The secondary outcome measured was ‘Complications at the injection site’—defined as reporting at least one complication at the injection site during the previous 4 weeks, such as: bruises, abscesses, oedemas, burns, infections, necrosis or other.

### Statistical analysis

A two-step Heckman model, adapted for longitudinal studies, was used to account for the potential bias arising due to the non-randomized clustering of the intervention and control groups [24].

In the first step, a probit model was used to identify baseline characteristics of those exposed (at least once) to the educational intervention.

In the second step, a probit mixed model was used to identify factors associated with each outcome: unsafe HIV–HCV transmission practices and having complications at the injection site. The residuals of the model of

the first step were used to compute the inverse Mills ratio (IMR), which was then introduced into the model of the second step as a covariate in order to correct for potential bias due to non-random assignment to the intervention. An exchangeable correlation matrix was used for the probit mixed models. Bias-corrected confidence intervals and *P*-values in the second step were based on 500 bootstrap replicates.

For each of the two outcomes, univariate analyses based on this two-step Heckman approach were used to test the association of each potential explanatory variable with the outcome after adjustment for the IMR term. Tested factors included: (1) socio-demographic characteristics: sex, age, educational level (having a high school certificate or not), living in a couple or not, employment status (having a paid activity or not), precarious housing (street, squat, caravan); (2) history of drug use (age at first drug injection); (3) harmful alcohol consumption (AUDIT-C score  $\geq 3$  for women and  $\geq 4$  for men); (4) recent drug use (heroin, cocaine or crack, sulphate morphine, buprenorphine), polydrug use (at least two drugs), daily frequent injection (more than three times a day), being on opiate maintenance treatment or not; and (5) having being screened for HCV or not.

Due to the high degree of confounding in the data we used a threshold of *P*-value  $< 0.20$  in univariate analyses to identify the variables eligible to enter the two multivariate Heckman models (one for each outcome). A backward procedure was then used to select the explicative variables in the final multivariate model, with a *P*-value  $< 0.05$ . We also tested the interaction between follow-up duration and receiving the intervention.

In addition, to measure the impact of the follow-up duration on both outcomes without including the control group, we performed a sensitivity analysis based on a probit mixed model by selecting only those participants who had received at least one intervention ( $n = 113$ ) during the first 6 months, adjusting for the same factors as those found in the main analysis.

To confirm if missing data were missing at random and did not bias our results, we performed a sensitivity analysis using a double Heckman model, taking into account the two potential sources of statistical bias: non-randomization [25] and missing data [26].

## RESULTS

### Baseline sample description

The study recruited 144 and 127 participants in the intervention and control groups, respectively (Fig. 1). Thirty-one participants in the intervention group who did not receive any educational session during the study were excluded from the analyses.

Study sample ( $n = 240$ ) characteristics at baseline are presented in Table 1. Twenty-two per cent of the participants were female and median age [interquartile range (IQR)] was 30 (26–37) years. One-quarter of the sample had a high school certificate and one-third were employed. Twenty per cent of the sample was living in precarious conditions. At baseline, more than half the sample had harmful alcohol consumption; one-third were using heroin, 44% cocaine, 40% sulphate morphine and 40% buprenorphine.

In terms of the attrition rate in the intervention ( $n = 113$ ) and the control ( $n = 127$ ) groups, 38 (34%) and 35 (28%) participants, respectively, were lost to follow-up at M6, and 69 (61%) and 56 (44%), respectively, at M12.

We compared enrolled individuals having no follow-up assessment with those having at least one assessment (M6 and/or M12). Those lost to follow-up after M0 were more likely to report polydrug use (39 versus 19%). It is worth noting that unsafe HIV–HCV practices ( $P = 0.64$ ) and complications at the injection site ( $P = 0.52$ ) at M0 did not differ in the two groups (lost and not lost to follow-up).

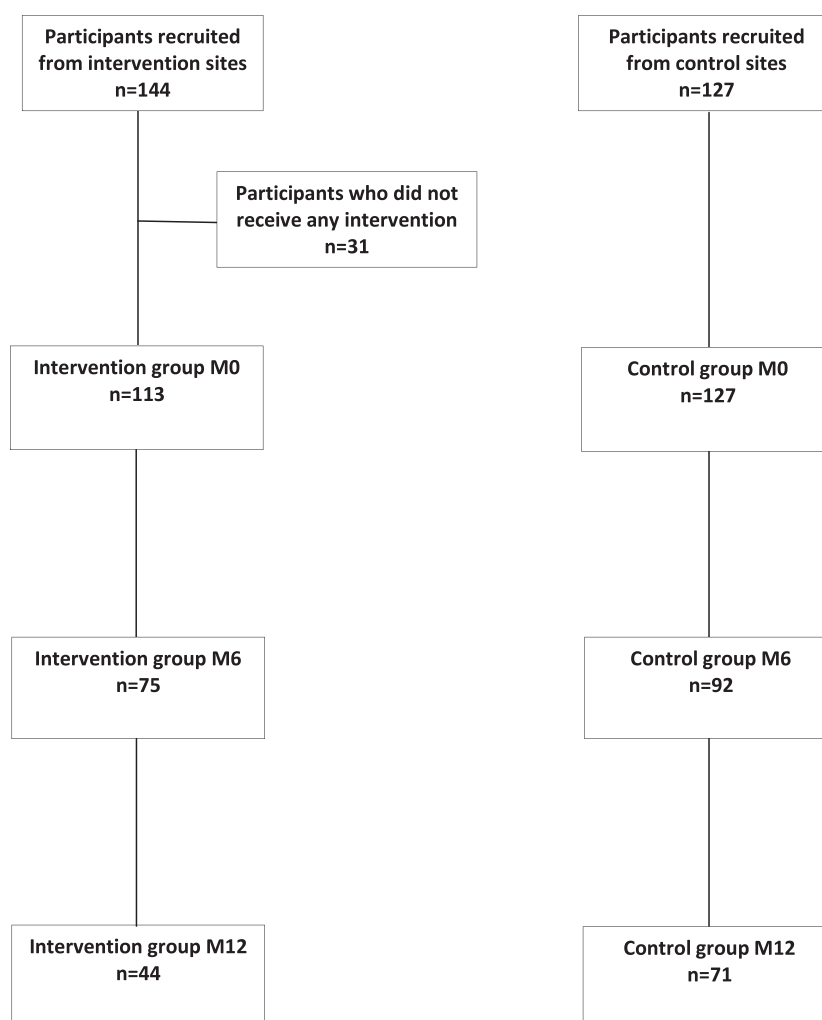
### Characteristics of participants exposed to the intervention

The characteristics of participants exposed to the intervention at least once during the first 6 months are presented in Table 2. Multivariate analysis highlighted that participants who had a high school certificate, precarious housing and those who were using heroin or sulphate morphine were more likely to receive the educational session intervention at least once. Conversely, PWID who used buprenorphine were less likely to receive the intervention.

### Evolution of efficacy outcomes during the 12-month follow-up

Figure 2 describes the evolution of the primary and secondary outcomes: unsafe HIV–HCV transmission practices (Fig. 2a) and complications at the injection site (Fig. 2b).

The results show that in the intervention group, the proportion of participants with at least one unsafe HIV–HCV practice decreased significantly, from 44% at M0 to 25% at M6, while in the control group it remained mostly stable (from 27 to 23%). Having at least one complication at the injection site decreased significantly, from 66% at M0 to 39% at M12 in the intervention group, while a small increase was observed in the control group (from 56 to 62%). However, a significant difference was seen at enrolment between the two groups concerning unsafe HIV–HCV transmission practices, with those enrolled in the intervention group presenting more unsafe practices at baseline than those in the control group. For this reason,



**Figure 1** Flow-chart [ANRS-AERLI (French National Agency for Research for AIDS and Viral Hepatitis–Accompagnement et Education aux Risques Liés à l'Injection),  $n = 271$ ]

we used a two-step Heckman model to take into account the possible bias due to these differences at enrolment.

#### Impact of the intervention on unsafe HIV–HCV transmission practices

The univariate and multivariate analyses, described in Table 3, show the factors associated with unsafe HIV–HCV transmission practices in the whole study sample ( $n = 240$ ). After adjusting for other factors associated significantly with unsafe HIV–HCV transmission practices (being female, younger age, having harmful alcohol consumption, cocaine/crack use, being a polydrug user) and the IMR term, we found a significant interaction effect between the intervention and follow-up, showing that participants exposed to the intervention at least once were less likely to have unsafe HIV–HCV transmission practices at M6 than at M0 [coefficient, 95% confidence interval (CI) =  $-0.73$  ( $-1.47$ ;  $0.01$ )]. At M12, compared with M0, the intervention group tended to have fewer

unsafe HIV–HCV transmission practices, but this decrease was not significant.

The sensitivity analysis, limited to participants recruited in the intervention group units and adjusted for the same factors as those found in the main analysis, confirmed the significant decrease in unsafe HIV–HCV transmission practices between M0 and M6 [coefficient, 95% CI =  $-0.05$  ( $-0.10$ ;  $-0.002$ )] (results not shown).

#### Impact of the intervention on the variable ‘at least one complication at the injection site’

Table 3 describes also the results of the univariate and multivariate analyses regarding the outcome at least one complication at the injection site. We found that younger age and sulphate morphine use were associated both positively and significantly with having at least one complication at the injection site. After adjusting for these associated



**Table 1** Baseline characteristics [*n* (%) or median (IQR)], ANRS-AERLI (French National Agency for Research for AIDS and Viral Hepatitis–Accompagnement et Education aux Risques Liés à l'Injection) study (*n* = 240).

	Control group ( <i>n</i> = 127)	Intervention group ( <i>n</i> = 113)	<i>P</i> -value
Gender			
Male	99 (78)	88 (78)	
Female	28 (22)	25 (22)	0.99
Age (years) <sup>a</sup>	31 (26–37)	30 (25–37)	0.39
Education			
< High school certificate	103 (82)	76 (68)	
≥ High school certificate	23 (18)	36 (32)	0.01
Living in a couple			
No	97 (77)	80 (71)	
Yes	29 (23)	32 (29)	0.33
Employment (paid activity)			
No	81 (64)	82 (73)	
Yes	46 (36)	31 (27)	0.15
Precarious housing			
No	110 (87)	81 (72)	
Yes	17 (13)	32 (28)	0.004
Age at first drug injection <sup>a</sup>	19 (17–23)	19 (17–23)	0.73
Harmful alcohol consumption <sup>b</sup>			
No	58 (46)	49 (44)	
Yes	69 (54)	63 (56)	0.77
Heroin use <sup>c</sup>			
No	95 (75)	67 (59)	
Yes	32 (25)	46 (41)	0.01
Cocaine/crack use <sup>c</sup>			
No	77 (61)	58 (51)	
Yes	50 (39)	55 (49)	0.15
Sulphate morphine use <sup>c</sup>			
No	91 (72)	53 (47)	
Yes	36 (28)	60 (53)	< 0.001
Buprenorphine use <sup>c</sup>			
No	60 (47)	83 (73)	
Yes	67 (53)	30 (27)	< 0.001
Frequent daily injection			
No	69 (54)	52 (46)	
Yes	58 (46)	61 (54)	0.20
HCV screening			
No	19 (15)	29 (26)	
Yes	108 (85)	84 (74)	0.04
Unsafe HIV–HCV transmission practices <sup>d</sup>			
No	92 (73)	63 (56)	
Yes	34 (27)	49 (44)	0.01
Complications at the injection site <sup>e</sup>			
No	56 (44)	38 (34)	
Yes	71 (56)	75 (66)	0.10
Self-reported HCV seropositivity	29 (23)	37 (33)	
Self-reported HIV seropositivity	5 (4)	2 (2)	

<sup>a</sup>In years. <sup>b</sup>Alcohol Use Disorders Identification Test (AUDIT)-C ≥ 3 for women and ≥ 4 for men. <sup>c</sup>During the previous 4 weeks. <sup>d</sup>At least one unsafe HIV–hepatitis C virus (HCV) transmission practice during the previous month. <sup>e</sup>At least one complication at the injection site during the previous month.

factors and the IMR term, we found a significant interaction effect between the intervention and follow-up duration, showing that exposure to the intervention at least once was associated with fewer people reporting at least

one complication at the injection site at M12 [coefficient, 95% CI = −1.01 (−1.77; −0.24)].

Similarly, for participants who were exposed at least once to the intervention over to the full follow-up, the sensitivity

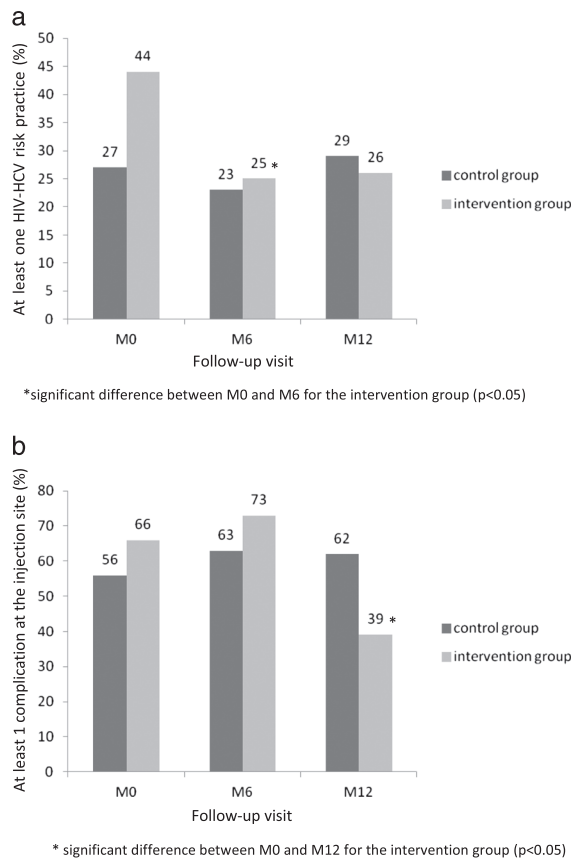
**Table 2** Characteristics of participants exposed to the intervention at least once; probit model, univariate and multivariate analyses, ANRS-AERLI (French National Agency for Research for AIDS and Viral Hepatitis–Accompagnement et Education aux Risques Liés à l'Injection) study ( $n = 240$ ).

	Univariate analyses		Multivariate analyses	
	Coefficient (95% CI)	P-value	Coefficient (95% CI)	P-value
Gender				
Male	0			
Female	−0.003 (−0.39; 0.38)	0.99		
Age <sup>a</sup>	−0.009 (−0.03; 0.01)	0.38		
Education				
< High school certificate	0		0	0.04
≥ High school certificate	0.47 (−0.10; 0.84)	0.01	0.42 (0.01; 0.82)	
Living in a couple				
No	0			
Yes	0.18 (−0.12; 0.55)	0.33		
Employment (paid activity)				
No	0			
Yes	−0.25 (−0.60; 0.09)	0.15		
Precarious housing				
No	0		0	0.001
Yes	0.59 (0.18; 0.99)	0.01	0.73 (0.30; 1.17)	
Age at first drug injection <sup>a</sup>	0.01 (−0.02; 0.03)	0.73		
Harmful alcohol consumption <sup>b</sup>				
No	0			
Yes	0.05 (−0.27; 0.37)	0.77		
Heroin use <sup>c</sup>				
No	0		0	0.04
Yes	0.45 (0.10; 0.79)	0.01	0.40 (0.03; 0.76)	
Cocaine use <sup>c</sup>				
No	0			
Yes	0.22 (−0.11; 0.54)	0.19		
Crack use <sup>c</sup>				
No	0			
Yes	1.34 (0.24; 2.43)	0.02		
Sulphate morphine use <sup>c</sup>				
No	0		0	0.01
Yes	0.67 (0.33; 0.99)	<0.001	0.50 (0.03; 0.76)	
Buprenorphine use <sup>c</sup>				
No	0		0	
Yes	−0.70 (−1.03; −0.37)	<0.001	−0.47 (−0.88; −0.70)	0.02
Daily frequent injection <sup>d</sup>				
No	0			
Yes	0.21 (−0.11; 0.53)	0.20		
Polydrug use <sup>c</sup>				
No	0			
Yes	0.33 (−0.05; −0.70)	0.09		
HCV screening				
No	0			
Yes	−0.42 (−0.82; −0.02)	0.04		

<sup>a</sup>In years. <sup>b</sup>Alcohol Use Disorders Identification Test (AUDIT)-C ≥ 3 for women and ≥ 4 for men. <sup>c</sup>During the previous 4 weeks. <sup>d</sup>More than three times a day. <sup>e</sup>≥ 2 drugs. At least one complication at the injection site (%).

analysis showed a significant decrease in the proportion of those reporting at least one complication at the injection site [coefficient, 95% CI = −0.93 (−1.50; −0.35)]. However, this was not observed at M6 (results not shown).

Multiple adjustments for all the explanatory variables included initially in the model (even when not significant) did not change our results significantly. This highlights that the variables not associated significantly



**Figure 2** Evolution of efficacy outcomes during the 12-month follow-up. (a) Percentage of participants who reported at least one unsafe HIV–hepatitis C virus (HCV) transmission practice at each follow-up visit. (b) Percentage of participants who reported at least one complication at the injection site at each follow-up visit

with the outcome were not confounders of the intervention effect. Finally, no random effect of the region was found.

The double Heckman model taking into account both sources of bias (non-randomization and missing data) confirmed that data were missing at random, as the corresponding IMR was not associated significantly with the outcome (unsafe HIV–HCV practices) in the multivariate model ( $P = 0.75$ ) after adjustment for non-randomization bias (results not shown).

## DISCUSSION

This study highlights important results regarding the impact of an innovative education intervention on injection practices of PWID. Indeed, our findings showed that implementing individually tailored educational sessions, based on observing a participant's injecting practices, is effective not only in reducing unsafe HIV–HCV transmission practices but also in reducing injection complications at the injection site.

Regarding the impact of the intervention on unsafe HIV–HCV transmission practices, our results showed that the intervention had a positive significant impact at 6 months of follow-up, after adjusting for potential risk factors and confounders. Females and younger participants were more likely to present unsafe HIV–HCV transmission practices. These results corroborate those of other studies, suggesting that women engage in more unsafe injection practices [27,28] than men. Indeed, a recent study showed that women were more likely than men to report high-risk injecting practices, especially in the context of sexual and drug-using relationships [29]. The literature has already highlighted the association between younger age and higher prevalence of paraphernalia-sharing in PWID [30]. Other factors, such as harmful alcohol consumption [31], cocaine use [32,33] and polydrug use [34], have also been associated with more frequent unsafe practices.

As mentioned above, this intervention had a positive impact on the number of injection-related local complications at the injection site, with a significant reduction observed in the proportion of people reporting at least one complication at M12. This was not observed at M6. Longer follow-up duration before observing an effect on complications at the injection site was to be expected, as several months may be required to treat complications, even when no other new complications occur. Moreover, this finding remained valid even after adjusting for two important confounders: younger age and sulphate morphine use. Indeed, previous studies showed that younger PWID were more likely to report injecting several times daily [35] and syringe-sharing [36]. In addition, sulphate morphine pills are not prescribed for intravenous use and have several associated complications, including infections from hazardous injecting practices, infections from particles contained in crushed pills [37] and cardiovascular complications [13]. Today, most particles contained in crushed sulphate morphine tablets can be removed by filtration using microfilters [38,39]. Accordingly, educating PWID about this possibility is of paramount importance in order to reduce the risks related to sulphate morphine injection.

Several behavioural interventions have already been evaluated in the literature to assess their efficacy in reducing unsafe HIV–HCV transmission practices. One recent review describing six trials on peer-education training and counselling interventions showed that only two of the six highlighted significantly greater reductions in unsafe injecting practices in the intervention group [40]. In one, Tucker *et al.* showed a reduction in unsafe HIV–HCV transmission behaviours, using both a standard educational intervention and an individually tailored brief behavioural intervention [41]. In the other, Zule *et al.* found a tendency towards a positive intervention effect, because those in the intervention group were almost twice as likely to have used a new needle at their most recent injection compared with



**Table 3** Factors associated with injecting practices, in terms of unsafe HIV–hepatitis C virus (HCV) transmission practices and local complications at the injection site: Heckman model, univariate and multivariate analyses ( $n = 240$ ,  $n = 522$  visits).

	Outcome 1: at least 1 unsafe HIV–HCV transmission practice			Outcome 2: at least 1 complication at the injection site		
	Univariate analysis coefficient (95% CI)	Multivariate analysis coefficient (95% CI)	P-value	Univariate analysis coefficient (95% CI)	Multivariate analysis coefficient (95% CI)	P-value
Gender						
Female	0	0	0.04	0		
Male	−0.66 (−1.10; −0.21)	−0.56 (−1.11; −0.02)		0.04 (−0.38; 0.46)		
Age <sup>a</sup>	−0.06 (−0.09; −0.03)	−0.05 (−0.08; −0.02)	0.001	−0.03 (−0.06; −0.01)	−0.04 (−0.06; −0.01)	0.01
Education						
< High school certificate	0	0		0		
≥ High school certificate	−0.31 (−0.78; 0.15)			−0.44 (−1.29; 0.41)		
Living in a couple						
No	0			0		
Yes	0.21 (−0.15; 0.58)			−0.12 (−0.46; 0.22)		
Paid activity						
No	0			0		
Yes	0.01 (−0.35; 0.36)			0.29 (−0.04; 0.62)		
Precarious housing						
No	0			0		
Yes	0.40 (−0.56; 0.85)			0.15 (−0.27; 0.58)		
Age at first drug injection <sup>a</sup>	−0.13 (−0.05; 0.02)			−0.04 (−0.07; −0.01)		
Harmful alcohol consumption <sup>b</sup>						
No	0	0	0.01	0		
Yes	0.62 (0.26; 0.98)	0.54 (0.12; 0.95)		0.30 (−0.02; 0.63)		
Heroin use						
No	0			0		
Yes	0.74 (0.36; 1.23)			0.43 (0.08; 0.79)		
Cocaine/crack use						
No	0	0	0.06	0		
Yes	0.80 (0.44; 1.16)	0.43 (−0.03; 0.89)		0.35 (0.03; 0.66)		
Sulphate morphine use						
No	0			0	0	
Yes	0.27 (−0.12; 0.65)			0.42 (0.04; 0.80)	0.41 (−0.02; 0.83)	0.06
Buprenorphine use						

No	0			0			
Yes	-0.00 (-0.43; 0.42)			0.23 (-0.17; 0.63)			
Polydrug use <sup>c</sup>							
No	0	0		0			
Yes	1.04 (0.61; 1.47)	0.74 (0.25; 1.23)	0.003	0.41 (0.04; 0.78)			
Frequent daily injection <sup>d</sup>							
No				0			
Yes				0.34 (0.03; 0.65)			
Opioid maintenance treatment							
No	0			0			
Yes	-0.22 (-0.68; 0.24)			0.45 (-0.01; 0.92)			
HCV screening							
No				0			
Yes				0.25 (-0.13; 0.64)			
Intervention							
No	0	0		0	0		
Yes	2.21 (1.20; 3.21)	1.96 (0.86; 3.07)	<10 <sup>-3</sup>	0.21 (-0.39; 0.80)	-0.81 (-1.80; 0.19)		0.11
Follow-up time							
M0	0	0		0	0		
M6	-0.47 (-0.81; -0.12)	-0.18 (-0.64; 0.28)	0.44	-0.45 (-0.78; -0.11)	0.23 (-0.19; 0.64)		0.29
M12	-0.30 (-0.68; 0.08)	0.23 (-0.38; 0.84)	0.46	-0.26 (-0.62; 0.11)	0.14 (-0.31; 0.59)		0.53
Interaction							
Intervention at M0		0			0		
Intervention at M6		-0.73 (-1.47; 0.01)	0.05		0.13 (-0.53; 0.78)		0.71
Intervention at M12		-0.86 (-1.79; 0.06)	0.07		-1.01 (-1.77; -0.24)		0.01
IMR		-0.99 (-1.68; -0.31)	0.005		0.78 (0.13; 1.43)		0.02

<sup>a</sup>Per 1-year increase. <sup>b</sup>Alcohol Use Disorders Identification Test (AUDIT)-C  $\geq 3$  for women and  $\geq 4$  for men. <sup>c</sup>> 2 drugs. <sup>d</sup>More than three times a day. IMR = inverse Mills ratio.

those in the control group [42]. Another recent intervention, entitled 'Staying Safe, a strength-based program to enhance prevention of HIV and HCV among PWID', has shown some promising results from an educational-based intervention [20].

The strengths and originality of our intervention lie in the fact that each face-to-face educational session was individualized and that participants were supervised by a trained community-based peer or a health-care professional while they injected. This has several implications which may explain the positive impact of the intervention on unsafe behaviours and on the number of complications at the injection site, as follows: first, individual observation of a drug-user's injecting practices by a community-based stakeholder enables the latter to provide a more tailored intervention, in the context of providing advice and explanations to improve injecting practices. This tailored information can then perhaps be implemented more readily by the individual PWID. Secondly, being supervised by a community-based peer may help to reduce the stigma associated with drug injection.

There are several advantages to implementing this intervention. First, it is not costly, as it takes fewer than 30 minutes and is supervised by community-based professionals. Secondly, it may be performed in different contexts where PWID need to receive help for injection. All needle exchange programmes and SIF could offer this service. As has already been suggested, the SIF environment may constitute a unique opportunity to promote safer injection education and provide support to high-risk populations [43]. Moreover, in line with what has already been observed for safer injection facilities [44], these educational interventions are likely to encourage other populations to use HR services. One advantage of this is that, thanks to an outreach approach, these interventions can also be offered to PWID who have no access to HR services.

Some limitations should be acknowledged. First, the use of self-reports is known to be subject to social desirability bias. Nevertheless, the reliability of self-reports in drug-using populations has already been demonstrated [45]. As serostatus information was based on self-reports, it is likely that under-reporting affected HIV and HCV serostatus prevalence estimates [46]. Secondly, because we used non-randomized clustering to compare the control and intervention groups, the populations of these two groups were different at baseline with high homogeneity inside and between clusters. However, we used a Heckman model to ensure that the two groups could be compared and to measure the effect of the intervention. Finally, the attrition rate was high, with 52% of participants not completing the study, including many participants lost to follow-up. This is not surprising, as retention in follow-up in the drug-injecting population is generally low. Regarding loss to follow-up, a first analysis comparing participants with

follow-up data and those lost to follow-up showed that the latter were more likely to be polydrug users, but they did not differ for unsafe HIV-HCV practices and complications at the injection site. In addition, our results showed that missing data were missing at random and then have no impact on the association between the intervention and the outcome. Finally, it is important to note that to avoid risks of imprisonment, police crackdowns, etc. this type of intervention, which involves field workers and PWID, must be explained thoroughly and discussed with local and national authorities in settings where drug use is highly criminalized.

In conclusion, our findings are important, as they highlight the effectiveness of an innovative intervention for PWID who still have a large number of unsafe HIV-HCV transmission practices. This study showed the positive impact of this peer-to-peer educational intervention on the reduction of such practices and on complications at injection sites. This intervention could be implemented in several other contexts, including needle exchange programmes, SIF and outreach interventions in settings where prevalence of PWID is high.

#### Declaration of interests

None.

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