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Sex Work as an Emerging Risk Factor for HIV Seroconversion among People who inject drugs in the SurvUDI Network

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Short summary: Among Central Eastern Canada PWID, sex work was independently associated with HIV incidence. Participants who engaged in sex work were compared with other participants with respect to HIV risks (**word count:** 29).

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46 **ABSTRACT**

47 Background: Recent analyses have shown an emerging positive association
48 between sex work and HIV incidence among people who inject drugs (PWIDs) in the
49 SurvUDI network.

50 Methods: Participants who had injected in the past 6 months were recruited across
51 the Province of Quebec and in the city of Ottawa, mainly in harm reduction
52 programs. They completed a questionnaire and provided gingival exudate for HIV
53 antibody testing. The associations with HIV seroconversion were tested with a Cox
54 proportional hazard model using time-dependent covariables including the main
55 variable of interest, sexual activity (sex work; no sex work; sexually inactive). The
56 final model included significant variables and confounders of the associations with
57 sexual activity.

58 Results: Seventy-two HIV seroconversions were observed during 5 239.2 person-
59 years of follow-up (Incidence rates: total=1.4/100 person-years (py), [95%CI: 1.1-
60 1.7]; sex work=2.5/100 py [1.5-3.6]; no sex work=0.8/100 py [0.5-1.2]; sexually
61 inactive=1.8/100 py [1.1-2.5]). In the final multivariate model, HIV incidence was
62 significantly associated with sexual activity (sex work: adjusted hazard
63 ratio (AHR)=2.19 [1.13-4.25],; sexually inactive: AHR=1.62 [0.92-2.88]), and injection
64 with a needle/syringe used by someone else (AHR=2.84, [1.73-4.66]).

65 Conclusions: Sex work is independently associated with HIV incidence among
66 PWIDs. At the other end of the spectrum of sexual activity, sexually inactive PWIDs
67 have a higher HIV incidence rate, likely due to more profound dependence leading to
68 increased vulnerabilities, which may include mental illness, poverty and social

69 exclusion. Further studies are needed to understand whether the association
70 between sex work and HIV is related to sexual transmission or other vulnerability
71 factors.

72 **Keywords** : people who inject drugs, HIV incidence, sex work, sexual activity,
73 injection behaviours

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77 **INTRODUCTION**

78 The Joint United Nations Programme on HIV/AIDS and World Health Organization
79 (UNAIDS/WHO) working group on global HIV/AIDS and STI surveillance provide
80 recent updated guidelines for HIV surveillance activities in several epidemiological
81 contexts ¹. In concentrated HIV epidemics, it is recommended to carry out regular
82 biobehavioural surveys in key populations at higher risk for HIV infection in order to
83 understand the local HIV epidemic and how it is changing, as well as to identify
84 opportunities to control the epidemic. These key populations include people who
85 inject drugs (PWIDs), men who have sex with men (MSM) and commercial sex
86 workers as well as their clients, because behaviours that increase the HIV risk are
87 frequent among these populations, i.e. unprotected sex with multiple partners,
88 injection drug use (needle/syringe-sharing) and unprotected anal sex ¹.

89 People who inject drugs are considered at increased risk for HIV infection mainly
90 because of sharing contaminated syringes and other injection paraphernalia. Sexual
91 transmission is possible, but its extent is generally difficult to estimate ². It has been
92 suggested that in PWIDs, sexual risks are present but may be masked or
93 overshadowed by parenteral risks ³. This would be rather likely considering the much
94 higher risk of HIV transmission of needle/syringe-sharing (0.7% per exposure)
95 compared to oral (maximum of 0.06% per exposure) or vaginal sex (maximum of
96 0.15% per exposure), with the exception of anal sex (maximum of 3% per
97 exposure)⁴⁻⁶. Thus, sexual transmission is more likely to occur in specific situations
98 such as in the context of commercial sex trade or male homosexual intercourse i.e.
99 high number of sex partners or frequent anal sex. This in turn may lead to bridging of
100 HIV and other sexually transmitted and blood-borne infection epidemics between

101 PWIDs, who cumulate risks, and individuals who do not, as for example, persons in
102 the general population ^{7,8}.

103 Important sex differences exist for sex work and should be taken into account ⁹⁻¹¹.
104 For example, sex work is frequent in PWIDs, but generally much more frequent in
105 female than in male PWIDs ¹¹. It occurs generally in the context of heterosexual sex
106 for women (i.e. very low HIV prevalence in clients in most developed countries) and
107 women are particularly vulnerable to sexual violence and abuse including negotiation
108 of condom use ¹⁰. On the other hand, sex work in men takes place generally in the
109 context of sex with other men (i.e. very high HIV prevalence in clients in most
110 developed countries) ¹².

111 The SurvUDI network is a biobehavioural survey among PWIDs of Central Eastern
112 Canada, ongoing since 1995. Recent analyses of SurvUDI data have shown an
113 emerging positive association between sex work and HIV incidence among PWIDs
114 ¹³. In this previous analysis, a time period interaction variable was included (1995-
115 2002 vs. 2003-2009) in a multivariate model and the association of sex work with
116 HIV incidence was significant for 2003-2009 but not for 1995-2002. Considering that
117 the questionnaire for the period 2004-2014 includes much more variables than for
118 the period 1995-2002, repeating this analysis for 2004-2014 has allowed a better
119 characterization of participants according to the main variable of interest. The
120 hypothesis was that the association with sex work would be detected for the period
121 2004-2014. The objectives of the present study were to examine the association
122 between sex work and HIV seroconversion among PWIDs in the SurvUDI network
123 between 2004 and 2014 and to compare participants engaging in sex work with
124 other participants with respect to HIV risks.

125

126 **METHODS**

127 ***Study design and subjects.*** The complete methodology of the SurvUDI study has
128 been described elsewhere ¹⁴. Briefly, the SurvUDI network is an ongoing
129 biobehavioural survey for HIV, HCV and associated risk behaviours among PWIDs in
130 Eastern Central Canada. The network was implemented in 1995 and targets hard-to-
131 reach, mostly out-of-treatment PWIDs. Eligibility criteria include being aged 14 and
132 older, injecting at least once within the past 6 months, speaking French or English
133 and being able to provide informed consent. Participants are recruited in urban
134 areas, including Montréal and neighbouring South Shore, Québec City, the Hull-
135 Ottawa region, and five semi-urban areas of the province of Québec. Overall, since
136 2004, 94.6% of participants were recruited in harm reduction programs. Others were
137 recruited in drop-in centres, detention centres, detoxification clinics, and
138 rehabilitation programmes. Participation includes an interviewer-administered
139 questionnaire and collection of gingival exudate using the Orasure device
140 (Bethlehem, Pennsylvania, US) for HIV and HCV antibody testing. The study design
141 is an open cohort of services where participants who attend harm reduction
142 programs more than once at times of study enrollment are followed longitudinally.
143 The present sample includes participants recruited from March 2004 to March 31
144 2014 who were initially HIV seronegative and with at least one follow-up visit.
145 Participants are identified using an encrypted code based on their initials, birth date
146 and sex, and they are given a stipend ranging from CAN\$5.00 to \$10.00 at the end
147 of each study visit. All procedures have been approved by the ethics committee of
148 the Centre de recherche du CHU de Québec.

149 **Study variables.** The dependent variable was HIV incidence. HIV infection was set
150 at the midpoint between the last HIV negative follow-up visit and the visit when the
151 HIV positive result was first detected. Potential confounders were identified based on
152 a literature review and on previous analyses in this cohort. Covariates considered in
153 the multivariate analyses as potential confounders included age (<25; ≥25
154 years)^{13,15,16}, sex^{13,15,16}, the region where the interview took place (urban or semi-
155 urban/rural)¹³, high school completion¹⁷, homelessness^{18,19}, recent incarceration
156^{15,19}, injected and non injected drug use^{13,20}, cocaine as the most often injected drug
157¹³, injection with strangers (unknown people)^{14,18}, injection with needles/syringes
158 used by someone else^{13,17}, daily injection^{13,21}, the number of sexual partners¹⁷,
159 consistent condom use for vaginal and anal sex²², always injecting alone and
160 injecting in public places (previous analyses, unpublished data). Sexual activity, the
161 main exposure of interest, was categorized as a three-level variable, namely, being
162 sexually active without engaging in sex work (no sex work, NSW), being sexually
163 active and engaging into sex work (sex work, SW) or being sexually inactive. Sex
164 work was defined as having client sex partners in the past six months, i.e. partners
165 giving money, drugs, goods or other things in exchange for sex. The choice for the
166 reference category (no sex work) was based on the hypothesis that this group would
167 show the lowest risk compared to the other two groups. This assumption was based
168 on previous analyses in our population showing that sexual inactivity in male IDUs
169 was associated with a higher HIV prevalence¹⁴. In the descriptive analyses of
170 participants according to sexual activity, several variables considered relevant were
171 presented even if not retained as confounders in the multivariate analysis. Sexual
172 orientation was added to the questionnaire in February 2011. Questions on

173 behaviours referred to the 6 months prior to the interview, except for daily injection
174 which refers to the last month.

175 **Laboratory procedures.** Collected oral fluid samples were kept at 4°C and shipped
176 within 2 weeks to the Laboratoire de santé publique du Québec (LSPQ; Institut
177 national de santé publique du Québec), where they were centrifuged upon reception.
178 The extracted liquid was kept at -20°C for a maximum of 6 weeks until analysis. The
179 presence of HIV antibodies was assessed by enzyme immunoassay (EIA) using
180 HIV-1 Vironostika Microelisa System (bioMérieux, Durham, North Carolina, USA)
181 from 2004 to 2009 and GS HIV-1/HIV-2 PLUS O EIA (Bio-Rad Laboratories
182 (Canada) Ltd., Montréal, Qc, Canada) thereafter. The presence of HCV antibodies
183 was assessed using ORTHO® HCV 3.0 ELISA Test System (Bio-Rad Laboratories
184 (Canada) Ltd., Montréal, Qc, Canada) according to a modified method developed by
185 Judd *et al.*²³. Samples were considered negative if results were less than 75% of the
186 cut-off value. Sample results that were greater than 75% of the cut-off value were
187 retested in duplicate. A sample was deemed positive if at least two out of three
188 results were greater than the cutoff value.

189 **Statistical analyses.** HIV seronegative participants at baseline who had at least one
190 follow-up visit for the period from 2004 to 2014 were considered when assessing HIV
191 incidence rates. Baseline characteristics and behaviours are those reported at the
192 second visit, i.e. exposure during the first time interval in the Cox proportional hazard
193 model. Using the Kaplan-Meier method, we estimated the cumulative probability of
194 seroconversion during follow-up. The cumulative HIV incidence rates were plotted
195 and compared for sexual activity reported at baseline using the log-rank test.
196 Bivariate and multivariate Cox proportional hazard regression analyses were carried

197 out to evaluate the association between HIV incidence and sexual activity.
198 Behavioural variables and age were treated as time-dependent variables. The
199 exposure used for a given time interval corresponds to the exposure measured at
200 the visit at the end of this interval, i.e. exposure reported for the preceding 6 months.
201 The final model included significant ($p < 0.05$) variables and confounders i.e. variables
202 changing other AHR by 10% or more when removed of the complete model. Effect
203 modification by sex was also tested for the association between sexual activity and
204 HIV incidence, and was considered statistically significant at a p value of 0.15 or less
205 (Wald chi-squared test). To compare risk profiles between participants engaged in
206 sex work and other participants, cross-sectional sex-stratified descriptive analyses
207 were performed using the last visit for non-seroconverters and the visit when HIV
208 infection was first detected for seroconverters. Cross-sectional comparisons were
209 performed using Pearson's chi-squared tests or ANOVA. All analyses were carried
210 out using the SAS statistical suite software version 9.4 (SAS Institute Inc., Cary,
211 North Carolina, USA).
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214 **RESULTS**

215 Table 1 shows baseline characteristics of participants. The sample included 1 528
216 participants cumulating 5 239.2 person-years of follow-up, with a majority of men and
217 of subjects from urban sites. Only a small proportion of PWIDs were less than 25
218 years old. Homelessness as well as cocaine as the most often injected drug were
219 frequently reported. Sex work was more frequently observed in women whereas
220 sexual inactivity was more frequent in men.

221 Figure 1 shows cumulative hazard of HIV seroconversion and HIV incidence
222 according to baseline sexual activity for the ten-year period (2004-2014). Occurrence
223 of seroconversions was proportionally distributed throughout the follow-up period in
224 all groups. A statistically significant difference was observed between groups, with
225 the highest cumulative hazard observed in participants who reported sex work
226 ($p < 0.0001$). The highest HIV incidence rate was observed in participants who
227 reported sex work (more than three-fold higher compared to sexually active
228 participants who did not report sex work), followed by HIV incidence rate in sexually
229 inactive individuals.

230 In the final multivariate model (Table 2), the association of HIV incidence with sex
231 work is the second strongest with an adjusted incidence rate ratio of 2.19 [1.13-4.25].
232 The strongest association was observed for injection with a needle/syringe used by
233 someone else (AHR=2.84, [1.73-4.66]). Effect modification analyses showed that the
234 association between HIV incidence and sexual activity did not vary significantly
235 according to sex (p -value for effect modification=0.5729). Sex-stratified rate ratios
236 are presented in table 2.

237 Tables 3 and 4 show cross-sectional, sex-stratified analyses of injection and sex
238 behaviours according to sexual activity. Male SW (Table 3) were significantly
239 younger and more likely to be homeless and to report a history of incarceration in the
240 past 6 months compared to other groups. Male SW were also significantly more
241 likely to use heroin by injection, to report cocaine as the most often injected drug and
242 to use non-injected crack/freebase, amphetamines and ecstasy. Male SW were
243 significantly more likely to inject with strangers and to inject with needles/syringes
244 used by someone else obtained mainly from strangers compared to male NSW. A
245 large proportion of male SW had sex with at least 6 male sex partners in the past 6
246 months (41.2%) and reported at least one female sex partner (58.8%). Among male
247 SW who had multiple male sex partners, 72% reported heterosexual or bisexual
248 orientation (data not shown). The proportion of men who reported inconsistent
249 condom use for vaginal or anal sex is high (sex work=42.6%, no sex work=62.7%).
250 Sexually inactive men were significantly more likely to report daily injection and to
251 always inject alone compared to other groups. Male SW and sexually inactive men
252 were more likely to report injection with needles/syringes used by someone else
253 obtained mainly from strangers compared to male NSW. HCV prevalence (positivity
254 for HCV antibodies) was significantly higher in male SW compared to other groups
255 (intermediate in sexually inactive men).

256 Female SW (Table 4) were more likely to be homeless and to report a history of
257 incarceration in the past 6 months compared to other groups. They were also
258 significantly more likely to use injected cocaine, to report cocaine as their most often
259 injected drug and to use non-injected crack/freebase and ecstasy. Female SW were
260 more likely to report injection with strangers and injection with a needle/syringe used
261 by someone else obtained mainly from strangers. The majority of women were

262 sexually active. Among female NSW, 25.3% reported at least two male sex partners
263 in the past six months. Approximately half of female SW had sex with at least 21
264 male partners in the past six months (48.1%). A high proportion of women reported
265 inconsistent condom use for vaginal or anal sex (sex work=60.9%, no sex
266 work=84.1%). Sexually inactive women were significantly more likely to always inject
267 alone. HCV prevalence (positivity for HCV antibodies) was significantly higher in
268 female SW compared to the other groups.

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271 **DISCUSSION**

272 The objectives of the present study were 1) to characterize the association between
273 sex work (i.e reporting client sex partners) and HIV seroconversion among PWIDs in
274 the SurvUDI network between 2004 and 2014 and 2) to describe the characteristics
275 and risk profile of participants who reported sex work in the past 6 months. The
276 highest HIV incidence rate was observed in participants who reported sex work. In
277 the multivariate analysis, sex work and injection with a needle used by someone else
278 were significantly and independently associated with HIV incidence. Both male and
279 female PWIDs who reported sex work were more frequently in situation of
280 homelessness and reported more unsafe injecting as well as sexual behaviours.

281 In the present study, the association between HIV incidence and sexual activity did
282 not show significant effect modification by sex. Although the direction of the
283 association is the same for men and women, the association observed in men is not
284 significant and is weaker than in women. This is not surprising given the small
285 number of men reporting client sex partners. Thus, it is not clear whether the
286 absence of a significant modifying effect by sex, as well as the absence of a
287 significant association among men in the sex-specific analyses, are due to a lack of
288 power (inability to detect an existing effect modification that could show an
289 association among women only) or to the absence of modifying effect.

290 Recently, Kerr *et al.*¹⁵ also observed a significant association between sex work and
291 HIV incidence in Vancouver PWIDs (men and women combined), but it did not
292 remain significant in multivariate analysis. A methodological issue that may explain
293 differences with the present study is the definition of the reference category for the

294 sex work variable. Kerr *et al.* ¹⁵ defined sex work as a dichotomous variable where
295 «no sex work» presumably included sexually inactive individuals. As observed in the
296 present study, sexually inactive PWIDs may differ from other participants in their
297 characteristics as well as their drug use risk patterns. In the present study, compared
298 to sexually active male who did not report sex work, sexually inactive male were
299 significantly more likely to report daily injection and injection with needles/syringes
300 used by someone else obtained mainly from strangers. Sexually inactive participants
301 may have a more profound dependence associated to increased vulnerabilities,
302 which may include mental illness, poverty and social exclusion. This could have
303 confounded the association observed in the above-mentioned study. Several other
304 studies have examined the link between sex work or sexual risk profile and HIV
305 transmission in PWIDs of developed countries ^{16,17,24-29}. Most of these studies
306 reported very similar findings i.e associations with homelessness, incarceration,
307 cocaine injection and crack use.

308 Unprotected sex with multiple partners, including unprotected anal sex ³⁰, are
309 common among the participants of our study. It is difficult to estimate the relative
310 contribution of unsafe injection and sexual behaviours to the transmission of HIV.
311 Vickerman *et al.* ² have recently proposed a deterministic mathematical model to
312 estimate the proportion of HIV infections due to sexual transmission in PWIDs
313 populations. In this model, the HCV prevalence in HIV-infected PWIDs and the
314 HIV/HCV prevalence ratio are used as markers of sexual transmission.

315 Several authors have suggested that in PWIDs, sexual risks are present but may be
316 masked by parenteral risks ³. This may be an explanation why sex work was not
317 significantly associated with HIV incidence in PWIDs of the SurvUDI network for the

318 period 1995-2002 while a positive association emerged afterward ¹³. Similar findings
319 were obtained in at least another recent study performed in MSM-PWIDs in San
320 Francisco ¹⁷. In that study, it was suggested that an independent association with
321 sex work had emerged as a result of an “unmasking” effect, with the prevalence of
322 needle-sharing declining. This may also be a plausible hypothesis in the present
323 situation as needle/syringe-sharing in the SurvUDI network significantly decreased
324 from 1995 to 2014 (data not shown), with large-scale implementation of harm
325 reduction programs on the whole territory during that period.

326 In some studies, authors suggested that the association frequently observed
327 between HIV transmission and crack use may be explained by higher-risk sexual
328 behaviours in crack users ^{28,31}. This is consistent with the present data where
329 participants of both sexes who reported sex work were also significantly more likely
330 to use non injected crack. Interestingly, men who reported sex work were
331 significantly more likely to report non injected use of amphetamines (similar
332 observation in women, but not significant) and women who reported sex work were
333 more likely to use ecstasy. Regardless of whether they reported sex work or not,
334 sexually active men also reported frequent use of ecstasy. Men who reported sex
335 work were slightly more likely to report methamphetamine use, but this was not
336 significant. The complex relationships between drug use and sexual behaviours have
337 been discussed previously ³². Amphetamine-like drugs, including ecstasy, are known
338 to be typically used during sexual activities and to be associated with unsafe sexual
339 activities ³².

340 The present study may provide several indications to target local public health
341 interventions. First, most participants who reported sex work are women, more likely

342 homeless and reporting frequent unsafe injecting as well as sexual behaviours.
343 Several authors ^{9,33} have suggested that public health interventions should be
344 developed to reduce vulnerabilities among female PWIDs who engage in sex work.
345 A multilevel, combined approach has been proposed ⁹, which includes individual and
346 social harm reduction initiatives, biomedical, as well as structural interventions i.e
347 addressing homelessness, mental health and poverty issues as well as supporting
348 legal reform for sex workers to reduce the risk of bloodborne infections, violence and
349 homicide death ²⁹. Some authors also reported that HIV prevention programs may be
350 inadequate for MSM/PWIDs ^{26,27}. In the present study, men who reported client sex
351 partners had multiple male sex partners, but most of them said that their sexual
352 orientation was heterosexual or bisexual. Consequently, these men are very unlikely
353 to be reached by interventions targeting MSM whereas interventions targeting
354 PWIDs may not be adapted to their high risk sexual exposure ^{26,27}. Despite the fact
355 that PWIDs/MSM/sex workers represent a very small population, targeting
356 interventions to this population should be a priority considering their potential for a
357 high level of effectiveness and the possibility of bridging HIV and HCV epidemics
358 between PWIDs and MSM, as well as between male PWIDs reporting sex work and
359 their female sex partners ^{34,35}.

360 The data obtained through the SurvUDI network have some limitations. First,
361 participants are not representative of all PWIDs. They are probably more
362 representative of those who frequent harm reduction programs, where approximately
363 90% of participants were recruited. Moreover, participants who returned differ slightly
364 from those with a single visit ¹³. Participants who returned may have more at risk
365 behaviours, and this could have overestimated the association with sex work.
366 Second, self reporting of behaviours may involve social desirability and recall biases

367 that may lead to over-reporting of protective behaviours, like condom use, and
368 underreporting of high risk behaviours, like syringe-sharing, possibly reducing the
369 strength of the observed associations with HIV incidence.

370 In conclusion, further studies are needed to understand whether the independent
371 association between HIV incidence and sex work is related to sexual transmission or
372 other vulnerability factors, which may include mental illness, poverty and social
373 exclusion, but increased risk due to sexual transmission cannot be excluded.

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FIGURE HEADINGS

Figure 1: Cumulative hazard of HIV seroconversion and HIV incidence according to baseline sexual activity, 2004-2014. Incidence rate calculation based on the sexual activity status reported at the second visit (baseline), i.e. exposure during the first time interval in the Cox proportional hazard model; Sexual activity is missing for 5 participants; Sexually active who did not report sex work; py: person-years.

Table 1: Baseline¹ characteristics and behaviours of participants, 2004-2014

Characteristics and behaviours n (%)	Men (n=1 147)	Women (n=378)	Total (n=1 528) ²
Number of visits, median (min-max)	3 (2-18)	3 (2-14)	3 (2-18)
Age, mean \pm SD	37.8 \pm 10.1	32.9 \pm 9.5	36.6 \pm 10.1
Age (< 25 years)	113 (9.9)	88 (23.3)	201 (13.2)
High school completed	563 (49.4)	203 (54.0)	769 (50.7)
Urban recruitment region	1 027 (89.5)	322 (85.2)	1 352 (88.5)
Homelessness	506 (44.2)	134 (35.6)	640 (42.0)
History of incarceration	168 (14.7)	31 (8.2)	200 (13.1)
Cocaine as the most often injected drug	608 (53.3)	173 (46.0)	783 (51.6)
Injection with a needle/syringe used by someone else	234 (20.6)	110 (29.4)	344 (22.8)
Daily injection ³	405 (35.4)	145 (38.5)	550 (36.1)
Injection with strangers	402 (35.1)	134 (35.6)	536 (35.2)
Time since first injection (\geq 6 years)	873 (76.2)	249 (66.4)	1 125 (73.9)
Sexual activity			
No sex work ⁴	709 (61.9)	181 (48.3)	891 (58.5)
Sex work	76 (6.6)	151 (40.3)	229 (15.0)
Sexually inactive	360 (31.4)	43 (11.5)	403 (26.5)

¹ Baseline characteristics based on information reported at the second visit, i.e. exposure during the first time interval in the Cox proportional hazard model.

² Sex is missing for 3 participants

³ In the last month

⁴ Sexually active who did not report sex work

Table 2: Multivariate analysis¹ of the associations between HIV incidence and sexual activity, 2004-2014

	Crude HR	95% CI²	AHR	95% CI²
Model without effect modification				
<i>Socio-demographic variables</i>				
Sex (men vs women)	0.61	[0.37-1.02]	0.83	[0.45-1.51]
<i>Injection behaviours</i>				
Injection with a needle/syringe used by someone else	3.04	[1.87-4.93]	2.84	[1.73-4.66]
<i>Sexual activity</i>				
No sex work ³	1.00		1.00	
Sex work	2.81	[1.55-5.10]	2.19	[1.13-4.25]
Sexually inactive	1.48	[0.84-2.60]	1.62	[0.92-2.88]
Model with effect modification by sex⁴				
<i>Injection behaviours</i>				
Injection with a needle/syringe used by someone else	3.04	[1.87-4.93]	2.91	[1.77-4.77]
<i>Sexual activity</i>				
No sex work	1.00		1.00	
Sex work, women	3.50	[1.26-9.72]	3.31	[1.19-9.21]
Sexually inactive, women	2.40	[0.57-10.04]	2.86	[0.67-12.01]
Sex work, men	1.87	[0.64-5.41]	1.64	[0.56-4.77]
Sexually inactive, men	1.37	[0.74-2.53]	1.47	[0.80-2.73]

¹ Cox proportional hazard regression model; analysis performed using n=1 362 participants, excluding those with missing values for any of the independent variables

² 95 % confidence intervals

³ Sexually active who did not report sex work

⁴ p-value=0.5729 for effect modification, Wald chi-square test

HR: hazard ratio; AHR: adjusted hazard ratio

Table 3: Characteristics and, injection and sex behaviours according to reported sexual activity in men¹, 2004-2014

Characteristics and behaviours n (%)	No sex work ² (n=656)	Sex work (n=51)	Sexually inactive (n=438)	p-value
Age, mean ± SD	38.3 ± 10.1	35.6 ± 10.0	42.4 ± 9.7	<0.0001
Age (<25 years)	56 (8.5)	6 (11.8)	16 (3.7)	0.0030
Urban recruitment region	582 (88.7)	47 (92.2)	397 (90.6)	0.4936
Homelessness	263 (40.2)	30 (60.0)	175 (40.1)	0.0200
History of incarceration	87 (13.3)	14 (28.0)	59 (13.5)	0.0142
Drugs used by injection				
Cocaine	518 (79.1)	44 (86.3)	328 (75.1)	0.0975
Heroin	206 (31.5)	19 (37.3)	110 (25.2)	0.0366
Dilaudid® (prescribed or not)	296 (45.2)	27 (52.9)	207 (47.6)	0.4707
Cocaine as the most often injected drug	325 (49.9)	34 (68.0)	224 (52.0)	0.0450
Non-injected drugs				
Crack/freebase	420 (64.0)	43 (84.3)	255 (58.2)	0.0007
Amphetamines	241 (36.7)	28 (54.9)	102 (23.3)	<0.0001
Methamphetamine	41 (6.3)	5 (9.8)	18 (4.1)	0.1302
Ecstasy	127 (19.4)	11 (21.6)	29 (6.6)	<0.0001
Dilaudid® (prescribed or not)	163 (24.9)	12 (23.5)	74 (17.0)	0.0083
Daily injection ³	190 (29.1)	17 (34.7)	184 (42.2)	<0.0001
Time since first injection (≥ 6 years)	542 (82.9)	44 (86.3)	371 (84.9)	0.5975
Injection with strangers	178 (27.3)	24 (47.1)	110 (25.2)	0.0042
Always injected alone	188 (28.8)	13 (25.2)	185 (42.4)	<0.0001
Injection in public places	368 (56.2)	35 (68.6)	248 (56.6)	0.2219
Injection with a needle/syringe used by someone else	119 (18.3)	12 (23.5)	62 (14.3)	0.0960
Injection with needles/syringes used by someone else obtained mainly from strangers	20 (3.1)	3 (6.0)	28 (6.5)	0.0291
Number of female sex partners				
0	32 (4.9)	21 (41.2)	438 (100)	-
1	363 (55.3)	8 (15.7)	0	
2-5	224 (34.2)	15 (29.4)	0	
6-20	33 (5.0)	5 (9.8)	0	
≥21	4 (0.6)	2 (3.9)	0	
Number of male sex partners				
0	607 (92.5)	11 (21.6)	438 (100)	-
1	30 (4.6)	8 (15.7)	0	
2-5	14 (2.1)	11 (21.6)	0	
6-20	4 (0.6)	7 (13.7)	0	
≥21	1 (0.2)	14 (27.5)	0	
Condom use				
Consistent use for vaginal or anal sex	207 (32.2)	8 (17.0)	-	-
Inconsistent use for vaginal or anal sex	403 (62.7)	20 (42.6)	-	
Oral sex only	33 (5.1)	19 (40.4)	-	
Positivity for HCV antibodies	460 (70.1)	45 (88.2)	340 (77.6)	0.0012

¹ Analyses performed using the last visit for non-seroconverters and the visit when HIV infection was first detected for seroconverters

² Sexually active who did not report sex work

³ In the last month

NS : non-significant

Table 4: Characteristics and, injection and sex behaviours according to reported sexual activity in women¹, 2004-2014

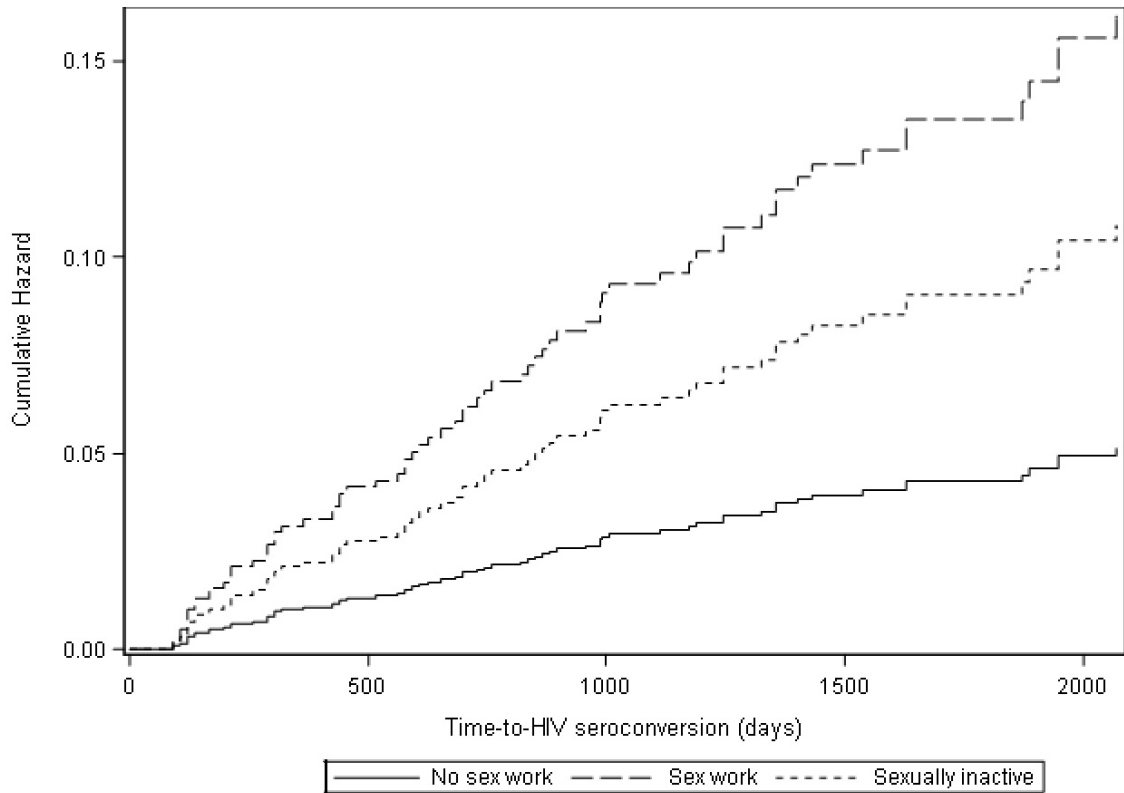
Characteristics and behaviours n (%)	No sex work ² (n=198)	Sex work (n=129)	Sexually inactive (n=46)	p-value
Age, mean \pm SD	33.5 \pm 10.0	34.4 \pm 8.6	40.5 \pm 10.7	<0.0001
Age (< 25 years)	46 (23.2)	15 (11.6)	3 (6.5)	0.0031
Urban recruitment region	168 (84.9)	106 (82.2)	44 (95.7)	0.0838
Homelessness	59 (30.0)	53 (41.4)	11 (23.9)	0.0365
History of incarceration	11 (5.6)	18 (14.1)	1 (2.2)	0.0068
Drugs used by injection				
Cocaine	132 (66.7)	112 (87.5)	25 (54.4)	<0.0001
Heroin	75 (37.9)	49 (38.3)	10 (21.7)	0.0977
Dilaudid® (prescribed or not)	98 (49.8)	66 (51.6)	21 (46.7)	0.8479
Cocaine as the most often injected drug	80 (40.8)	71 (55.5)	15 (33.3)	0.0085
Non-injected drugs				
Crack/freebase	113 (57.1)	92 (71.3)	23 (50.0)	0.0091
Amphetamines	64 (32.3)	51 (39.5)	14 (30.4)	0.3337
Methamphetamine	8 (4.0)	3 (2.3)	3 (6.5)	0.4171
Ecstasy	29 (14.7)	29 (22.5)	4 (8.7)	0.0540
Dilaudid® (prescribed or not)	31 (15.7)	30 (23.6)	6 (13.3)	0.1289
Daily injection ³	76 (38.8)	55 (42.6)	15 (32.6)	0.4756
Time since first injection (\geq 6 years)	144 (72.7)	109 (84.5)	39 (84.8)	0.0216
Injection with strangers	51 (25.9)	49 (38.6)	3 (6.5)	0.0001
Always injected alone	38 (19.3)	23 (18.1)	18 (39.1)	0.0069
Injection in public places	98 (49.5)	74 (57.8)	18 (39.1)	0.0762
Injection with a needle/syringe used by someone else	57 (28.9)	44 (34.9)	3 (6.5)	0.0011
Injection with needles/syringes used by someone else obtained mainly from strangers	6 (3.1)	11 (8.8)	0 (0.0)	0.0166
Number of female sex partners				
0	169 (85.4)	105 (82.0)	46 (100)	-
1	20 (10.1)	11 (8.6)	-	
2-5	9 (4.6)	8 (6.3)	-	
6-20	0 (0.0)	4 (3.1)	-	
\geq 21	0 (0.0)	0 (0.0)	-	
Number of male sex partners				
0	11 (5.6)	0 (0.0)	46 (100)	-
1	136 (69.0)	4 (3.1)	-	
2-5	44 (22.3)	29 (22.5)	-	
6-20	5 (2.5)	34 (26.4)	-	
\geq 21	1 (0.5)	62 (48.1)	-	
Condom use				
Consistent use for vaginal or anal sex	26 (13.3)	42 (32.8)	-	
Inconsistent use for vaginal or anal sex	164 (84.1)	78 (60.9)	-	
Oral sex only	5 (2.6)	8 (6.3)	-	
Positivity for HCV antibodies	139 (70.2)	107 (83.0)	32 (69.6)	0.0252

¹ Analyses performed using the last visit for non-seroconverters and the visit when HIV infection was first detected for seroconverters

² Sexually active who did not report sex work;

³ In the last month

NS : non-significant



	Number of participants	Seroconversions	Follow-up (py)	HIV incidence rate per 100 py [95 % confidence intervals]
Total	1 528	72	5 239.2	1.4 [1.1-1.7]
Sexual activity				
No sex work	891	25	2 965.1	0.8 [0.5-1.2]
Sex work	229	23	902.5	2.5 [1.5-3.6]
Sexually inactive	403	24	1 349.3	1.8 [1.1-2.5]