



# HIV and hepatitis C virus infections in Quebec's provincial detention centres: comparing prevalence and related risky behaviours between 2003 and 2014–2015

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## Abstract

**Objectives** To compare the prevalence of HIV, hepatitis C virus (HCV) infections, and related risky behaviours among inmates in Quebec's provincial prisons between 2003 and 2014–2015.

**Methods** Cross-sectional data were anonymously collected from May 2014 to March 2015 for men ( $n = 1315$ ) and women ( $n = 250$ ) and combined with data collected in 2003 to evaluate trends in the last decade. Participants completed a questionnaire and provided saliva samples. The data from the 2003 and 2014–2015 surveys were merged for statistical analysis.

**Results** HIV prevalence was stable between 2003 and 2014–2015 for men (2.4% vs. 1.8%,  $p = 0.4$ ), whereas it decreased for women (8.8% vs. 0.8%,  $p < 0.001$ ). HCV prevalence decreased between 2003 and 2014–2015 for both men (16.6% vs. 11.9%,  $p < 0.001$ ) and women (29.2% vs. 19.2%,  $p = 0.02$ ). HIV and HCV prevalence were higher among people who inject drugs (PWID), for both sexes and both studies. PWID-specific prevalence did not change between 2003 and 2014–2015, except for a decrease in HIV prevalence in PWID women. However, the proportion of prisoners reporting a history of injection drug use outside prison was lower in 2014–2015 than in 2003 for men (19.8% vs. 27.7%,  $p < 0.0001$ ) and women (28.6% vs. 42.6%,  $p = 0.002$ ).

**Conclusion** The lower proportion of PWID inmates in 2014–2015 compared to 2003 explained in large part the decrease in HIV and HCV prevalence. Despite the decrease in prevalence, HIV and HCV infections among incarcerated individuals still represent a major public health problem due to the sizable increase of individuals in Quebec's correctional system over the same period.

## Résumé

**Objectif** Comparer la prévalence des infections au VIH, l'hépatite C (VHC) et les comportements à risque chez les individus incarcérés dans les prisons provinciales du Québec en 2003 et 2014–2015.

**Méthodes** Les données transversales ont été collectées entre mai 2014 et mars 2015 chez les hommes ( $n = 1315$ ) et les femmes ( $n = 250$ ). Un questionnaire a été administré et un échantillon de salive recueilli. Les données recueillies ont ensuite été combinées aux données de 2003 pour les analyses statistiques.

**Résultats** La prévalence du VIH a été stable entre 2003 et 2014–15 pour les hommes (2,4% c. 1,8%,  $p = 0,4$ ), mais a diminué pour les femmes (8,8% c. 0,8%,  $p < 0,001$ ). La prévalence du VHC a diminué entre 2003 et 2014–2015 chez les hommes (16,6% c. 11,9%,  $p < 0,001$ ) et les femmes (29,2% c. 19,2%,  $p = 0,02$ ). Les prévalences du VIH et VHC étaient plus élevées chez les utilisateurs de drogues par injection (UDI) pour les deux sexes et les deux études. Les prévalences chez les UDI n'ont pas changé entre 2003 et 2014–2015, sauf pour le VIH chez les femmes UDI. La proportion de prisonniers UDI à l'extérieur de prison était moindre en 2014–2015 qu'en 2003 pour les hommes (19,8% c. 27,7%,  $p < 0,0001$ ) et les femmes (28,6% c. 42,6%,  $p = 0,002$ ).

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**Conclusion** La diminution de la proportion de prisonniers UDI en 2014–2015 se traduit par une diminution des prévalences globales du VIH et VHC. Malgré ces diminutions, les infections au VIH et au VHC demeurent un problème de santé publique en milieu carcéral.

**Keywords** Quebec · Hepatitis C · HIV · Prisons

**Mots-clés** Québec · Hépatite C · VIH · Prisons

## Introduction

For over two decades, studies have shown that incarcerated individuals are at risk of HIV and hepatitis C virus (HCV) infections. Previous studies from high-income countries found HIV prevalence in prison between 0% and 16.1% for men and between 1% and 25% for women (Begier et al., 2010; De et al., 2004; Dufour et al., 1996; Christensen et al., 2000; Calzavara et al., 2007; Ford et al., 2000; Hankins et al., 1994). A meta-analysis estimated the HCV antibody prevalence to range from 24% to 34% in North America (Larney et al., 2013). Between 1994 and 2007, HIV prevalence was estimated to range from 1.9% to 2.4% for men and 1.0% to 8.8% for women in Canadian provincial and federal detention centres (De et al., 2004; Dufour et al., 1996; Calzavara et al., 2007; Ford et al., 2000; Hankins et al., 1994; Poulin et al., 2007; Rothon et al., 1994; Hankins et al., 1991). For HCV, estimates ranged from 15.9% to 33.0% for men and 29.2% to 34.0% for women (Calzavara et al., 2007; Poulin et al., 2007). The most recent study conducted in Quebec found a higher prevalence of HIV infections among provincial inmates (3.4%) than in the general population (0.2%) (Poulin et al., 2007; Yang et al., 2010). The last study, conducted in 2003, also found a higher prevalence of HCV among inmates (18.5%) in Quebec's prisons than in the general population (0.8%) (Poulin et al., 2007; Zou et al., 2000). Many incarcerated individuals have a history of high-risk behaviours, such as injection drug use (particularly needle sharing), tattooing, and sex work. Despite the high level of security inherent in any prison system, many inmates continue to engage in high-risk activities while incarcerated. Given the prohibition policy, inmates are forced to use artisanal and/or shared paraphernalia for injecting drugs or tattooing in prison, which might increase the risk of transmission of blood-borne viruses.

To date, we found no publication on the evolution of the HIV and HCV epidemics in the Canadian prison system. Furthermore, the number of inmates in Quebec's prison system has increased by a third of prisoners, and the length of detention has doubled in the last decade (Giroux, 2011; MSPQ, 2016; MSPQ, 2003). With the new prevention and treatment options being developed, up-to-date knowledge of the HIV/HCV epidemic in prison is essential to respond to the needs of this at-risk, marginalized population (Liu et al., 2014; Carter et al., 2016; Kamarulzaman et al., 2016).

Our main objectives were to determine the prevalence of HIV and HCV infections and related risk factors among individuals incarcerated in Quebec's provincial prison system in 2014–2015 and to compare these results with those of a previous epidemiological study conducted in this population in 2003 (Poulin et al., 2007).

## Methods

### Site selection

In order to maximize comparability, the same detention centres were selected for both surveys. Seven out of the 17 provincial detention centres in Quebec were selected: five men's facilities and two women's facilities. The sites allow for urban (two men and two women's facilities), semi-rural (three men's facilities), and Indigenous populations to be represented in the sample. More than half of the men in Quebec's (57%) network were incarcerated in one of the prisons included in this study, whereas all women in the network were included. In accordance with the Canadian Criminal Code, two types of individuals may be incarcerated in provincial facilities: those awaiting trial and those sentenced for less than 2 years.

### Study population

In both surveys, all inmates present during the data collection period and incarcerated at the facility for more than 24 h were eligible to participate in the study. Posing a security risk to the research team, as determined by the correctional officer, was the only exclusion criterion. Detention centres were visited one at a time, sector by sector, to invite prisoners to participate. The sample size in each centre was similar to that of the 2003 study. It also had to represent at least 50% of the number of individuals incarcerated in that centre for centres with less than 1000 individuals or a third of prisoners in centres with more than 1000 individuals. To achieve a sufficiently large sample for female inmates, women's facilities were visited on three occasions (at least 3 months apart) by the survey team, with the recruitment of all women present at the first visit and all of those not previously recruited at the two

subsequent visits. Information on previous incarcerations and prison transfers during the data collection period was collected to ensure that no inmate participated more than once in the study. The data collection occurred between January and June 2003 in the first survey and between May 2014 and March 2015 in the second survey.

### Data collection

Interviewers, accompanied by a correctional officer, conducted the data collection in each prison included in the study. The correctional officer's duties were to transport prisoners and to ensure the safety of interviewers and participants. No prison personnel were present during the interview. Whether they decided to participate or not, all prisoners who met with an interviewer received a \$10 deposit in their personal account. The interviewer explained the study's objectives and what participation entailed before offering participation in the study and asking for verbal consent.

In 2014–2015, an extended and modified version of the 2003 questionnaire was used to collect information on risky behaviours, health history, and socio-demographic data, but the vast majority of questions were the same in both surveys. French and English versions of the questionnaire were available at all times. The questionnaires were designed to be self-administered, but interviewers were present for clarifications and/or to help with filling them out.

Saliva samples were collected with the Orasure device (Epitope, Beaverton, OR, USA). After collection, the saliva samples were kept at 4 °C until shipped to the laboratory.

Stickers with hidden code numbers were applied on the questionnaire and both saliva samples to anonymously link the test results to the questionnaires.

### Laboratory procedures

HIV antibodies were detected using the GS HIV-1/HIV-2 PLUS O system (Bio-Rad Laboratories, Canada) in 2014–2015 and the Vironostika HIV-I Microelisa System (BioMérieux, Durham, NC, Canada) in 2003. The samples with a weak positive or borderline negative preliminary result were retested in duplicate and declared positive if at least two tests had positive results. A single confirmation test was performed on strong positive samples. Strong negative samples were not retested. The Ortho HCV 3.0 ELISA (Ortho-Clinical Diagnostics, Mississauga, ON, Canada) system was used to detect HCV antibodies in both studies. Therefore, the HCV prevalence reported for both studies represents a combination of active (currently infected by the HCV virus) and cleared/cured (no current infection, but antibodies present because of previous exposure to the HCV virus) infections as we only tested for antibodies. Weak positive and weak negative preliminary test results were followed by a duplicate retest (one

positive result was needed to declare positivity). Strong negative and strong positive preliminary test results were not retested. Similar testing procedures were used in the 2003 study (Poulin et al., 2007). All laboratory work was completed at the *Laboratoire de santé publique du Québec*.

### Statistical analysis

The prevalence of HIV and HCV infections and 95% confidence intervals (CI) were calculated separately by year, sex, and injection drug use. Socio-demographic characteristics observed in each survey were compared using  $\chi^2$  and Fisher's exact tests. Continuous variables were compared using Student's *t* test. Univariate prevalence ratios and their 95% CI were used to compare the frequency of risky behaviours between the two surveys. The changes in HIV and HCV prevalence between 2003 and 2014–2015 were assessed using PR, and their 95% CI obtained from modified Poisson multivariate regression models to control for confounding variables (Zou, 2004; Fang, 2011). Confounding variables were kept in the final model if they changed the PR by 10% or more. All the analyses were carried out using SAS 9.4 software (SAS Institute Inc., NC, USA).

### Ethical considerations

All participants were met in a private environment, and their identity was never asked nor recorded by the research team. To ensure anonymity, verbal rather than written consent was chosen because participants did not have to identify themselves. All inmates who met with an interviewer were given information on counseling and testing services both in prison and in the community. The ethics committee of the *CHU de Québec – Université Laval* approved the 2014–2015 study. The 2003 study was approved by the ethics committee of the *Centre hospitalier affilié universitaire de Québec*.

## Results

### Study participants

A total of 1321 men and 258 women participated in the 2014–2015 study, whereas 1362 and 251 did in 2003, respectively. Given the selection method, it was not possible to estimate the participation rate. However, for both the 2003 and the 2014–2015 studies, only a few prisoners (less than 20) refused to participate once they met with the interviewer. The average age in the 2014–2015 group was 36.8 years, with no difference between sexes ( $p = 0.3$ ). There were more than twice as many participants aged 50 and over in the 2014–2015 group compared to the 2003 group (Table 1). Three quarters of the participants in both groups were French Canadian. There were

**Table 1** Comparison of socio-demographic characteristics of inmates of Quebec's provincial prisons between 2003 and 2014–2015, by sex

| Characteristics                                     | Men                        |                               |                 | Women                     |                              |                 |
|---|----------------------------|-------------------------------|-----------------|---------------------------|------------------------------|-----------------|
|   | 2003<br>( <i>n</i> = 1362) | 2014–15<br>( <i>n</i> = 1315) | <i>p</i> value* | 2003<br>( <i>n</i> = 251) | 2014–15<br>( <i>n</i> = 250) | <i>p</i> value* |
| Median age, years<br>(IQ range <sup>†</sup> )       | 33.0<br>24–40              | 35.0<br>26–46                 | 0.0004          | 36.0<br>29–42             | 37.0<br>29–47                | 0.4             |
| Age, years, %                                       |                            |                               |                 |                           |                              |                 |
| Less than 20  | 6.0                        | 3.3                           | < 0.0001        | 1.6                       | 1.6                          | < 0.0001        |
| 20–29   | 34.2                       | 31.2                          |                 | 25.1                      | 25.4                         |                 |
| 30–39   | 32.2                       | 26.6                          |                 | 37.9                      | 28.2                         |                 |
| 40–49   | 22.2                       | 22.0                          |                 | 30.7                      | 26.2                         |                 |
| 50 and older  | 6.3                        | 17.0                          |                 | 4.8                       | 18.7                         |                 |
| Cultural community, %                               |                            |                               |                 |                           |                              |                 |
| French Canadian                                     | 78.8                       | 76.5                          | 0.1             | 77.2                      | 74.8                         | 0.002           |
| English Canadian                                    | 4.9                        | 4.0                           |                 | 13.2                      | 6.0                          |                 |
| Indigenous  | 4.1                        | 5.9                           |                 | 4.8                       | 9.2                          |                 |
| Others  | 12.2                       | 13.6                          |                 | 4.8                       | 10.0                         |                 |
| Education, %  |                            |                               |                 |                           |                              |                 |
| High school not completed                           | 63.2                       | 55.4                          | < 0.0001        | 63.4                      | 49.8                         | 0.009           |
| High school completed                               | 21.6                       | 27.9                          |                 | 17.9                      | 24.3                         |                 |
| Post-secondary completed                            | 15.2                       | 16.7                          |                 | 18.7                      | 25.9                         |                 |
| Drug-related crime, %                               | 40.3                       | 44.6                          | 0.0001          | 35.6                      | 37.7                         | 0.9             |
| Pre-trial detention, %                              | 34.3                       | 34.6                          | 0.9             | 32.3                      | 24.2                         | 0.04            |
| Number of incarcerations (avg.)                     | 6.4                        | 7.0                           | 0.08            | 7.6                       | 4.1                          | < 0.0001        |
| Time spent in detention, months (avg.) <sup>‡</sup> | 40.5                       | 60.3                          | < 0.0001        | 26.0                      | 19.4                         | 0.09            |
| Length of sentence, days (avg.)                     | 332.1                      | 397.7                         | < 0.0001        | 289.5                     | 309.8                        | 0.6             |

\* *p* value for the comparison between the 2003 and 2014–2015 studies

<sup>†</sup> Interquartile range

<sup>‡</sup> Over lifetime

almost twice as many Indigenous and cultural minority women in 2014–2015 than in 2003. More than half the participants (54.5%) did not finish high school in both groups, but in general, the education level was higher for both men ( $p = 0.009$ ) and women ( $p < 0.0001$ ) in 2014–2015 compared to 2003 (Table 1).

A greater proportion of men than women were incarcerated for drug-related crimes in both studies—and these proportions increased from 2003 to 2014–2015. The differences in terms of incarceration history between the two studies were opposite for men and women. In 2014–2015, men reported more total time spent in detention and longer sentences than in 2003, but women reported fewer incarcerations and similar total time and length of sentence in 2014–2015 (Table 1).

### Risky behaviours

As shown in Table 2, a large proportion of participants reported risky behaviours outside prison. In 2014–2015, a greater proportion of women than men reported a history of injection drug use, for both their lifetime (PR = 1.45 (1.15–1.81),  $p =$

0.002) and the previous 6 months (PR = 2.21 (1.49–3.29),  $p = 0.0003$ ). Sharing injection paraphernalia habits was similar between both sexes. The drugs most frequently injected prior to incarceration were cocaine (75.2% of the participants) and prescription opioids (60.0% of the participants). Non-injection drug use (cocaine/heroin snorting and smoking crack) was much more frequent than injection drug use, with no differences between men and women. Women reported tattooing outside prison more frequently than men (PR = 1.27 (1.15–1.40),  $p < 0.0001$ ), but the use of unsafe equipment and total number of tattoos (average 4.9) were similar for both sexes. More women than men engaged in risky sexual behaviours, such as intercourse with people who inject drugs (PWID) ( $p = 0.03$ ) or sex work ( $p < 0.001$ ) (Table 2). A majority of participants reported inconsistent condom use, particularly for vaginal intercourse (over 89% inconsistent for both sexes), intercourse with PWID (68.7% inconsistent use for men and 74.6% for women), and men who have sex with men (MSM, 77.8% inconsistent condom use).

When compared to 2003, most risky behaviours were less frequent in 2014–2015 (Table 2). Injection drug use was lower

**Table 2** Comparisons of risky behaviours outside prison among inmates of Quebec's provincial prisons between 2003 and 2014–2015, by sex

| Behaviours                                | Men, %                     |                                 |                  | Women, %                  |                                |                  |
|---|----------------------------|---------------------------------|------------------|---------------------------|--------------------------------|------------------|
|   | 2003<br>( <i>n</i> = 1362) | 2014–2015<br>( <i>n</i> = 1315) | PR (95% CI)*     | 2003<br>( <i>n</i> = 251) | 2014–2015<br>( <i>n</i> = 250) | PR (95% CI)*     |
| <b>Outside prison</b>                     |                            |                                 |                  |                           |                                |                  |
| Injection drug use, ever                  | 27.7                       | 19.8                            | 0.73 (0.63–0.84) | 42.6                      | 28.6                           | 0.67 (0.52–0.86) |
| Sharing syringes/needles <sup>†</sup>     | 55.2                       | 46.1                            | 0.83 (0.71–0.98) | 60.7                      | 41.4                           | 0.68 (0.50–0.94) |
| Injection drug use, last 6 months         | NA <sup>‡</sup>            | 5.8                             | NA               | NA                        | 12.6                           | NA               |
| Sharing syringes/needles <sup>†</sup>     | NA                         | 21.6                            | NA               | NA                        | 32.3                           | NA               |
| Non-injection drug use, ever <sup>§</sup> | 78.6                       | 80.5                            | 1.02 (0.99–1.06) | 80.5                      | 78.5                           | 0.99 (0.89–1.07) |
| Sharing paraphernalia <sup>†</sup>        | 71.2                       | 72.2                            | 1.02 (0.97–1.08) | 71.6                      | 76.6                           | 1.07 (0.96–1.21) |
| Tattooing                                 | 48.2                       | 54.3                            | 1.13 (1.05–1.21) | 60.2                      | 69.1                           | 1.15 (1.01–1.31) |
| Non-sterile equipment <sup>†</sup>        | 23.7                       | 6.2                             | 0.25 (0.17–0.37) | 37.1                      | 7.1                            | 0.19 (0.10–0.35) |
| MSM                                       | 6.1                        | 7.0                             | 1.15 (0.86–1.53) | — <sup>  </sup>           | —                              | —                |
| Sex with IDU                              | 25.9                       | 21.2                            | 0.82 (0.71–0.94) | 44.6                      | 27.7                           | 0.62 (0.49–0.79) |
| Received money/drug for oral sex          | 7.8                        | 2.2                             | 0.28 (0.19–0.42) | 46.6                      | 29.4                           | 0.63 (0.50–0.80) |
| Received money/drug for vaginal/anal sex  | 6.0                        | 10.6                            | 1.76 (1.36–2.29) | 69.5                      | 28.9                           | 0.42 (0.33–0.52) |

\* Prevalence ratio and 95% confidence interval comparing 2014–2015 to 2003

<sup>†</sup> Among those reporting the previous behaviour only

<sup>‡</sup> Not asked

<sup>§</sup> Non-injection drug use: nasal snorting of cocaine/heroin and/or smoking crack

<sup>||</sup> Not applicable

in 2014–2015, but non-injection drug use remained the same as in 2003. Tattooing was the only behaviour more frequent in 2014–2015 than in 2003, but practiced much more safely in recent years. The only sexual behaviour that was more frequent in 2014–2015 was sex work with vaginal/anal penetration for men (Table 2), thus including heterosexual (reported by 9.7% of the men), homosexual sex work (reported by 0.6% of the men), and both (reported by 0.3% of the men).

Self-reported risky behaviours in prison are presented in Table 3. In 2014–2015, injection drug use was similar for both sexes, but only a few participants reported injection drug use during the current incarceration (Table 3). Men reported significantly more lifetime use of non-injection drugs inside prison than women (24.0 vs. 13.8%,  $p = 0.003$ ). Similar to what was observed outside prison, non-injection drug use was much more prevalent than injection drug use in prison (Table 3). More men than women were tattooed in prison, but men generally had safer practices. Those with a prison tattoo had a lifetime average of 5.8 tattoos done in prison, whereas it was 2.6 for the current incarceration (no difference between sexes). PWID had a higher lifetime average of prison tattoos than non-PWID (7.7 vs. 5.3,  $p = 0.01$ ), but a lower average for the current incarceration (1.7 vs. 2.3%,  $p = 0.002$ ). Women reported sharing the tattooing paraphernalia more often than men. Only a small proportion of participants reported sexual intercourse while incarcerated. However, almost none of these encounters included protection by

condom. In prison, all risky behaviours were equally or less frequently reported in 2014–2015 than in 2003. For men, most risky behaviours in prison remain as common as in 2003, but in a significantly safer way (Table 3). Oral sex while incarcerated was less frequent in 2014–2015 than in 2003 and was the only significant behaviour difference for women (Table 3).

### HIV and HCV prevalence

In univariate analyses, HIV prevalence was lower in 2014–2015 than in 2003, but the difference was only significant for women due to a sharp decrease among PWID women (men, PR = 0.79 (0.47–1.33); women, PR = 0.09 (0.02–0.39)). HCV prevalence was lower in 2014–2015 than in 2003 for both men and women, and it was almost two times higher among women compared to men in both surveys. In both studies, most HIV- and HCV-infected participants reported a history of injection drug use. In the multivariate analyses comparing HIV and HCV prevalence in 2014–2015 and the corresponding figures in 2003, all 95% CI of the prevalence ratios included the value 1 (Table 4). In a global regression analysis (including both men and women), neither the HIV (PR = 0.59 (0.30–1.15)) nor the HCV (PR = 0.96 (0.80–1.14)) prevalence was different between the surveys when controlling for the same confounding variables than in Table 4 plus sex. In 2014–2015, almost one third (30.8%) of HIV-positive participants were unaware of their status (reported no previous test/



**Table 3** Comparisons of risky behaviours inside prison among inmates of Quebec's provincial prisons between 2003 and 2014–2015, by sex

| Behaviours   | Men, %             |                         |                  | Women, %          |                        |                   |
|--|--------------------|-------------------------|------------------|-------------------|------------------------|-------------------|
|  | 2003<br>(n = 1362) | 2014–2015<br>(n = 1315) | PR (95% CI)*     | 2003<br>(n = 251) | 2014–2015<br>(n = 250) | PR (95% CI)*      |
| <b>Inside prison</b>                                       |                    |                         |                  |                   |                        |                   |
| Injection drug use, ever                                   | 4.4                | 2.2                     | 0.51 (0.33–0.78) | 0.8               | 1.2                    | 2.05 (0.38–11.09) |
| Sharing syringe/needles <sup>†</sup>                       | 66.7               | 44.8                    | 0.83 (0.71–0.98) | 50                | 25                     | 0.50 (0.056–4.47) |
| Injection drug use, current incarceration                  | NA <sup>‡</sup>    | 0.2                     | NA               | NA                | 0.8                    | NA                |
| Sharing syringe/needles <sup>†</sup>                       | NA                 | 0.0                     | NA               | NA                | 0.0                    | NA                |
| Non-injection drug use, ever <sup>§</sup>                  | 23.9               | 24                      | 1.00 (0.88–1.15) | 12.7              | 13.8                   | 1.08 (0.69–1.69)  |
| Sharing paraphernalia <sup>†</sup>                         | 51.3               | 38.9                    | 0.8 (0.6–0.9)    | 65.6              | 65.6                   | 1.0 (0.7–1.4)     |
| Non-injection drug use, current incarceration <sup>§</sup> | NA                 | 10.6                    | NA               | NA                | 7.3                    | NA                |
| Sharing paraphernalia <sup>†</sup>                         | NA                 | 38.5                    | NA               | NA                | 50                     | NA                |
| Tattooing  | 37.7               | 37.2                    | 0.99 (0.89–1.09) | 4.8               | 3.9                    | 0.83 (0.37–1.89)  |
| Sharing paraphernalia <sup>†</sup>                         | 27.0               | 12.6                    | 0.46 (0.35–0.62) | 50.0              | 55.5                   | 1.11 (0.49–2.51)  |
| <b>Oral sex</b>  |                    |                         |                  |                   |                        |                   |
| Ever   | 4.7                | 1.9                     | 0.41 (0.26–0.64) | 16.1              | 9.7                    | 0.60 (0.37–1.89)  |
| Current incarceration                                      | NA                 | 0.8                     | NA               | NA                | 4.5                    | NA                |
| <b>Anal sex</b>  |                    |                         |                  |                   |                        |                   |
| Ever   | 1.5                | 1.0                     | 0.67 (0.34–1.35) | –                 | –                      | –                 |
| Current incarceration                                      | NA                 | 0.4                     | NA               | –                 | –                      | –                 |
| <b>Received money/drug for sex</b>                         |                    |                         |                  |                   |                        |                   |
| Ever   | 1.2                | 0.5                     | 0.43 (0.18–1.04) | 0.4               | 0.4                    | 1.01 (0.06–16.03) |
| Current incarceration                                      | NA                 | 0.2                     | NA               | NA                | 0.0                    | NA                |

\* Prevalence ratio and 95% confidence interval comparing 2014–2015 to 2003

<sup>†</sup> Among those reporting the previous behaviour only

<sup>‡</sup> Not asked

<sup>§</sup> Non-injection drug use

<sup>||</sup> Nasal snorting of cocaine/heroin and/or smoking crack

<sup>¶</sup> Not applicable

no positive test and tested positive in this study), with non-PWID more than eight times more likely to be unaware of their HIV status (85.7% unaware for non-PWID vs. 10.5% for PWID,  $p < 0.001$ ). Among HCV-positive participants, 12.3% were unaware of their status. Non-PWID were more likely to be unaware of their HCV status than PWID (26.7% non-PWID vs. 9.8% PWID,  $p = 0.02$ ). Among those unaware of their status, HIV prevalence was 0.52% (8/1549) and HCV prevalence was 11.25% (113/1004).

## Discussion

### Interpretation

When compared to the cross-sectional study of 2003, the 2014–2015 survey found lower prevalence for HIV and HCV infections. The HIV prevalence for women in 2014–

2015 was one tenth of what it was in 2003, while the prevalence for men remained similar. The differences in risky behaviours cannot fully explain this drastic decrease in HIV prevalence among PWID women. An important proportion of HIV/HCV-infected prisoners were unaware of their status, a situation that could be addressed with systematic screening of all prisoners (Iacomi et al., 2013; Eyawo et al., 2013; Hall et al., 2012). In 2014–2015, the daily average of inmates in Quebec's provincial network was 5177, an important increase from 3757 in 2003 (MSPQ, 2016). We therefore estimate that there were 90 HIV-positive and 627 HCV-positive prisoners incarcerated at any given time, which is similar to the 2003 estimates (99 HIV+ and 619 HCV+ prisoners). In absolute terms, the decrease in prevalence between the two surveys was entirely offset by the 34% increase in prison population during the same decade (MSPQ, 2016; MSPQ, 2003). Therefore, the resources needed in prison for HIV- and HCV-infected individuals remain as crucial as ever. As

**Table 4** Comparison of HIV and HCV prevalence and prevalence ratio among inmates of Quebec's provincial prisons between 2003 and 2014–2015, by sex and injection drug use outside prison

|     |                    | Men                    |                      |                  | Women                  |                     |                  |
|-----|--------------------|------------------------|----------------------|------------------|------------------------|---------------------|------------------|
|     |                    | Prevalence, % (95% CI) |                      | PR (95% CI)*     | Prevalence, % (95% CI) |                     | PR (95% CI)*     |
|     |                    | 2003 (n = 1362)        | 2014–2015 (n = 1315) |                  | 2003 (n = 251)         | 2014–2015 (n = 250) |                  |
| HIV | All participants   | 2.4 (1.6–3.3)          | 1.8 (1.2–2.7)        | 0.85 (0.4–1.81)  | 8.8 (5.6–13.0)         | 0.8 (0.1–2.9)       | 0.13 (0.02–1.07) |
|     | IDU outside prison |                        |                      |                  |                        |                     |                  |
|     | Yes                | 7.2 (4.8–10.3)         | 6.7 (3.9–10.5)       | 0.93 (0.51–1.71) | 20.6 (13.4–29.5)       | 2.9 (0.0–6.8)       | 0.15 (0.02–1.17) |
|     | No                 | 0.5 (0.2–1.2)          | 0.7 (0.2–1.4)        | 0.95 (0.54–1.65) | 0.0 (0.0–0.0)          | 0.0 (0.0–0.0)       | NA               |
| HCV | All participants   | 16.6 (14.6–18.7)       | 11.9 (10.2–13.8)     | 0.96 (0.78–1.18) | 29.2 (23.6–35.3)       | 19.2 (14.5–24.6)    | 0.76 (0.47–1.22) |
|     | IDU outside prison |                        |                      |                  |                        |                     |                  |
|     | Yes                | 53.3 (48.1–58.5)       | 51.0 (44.7–57.3)     | 0.71 (0.50–1.00) | 63.6 (53.7–72.6)       | 61.4 (49.0–72.8)    | 0.76 (0.45–1.28) |
|     | No                 | 2.6 (1.7–3.8)          | 2.4 (1.6–3.5)        | 1.08 (0.60–1.96) | 3.5 (1.2–8.0)          | 2.8 (0.9–6.5)       | 1.07 (0.58–1.95) |

\* Prevalence ratios of infection in 2014–2015 compared to 2003 and 95% confidence intervals based on multivariate modified Poisson regression models adjusting for confounding variables: age, cultural community, education, drug-related incarceration, injection drug use (where applicable), sharing injection paraphernalia (where applicable), tattooing, sex with PWID, sex work, and injection drug use in prison

reported in the previous study, most HIV- and HCV-infected inmates report a history of injection drug use (Poulin et al., 2007). Despite decreases in overall prevalence, PWID-specific prevalence is similar in both studies, with the exception of HIV among women, suggesting that the observed decrease in prevalence is mainly due to a decrease in the proportion of inmates with a history of injection drug use. Other studies have shown a similar situation: the burden of HIV and HCV in prison populations is mainly due to the criminalization of drug use and mass incarceration of drug users (Dolan et al., 2016; Vescio et al., 2008).

Participants in the 2014–2015 survey generally reported fewer risky behaviours than those in 2003, particularly injection drug use, including sharing paraphernalia, and all risky sexual behaviours. Only a quarter of those reporting a history of injection drug use in 2014–2015 were still injecting in the months prior to their incarceration, and they were even less likely to have shared injection paraphernalia. These results indicate that some participants no longer engage in risky behaviours, and those who carried on do so more safely than in the past. As reported in 2003, an overwhelming majority of participants reported intranasal/inhaled drug use in 2014–2015. The many public health campaigns targeted mainly at PWID and the availability of drugs on the streets could explain the opposite trends for injection vs. intranasal/inhaled drug use.

Despite all security measures, drug use was and remains a problem in Quebec's provincial prisons. Most participants reporting drug use while incarcerated did not consume drugs in their current incarceration, but drugs are still available within prison walls. Tattooing in prison remains marginal among women in 2014–2015 and remains almost ten times more frequent

among men. Generally, risky behaviours, such as sharing tattooing paraphernalia, are less frequent in prison, but they are practiced less safely inside prison than outside (Kamarulzaman et al., 2016). This is largely due to the absence of most (if not all) harm reduction measures offered in prison. There is currently no needle exchange program offered to prisoners in Quebec's provincial prisons, and liquid bleach and condoms are offered on arbitrary bases.

Individuals incarcerated in Quebec's provincial prisons are a highly criminalized population, most of them are repeat offenders. In addition, the number of incarcerated individuals in the province of Quebec is expected to increase for the next decade due to legislative changes bringing stricter directives for prison sentences (Chéné & Analyse, 2015).

### Comparing to literature

Only a few studies are available to assess the changes in HIV/HCV prevalence among incarcerated individuals. Similar to what we observed for women incarcerated in Quebec's prison system, a decrease in HIV prevalence was reported between 2001 and 2010 in the American prison system (Maruschak L. HIV in prisons, 2001–2010. Department of Justice, Bureau of Justice Statistics, 2012). However, similar to what we observed in men, three successive surveys in Australian prisons found no changes in HIV prevalence between 2004 and 2010 (Reekie et al., 2014). As we observed in Quebec's prisons, the HCV prevalence decreased over time among Australian prisoners (Reekie et al., 2014). In a 2013 systematic review, recent studies on HCV in prisoners tend to report lower prevalence (Larney et al., 2013). Many challenges faced by incarcerated individuals in this study have been documented

elsewhere. The relatively high rates of HIV- and HCV-positive individuals unaware of their status reported in this study is no exception; a 2015 systematic review even found rates up to 76% (Iroh et al., 2015). The higher proportion of individuals unaware of their status among non-PWID was also previously reported in New York City jails (Begier et al., 2010). Interestingly, incarcerated individuals were more likely to be unaware of their HIV status than the Canadian population, but less likely to be unaware of their HCV status (Public Health Agency of Canada, 2012; Remis, 2007). HIV and HCV screening is of critical importance in the correctional setting, as both prevalences are higher among prisoners unaware of their status than in the Canadian general population. The decrease in risky behaviours observed between 2003 and 2014–2015 had not been reported in the literature, but a decrease in injection drug use in recent years has been observed in Montreal (Leclerc et al., 2014). A meta-analysis on HCV in prison concluded that the main factor explaining a decrease in prevalence was the proportion of PWID in the prison population, as we found in this study (Vescio et al., 2008).

### Study limitations

For both the 2003 and the 2014–2015 studies, neither the site nor participant selection was random. Prisons included in the studies were selected to ensure that both rural and urban populations would participate. Random selection of participants is not possible in a correctional setting; however, the participants' socio-economic characteristics are similar to the data available for the entire correctional population in Quebec (Giroux, 2011). Information bias could be present given the personal/delicate nature of this study, thus potentially leading to a social desirability bias. Many risky behaviours studied are illegal in prison; therefore, all participants were met in a private room and were assured of the confidentiality of their responses. Recall bias is also possible for lifetime behaviours, mostly for specific behaviours (i.e., type of drug injected), while it is expected to be minimal for general behaviours (i.e., lifetime injection drug use). The use of similar questionnaires in both studies is also likely to make the information bias (either due to social desirability or recall issues) similar in both studies, thus minimizing the biases when comparing data from both surveys.

### Conclusion

Despite a lower prevalence in 2014–2015 than in 2003, prisoners incarcerated in Quebec's provincial network remain at high risk of HIV and HCV infections. Due to the important population increase between 2003 and 2014–2015, the number of HIV- and HCV-positive individuals incarcerated in the network remains the same. Quebec's correctional population is expected to grow in the next decade, therefore adding to the

problematic situation already present. Many effective interventions in correctional settings, such as optimal screening procedures and safer tattooing, have been identified, but political will and financial investment are needed (HIV screening of male inmates during prison intake medical evaluation—Washington, 2006–2010, 2011; Elliott, 2007). Additionally, risky behaviours—although less frequent than in 2003—are still common in 2014–2015. Access to prevention and harm reduction programs in prison is needed. Emphasis on coordination between community services and the prison system is necessary given that individuals incarcerated in Quebec's system are often detained for short periods of time and on multiple occasions.

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### Compliance with ethical standards

**Conflict of interest** Michel Alary and Bouchra Serhir both received funding from Quebec's ministère de la Santé et des Services sociaux.

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