Association between short-term housing patterns and hepatitis C acquisition: findings from a cohort of people who inject drugs in Montréal, Canada

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8th International Conference on Hepatitis Care in Substance Users
Montréal, Canada – September 12th, 2019
Before we get started…

- Welcome to Montréal
- Thanks to INHSU for the opportunity
- Thanks to PWID who participated in this study
- No conflicts of interest to declare
Background

- Unstable housing:
  - Living on the street or in other types of transitional living arrangements (e.g. hotel/motel room, rooming/boarding house, shelter, etc.)
Background

- Unstable housing = associated with drug injecting initiation (+), cessation (−), and relapse (+)

- Unstable housing = seems to play a role in the global burden of disease related to drug injecting:
  - ↑ injecting equipment sharing + ↑ public injecting
  - ↑ HCV/HIV acquisition + ↓ HCV/HIV treatment access
  - ↓ addiction treatment access

Abelson et al., 2006; Feng et al., 2013; Linton et al., 2013; Mehta et al., 2012; Roy et al., 2003; Shah et al., 2006; De et al., 2007; Roth et al., 2015; Topp et al., 2013; Whittaker et al., 2015; Harris and Rhodes, 2013; Prangnell et al., 2016; Wood et al., 2005; Kim et al., 2009
Background

- Housing stability = dynamic process + tends to fluctuate over time:
  - Various housing patterns observed in studies of street youth followed up to 2 years (e.g. slow to rapid housing stabilization, fluctuation, or chronic instability)
  - Housing trajectories not studied specifically among PWID

Examine housing fluctuations among PWID and their association with HCV infection could help inform clinical and public health strategies to improve HCV prevention

Roy et al., 2014; Tevendale et al., 2011
Objectives

1. To identify distinct **trajectories of housing stability** evolving over **12 months** among PWID at risk of HCV infection in Montréal, Canada

2. To examine the relationship between trajectories of housing stability and **incident HCV acquisition**
Study participants / design

• **Hepatitis Cohort (HEPCO):**
  – Established in 2004 in Montréal, Canada (i.e. here!)
  – **Ongoing prospective cohort of PWID**
  – Enrolment through community-based programs, word-of-mouth, posters, and cards
  – Inclusion criteria: age ≥18 y/o, **injecting past 6 months**
Inclusion criteria for this study

- 723 PWID were enrolled between March 2011 and June 2016
- 518/723 (72%) participants were HCV RNA– at ≥1 assessment
- 1st visit where a participant was HCV RNA– = baseline assessment
- 386/518 (75%) participants returned for follow-up within 9 months of baseline
- 205/723 (28%) participants remained HCV RNA+ throughout the study period
- 132/518 (25%) participants did not return for follow-up within 9 months of baseline
Data collection

- Visits at baseline and three-monthly follow-up:
  - Interviewer-administered questionnaire:
    - Socio-demographics, drug use and related behaviors, treatments, service utilization, etc.
  - Venepuncture and blood collection:
    - HCV Ab, HIV-1/2 Ab & P24 Ag: AxSYM (Abbott)
    - HCV RNA: COBAS AMPLICOR or COBAS AmpliPrep/COBAS TaqMan HCV Quantitative Test v2.0 (Roche)
Housing stability

- Participants questioned on the type of accommodation they lived in the longest for each of the past 3 months.

- Categorized on a binary scale:
  - **Unstable housing**: living, for most of the month, in hotel/motel rooms, rooming/boarding houses, shelters, or on the street (squat, park, bus station, car, etc.)
  - **Stable housing**: living in longer-term types of accommodation

- Trajectories estimated using the first 12 months of observations.
HCV acquisition

• Participants initially at risk of:
  – **Primary HCV infection** (HCV Ab– & HCV RNA–)
  – **HCV recurrence** (reinfection or relapse; HCV Ab+ & HCV RNA–)

• Incident HCV case = newly + test for HCV RNA or HCV Ab

• Estimated to occur at the midpoint between last – and first + test

• Incidence analyses conducted using the entire study period (from March 2011 to June 2016; max. 63 months)
Statistical analyses

- Estimation of housing stability trajectories:
  - **Group-based trajectory modeling (logistic model):** identification of latent groups of individuals who share similar trajectories of housing (approximation of archetypal tendencies over time)

- HCV acquisition analyses:
  - Participants divided into groups based on their most likely trajectory
  - **HCV incidence** according to trajectories (Poisson distribution)
  - **Cumulative incidence curves** according to trajectories (log-rank test)

Nagin, 2005; Nagin, 1999; Nagin and Odgers, 2010; Jones and Nagin, 2007; Jones et al., 2001
## Baseline characteristics

<table>
<thead>
<tr>
<th>Characteristics, n (%)</th>
<th>Included (n=386)</th>
<th>Excluded (n=132)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (± standard deviation)</td>
<td>40.0 (±10.4)</td>
<td>36.9 (±10.9)</td>
<td>0.007</td>
</tr>
<tr>
<td>Female gender</td>
<td>70 (18)</td>
<td>28 (21)</td>
<td>0.436</td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>150 (39)</td>
<td>57 (43)</td>
<td>0.405</td>
</tr>
<tr>
<td>Incarceration, past 3 months</td>
<td>41 (11)</td>
<td>15 (11)</td>
<td>0.813</td>
</tr>
<tr>
<td>Opioid injecting, past 3 months</td>
<td>214 (55)</td>
<td>70 (53)</td>
<td>0.613</td>
</tr>
<tr>
<td>Cocaine injecting, past 3 months</td>
<td>211 (55)</td>
<td>74 (56)</td>
<td>0.781</td>
</tr>
<tr>
<td>Amphetamine injecting, past 3 months</td>
<td>27 (7)</td>
<td>12 (9)</td>
<td>0.431</td>
</tr>
<tr>
<td>Opioid agonist treatment, past 3 months</td>
<td>137 (35)</td>
<td>39 (30)</td>
<td>0.213</td>
</tr>
<tr>
<td>Other addiction treatment, past 3 months*</td>
<td>29 (8)</td>
<td>16 (12)</td>
<td>0.105</td>
</tr>
<tr>
<td>Positive HCV antibody status</td>
<td>201 (52)</td>
<td>61 (47)</td>
<td>0.276</td>
</tr>
<tr>
<td>Positive HIV status</td>
<td>28 (7)</td>
<td>5 (4)</td>
<td>0.160</td>
</tr>
</tbody>
</table>

*Detoxification, inpatient therapy, or therapeutic community participation
Short-term housing stability trajectories

- Sustained housing stability (53%)
- Declining housing stability (22%)
- Improving housing stability (25%)

Probability of unstable housing vs. Months of follow-up
Baseline characteristics

<table>
<thead>
<tr>
<th>Characteristics, n (%)</th>
<th>Sustained (n=206)</th>
<th>Declining (n=78)</th>
<th>Improving (n=102)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (± standard deviation)</td>
<td>38.9 (±10.0)</td>
<td>39.1 (±10.6)</td>
<td><strong>42.8</strong> (±10.8)</td>
<td><strong>0.006</strong></td>
</tr>
<tr>
<td>Female gender</td>
<td>47 (23)</td>
<td>11 (14)</td>
<td>12 (12)</td>
<td><strong>0.035</strong></td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>73 (35)</td>
<td>36 (47)</td>
<td>41 (41)</td>
<td>0.207</td>
</tr>
<tr>
<td>Incarceration, past 3 months</td>
<td>19 (9)</td>
<td>13 (12)</td>
<td>13 (13)</td>
<td>0.613</td>
</tr>
<tr>
<td>Opioid injecting, past 3 months</td>
<td>126 (61)</td>
<td>41 (49)</td>
<td>47 (48)</td>
<td><strong>0.040</strong></td>
</tr>
<tr>
<td>Cocaine injecting, past 3 months</td>
<td>95 (46)</td>
<td>53 (64)</td>
<td>63 (64)</td>
<td><strong>0.003</strong></td>
</tr>
<tr>
<td>Amphetamine injecting, past 3 months</td>
<td>9 (4)</td>
<td>11 (13)</td>
<td>7 (7)</td>
<td><strong>0.028</strong></td>
</tr>
<tr>
<td>Opioid agonist treatment, past 3 months</td>
<td>102 (50)</td>
<td>16 (21)</td>
<td>19 (19)</td>
<td><strong>&lt;.001</strong></td>
</tr>
<tr>
<td>Other addiction treatment, past 3 months*</td>
<td>15 (7)</td>
<td>8 (10)</td>
<td>6 (6)</td>
<td>0.535</td>
</tr>
<tr>
<td>Positive HCV antibody status</td>
<td>114 (55)</td>
<td>36 (46)</td>
<td>51 (50)</td>
<td>0.341</td>
</tr>
<tr>
<td>Positive HIV status</td>
<td>15 (7)</td>
<td>7 (9)</td>
<td>6 (6)</td>
<td>0.730</td>
</tr>
</tbody>
</table>

*Detoxification, inpatient therapy, or therapeutic community participation
HCV incidence analyses

<table>
<thead>
<tr>
<th>Housing trajectories</th>
<th>No. at risk</th>
<th>No. infected</th>
<th>Incidence per 100 PY (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained</td>
<td>206</td>
<td>31</td>
<td>6.0 (4.2-8.5)</td>
</tr>
<tr>
<td>Declining</td>
<td>78</td>
<td>19</td>
<td>12.0 (7.4-18.3)</td>
</tr>
<tr>
<td>Improving</td>
<td>102</td>
<td>22</td>
<td>10.0 (6.4-14.9)</td>
</tr>
<tr>
<td>Overall</td>
<td>386</td>
<td>72</td>
<td>8.1 (6.4-10.1)</td>
</tr>
</tbody>
</table>

Product-Limit Failure Curves
With Number of Subjects at Risk

Logrank p=0.0667

(1) Sustained housing stability
(2) Declining housing stability
(3) Improving housing stability
Discussion

• Among the 1\textsuperscript{st} studies to evaluate housing patterns among PWID:
  
  – 47\% followed trajectories with high probability of experiencing unstable housing at some point over one year (declining or improving housing)
  
  – Consistent with previous evidence that housing stability is problematic among PWID:
    
    • Cross-sectional survey conducted among Canadian PWID from 2010–12: 39\% currently experiencing unstable housing
Discussion

- HCV incidence appeared to differ across housing stability trajectories:
  - Declining > improving > sustained housing stability
    - However: overlaps between 95% CIs; log-rank test 0.067; no adjustment for confounding due to limited power

- Previous research on housing stability in association with HCV:
  - Collaboration between two prospective cohorts of PWID based in Vancouver, Canada:
    - Unstable housing associated with HCV acquisition: HR=1.47, 95% CI=1.02–2.13

Kim et al., 2009
Discussion

- New supportive housing interventions targeting PWID are needed:
  - Addressing effectively drug addiction and drug injecting; focusing on stimulant use; using gender-specific approaches

- Housing First programs provide housing and support to marginalized populations, including PWUD:
  - No requirement to stop drug use or undergo addiction treatment
  - Addiction services made available on-site
  - Promising results with programs offering more robust addiction services: reduction of drug use at 12 months (opioids, stimulants)
  - Less conclusive results in the presence of co-morbidities, e.g. mental health problems, among clinical trials in Canada

Davidson et al., 2014; Kirst et al., 2015; Padgett et al., 2011; Somers et al., 2015
• Supportive housing may not be sufficient to prevent risk behaviors and HCV:
  – A sample of American homeless people remained **socially excluded** after being provided with supportive housing:
    • People with improved housing tend to be less involved with peers and community-based services and staff
    • People with improved housing tend to desire autonomy/privacy and to fear being exploited/negatively influenced by others, conflicting with development of close relationships
  – To reduce PWID isolation: **improve access to/engagement in care**, including primary care, long-term addiction therapies, and other harm reduction services

Tsai et al., 2012; Henwood et al., 2013; Henwood et al., 2015; Whitley et al., 2008; Bruneau et al., 2018
Acknowledgments

Dr Julie Bruneau (supervisor)
Dr Jason Grebely (co-supervisor)

Scholarships
Université de Montréal, CIHR & INHSU

Financial support – HEPCO
CIHR & FRQS

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Adelina Artenie, PhD candidate
Geng Zang, biostatistician
Trainees & Staff
Participants
References

Thank you!

Questions?

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Backup slides
# HCV acquisition

<table>
<thead>
<tr>
<th>Type of HCV infection</th>
<th>No. at risk of HCV infection</th>
<th>No. who got infected</th>
<th>Incidence per 100 PY (95%CI)</th>
<th>Median no. months to infection (Q1-Q3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary HCV infection</td>
<td>185</td>
<td>29</td>
<td>7.0 (4.8-9.9)</td>
<td>8.5 (2.4-17.1)</td>
</tr>
<tr>
<td>HCV recurrence</td>
<td>201</td>
<td>43</td>
<td>9.0 (6.6-12.0)</td>
<td>10.4 (2.2-27.3)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>386</strong></td>
<td><strong>72</strong></td>
<td><strong>8.1 (6.4-10.1)</strong></td>
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<table>
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<th>Housing trajectories</th>
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<td>Declining</td>
<td>78</td>
<td>19</td>
<td>12.0 (7.4-18.3)</td>
<td>8.2 (1.6-18.6)</td>
</tr>
<tr>
<td>Improving</td>
<td>102</td>
<td>22</td>
<td>10.0 (6.4-14.9)</td>
<td>11.0 (1.6-17.1)</td>
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</tbody>
</table>
Time to HCV infection

Trajectories of housing stability

- Overall (n=72)
- Sustained housing stability (n=31)
- Declining housing stability (n=19)
- Improving housing stability (n=22)
Housing trajectory groups were further differentiated by a few baseline sociodemographic characteristics:

- Participants with **improving housing** were more likely to be **older**:
  - Older age associated with stable housing in an Australian cross-sectional study of PWID
  - However: older participants were less likely to be included in study
  - *No conclusions can be drawn from this result*
Gender

- Participants with **sustained stability** were more likely to be **female**:
  - Female gender associated with stable housing in cross-sectional studies of PWID
  - Female (vs. male) homeless street youth tend to rely more on their social networks to deal with unstable housing and reach stability
  - Homeless women (vs. men) are, however, generally more victimized

✓ **Housing interventions should that target both male and female PWID using gender-specific approaches**

Public Health Agency of Canada, 2014; Topp et al., 2013; Hutson, 1994; Novac et al., 2002; Roy et al., 2016; Wrate and Blair, 1999; Pfeffer, 1997; Wardhaugh, 2000
Opioid agonist treatment

• Participants with **sustained housing stability** were more likely to have recently undergone **OAT**:  
  – Recent evidence has associated retention in OAT with stable housing

Damian et al., 2017; Klimas et al., 2018; Lo et al., 2018
Injecting drugs

• Participants with **sustained stability** were **more likely to inject opioids** and **less likely to inject cocaine** + those with **declining housing** were **more likely to inject amphetamines**:
  
  – PWID who use cocaine or methamphetamines as primary drugs are more likely to be unstably housed compared to PWID who primarily inject heroin

✓ **Efforts to develop treatments for stimulant use disorders should be intensified, given limited effective treatment options**

De et al., 2007; Roth et al., 2015; Indave et al., 2016; Minozzi et al., 2015a; Minozzi et al., 2015b; Minozzi et al., 2016; Pani et al., 2011
HCV reinfection

- Incidence of primary HCV infection (8.5 per 100 PY) < incidence of HCV recurrence (10.4 per 100 PY)

- Previous studies on HCV reinfection generally reported the opposite:
  - Participants mostly recruited from clinical settings and underwent interferon-based treatments

✔ Need for studies with clinical and community-based samples to examine reinfection trends as direct-acting antivirals become increasingly available to active PWID

Midgard et al., 2016; Falade-Nwulia et al., 2018
Limitations

- Recruitment methods:
  - (−) Non-random: reduced generalizability to PWID who are underserviced
  - (+) Various recruitment strategies

- Losses to follow-up:
  - (−) Reduced generalizability to younger PWID
  - (+) Retention rates acceptable for a drug-using population

- Social desirability bias:
  - (−) Drug use/behaviors were evaluated
  - (+) Self-reported drug use/behaviors generally reliable/valid among samples of PWUD

✓ Reminder: trajectories are statistical approximations of archetypal tendencies for a behavior over time; not literal depictions of reality

Darke, 1998; Nagin and Odgers, 2010; Nagin and Tremblay, 2005