

**The contribution of unstable housing to HIV and hepatitis C virus transmission among people who inject drugs globally, regionally, and at country level: a modelling study**

**Jack Stone**



# Unstable Housing and PWID

- Growing recognition of the role of social and structural factors (“risk environment”) in influencing risk behaviours and the need to expand current prevention efforts to address them.
- Unstable housing, defined as lacking access to fixed housing
  - includes homelessness (extreme end of the spectrum)
- Globally, 22% of PWID have recently experienced unstable housing or homelessness (currently or within the past year)<sup>1</sup>
  - In some regions like North America, this proportion reaches 50%<sup>1</sup>
- PWID who are homeless or unstably housed are more likely to engage in high-risk behaviours associated with HIV and HCV transmission (e.g. sex work, public injecting, and sharing of injection equipment)<sup>2,3,4</sup>
- Homelessness has been linked to recent outbreaks of HIV infection in several European cities, Israel and Canada, despite the availability of comprehensive harm reduction in some of these settings<sup>5</sup>

## Homelessness, unstable housing, and risk of HIV and hepatitis C virus acquisition among people who inject drugs: a systematic review and meta-analysis



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### Summary

**Background** People who inject drugs (PWID) are at increased risk for HIV and hepatitis C virus (HCV) infection and also have high levels of homelessness and unstable housing. We assessed whether homelessness or unstable housing is associated with an increased risk of HIV or HCV acquisition among PWID compared with PWID who are not homeless or are stably housed.

**Methods** In this systematic review and meta-analysis, we updated an existing database of HIV and HCV incidence studies published between Jan 1, 2000, and June 13, 2017. Using the same strategy as for this existing database, we searched MEDLINE, Embase, and PsycINFO for studies, including conference abstracts, published between June 13, 2017, and Sept 14, 2020, that estimated HIV or HCV incidence, or both, among community-recruited PWID. We only included studies reporting original results without restrictions to study design or language. We contacted authors of studies that reported HIV or HCV incidence, or both, but did not report on an association with homelessness or unstable housing, to request crude data and, where possible, adjusted effect estimates. We extracted effect estimates and pooled data using random-effects meta-analyses to quantify the associations between recent (current or within the

Lancet Public Health 2021;  
6: e309–23

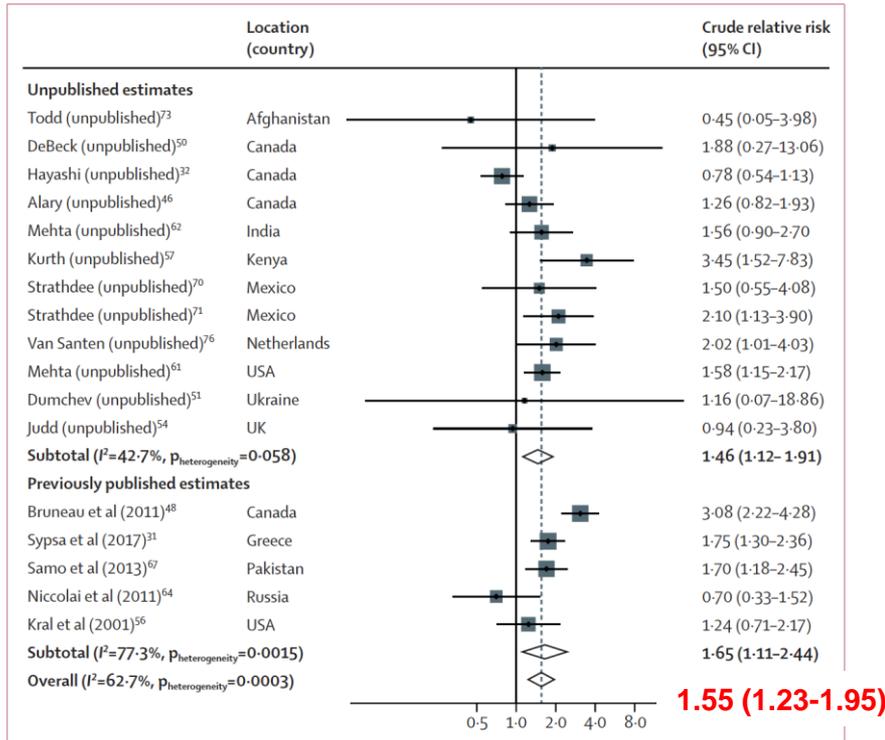
Published Online  
March 26, 2021  
[https://doi.org/10.1016/S2468-2667\(21\)00013-X](https://doi.org/10.1016/S2468-2667(21)00013-X)

See [Comment](#) page e265

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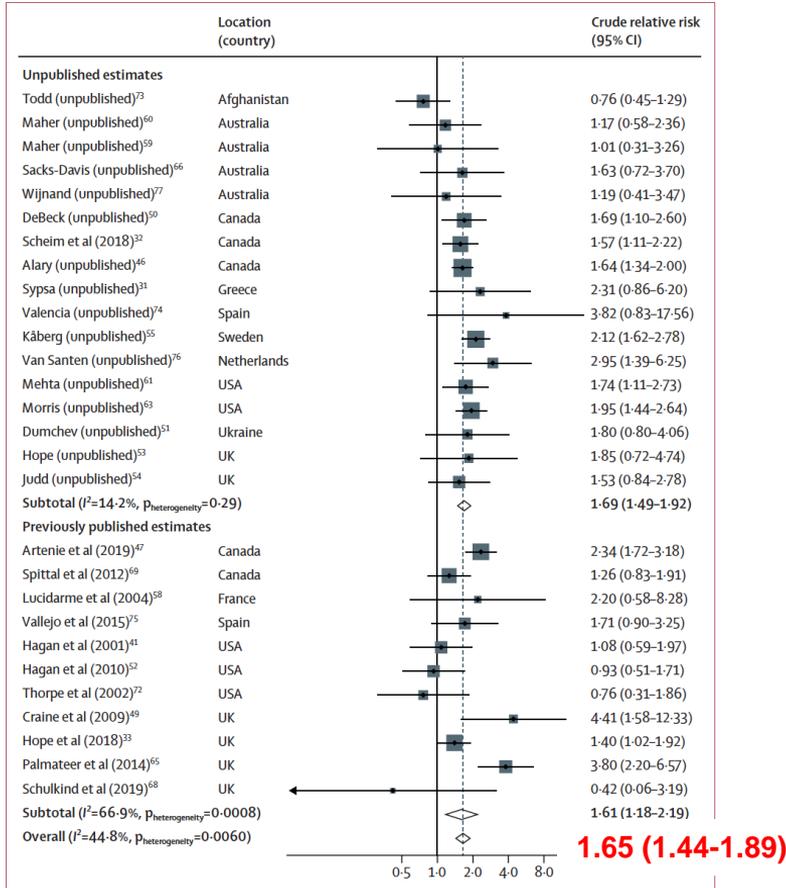
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# Unstable Housing Increases Risk of HIV Acquisition among PWID



- 17 crude estimates; 12 of which unpublished
- Unstable housing/homelessness associated with 55% increase in risk of HIV acquisition
- Effect persisted when pooling adjusted estimates but was lower than crude estimates: 1.39 vs 1.55

# Unstable Housing Increases Risk of HCV Acquisition among PWID



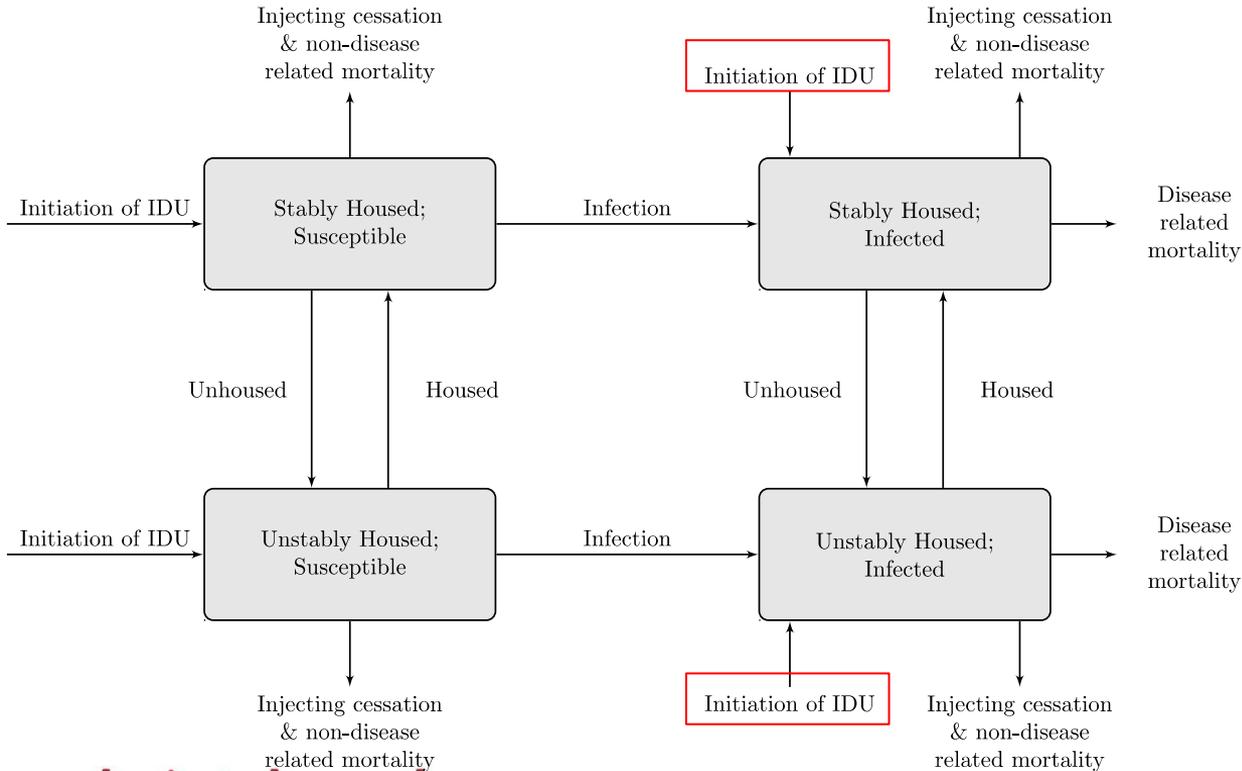
- 28 crude estimates; 17 of which unpublished
- Unstable housing/homelessness associated with 65% increase in risk of HCV acquisition
- Effect persisted when pooling adjusted estimates and pooled effect was similar: 1.64 vs 1.65

*Arum et al. Lancet Public Health 2021*

# AIM

- Estimate the contribution of unstable housing to HIV and HCV transmission among PWID
  - Nationally
  - Regionally
  - Globally

# Model Description



- Assumes random mixing
- All individuals assumed to start injecting HIV/HCV negative
  - Except in Sub-Saharan Africa, where we assume HIV prevalence at initiation is same as 15-24 year-olds in general public (data from UNAIDS)
- Assume % individuals starting injecting as unstably housed is same as % of PWID unstably housed (Varied in sensitivity analyses).

# Key Model Parameters

<b>HIV prevalence among PWID</b>	Differs by country	National estimates from Degenhardt et al. <i>Lancet Glob Health</i> 2017 or Mumtaz et al. <i>PLoS Med</i> 2014.
<b>Antibody HCV prevalence among PWID</b>	Differs by country	National estimates from Degenhardt et al. <i>Lancet Glob Health</i> 2017
<b>PWID population size</b>	Differs by country	National estimates from Degenhardt et al. <i>Lancet Glob Health</i> 2017 or Mumtaz et al. <i>PLoS Med</i> 2014.
<b>Proportion of PWID that are unstably housed</b>	Differs by country	National estimates from Degenhardt et al. <i>Lancet Glob Health</i> 2017 or Arum et al. <i>Lancet Pub Health</i> 2021
<b>Average duration of injecting</b>	Differs by country/region*	National/Regional estimates Hines et al. <i>Lancet Glob Health</i> 2020
<b>Relative increase in HIV transmission risk if unstably housed</b>	1.39 (95%CI: 1.06-1.84)	aRR from Arum et al. <i>Lancet Pub Health</i> 2021
<b>Relative increase in HCV transmission risk if unstably housed</b>	1.64 (95%CI: 1.43-1.89)	aRR from Arum et al. <i>Lancet Pub Health</i> 2021
<b>Average duration of unstable housing (years)</b>	0.25-2	Range across estimates from Scotland, Canada, USA and Australia

\*Regional values used if national estimates were missing because initial model analyses showed that average duration of injecting had little impact on tPAF.

- Degenhardt et al. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. *Lancet Glob Health* 2017
- Hines et al. Associations between national development indicators and the age profile of people who inject drugs: results from a global systematic review and meta-analysis. *Lancet Glob Health* 2020
- Mumtaz et al. HIV among people who inject drugs in the Middle East and North Africa: systematic review and data synthesis. *PLoS Med* 2014; 11(6): e1001663.
- Arum C et al. Homelessness, unstable housing and risk of HIV and hepatitis C virus acquisition among people who inject drugs - a systematic review and meta-analysis. *Lancet Public Health* 2021

# Model Calibration

- For each country, 1,000 parameter sets were sampled from their distributions
- The model was then separately calibrated for HIV and/or HCV using nonlinear least-squares fitting.
  - **Assuming both prevalence of HIV/HCV and unstable housing are stable**

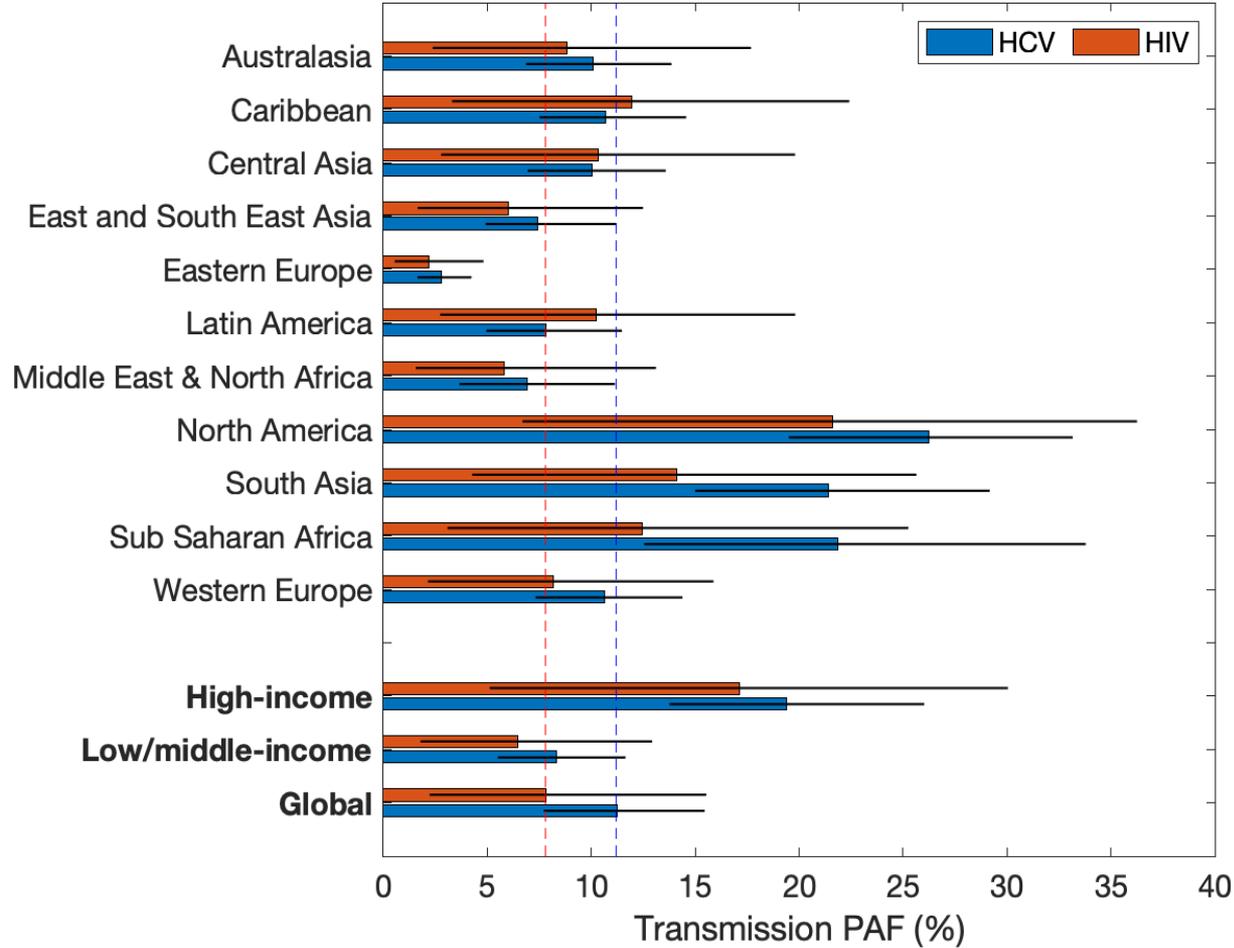
# Model Analyses: Transmission PAF (tPAF)

- Unlike classical PAFs, tPAFs account for the onward chain of transmission resulting from an infection event <sup>1</sup>
- tPAF is the proportion of new infections averted over next 10 years if the elevated risk associated with unstable housing is removed.
  - The baseline model fits for each country were run for a 10-year period.
  - Run counterfactual scenario where the increased risk of HIV or HCV transmission was removed (RR set to 1) in each model fit over that same 10-year period.
  - $tPAF = 100 - 100 * \frac{\text{New infections in counterfactual scenario over 10 years}}{\text{New infections in baseline scenario over 10 years}}$

# Results

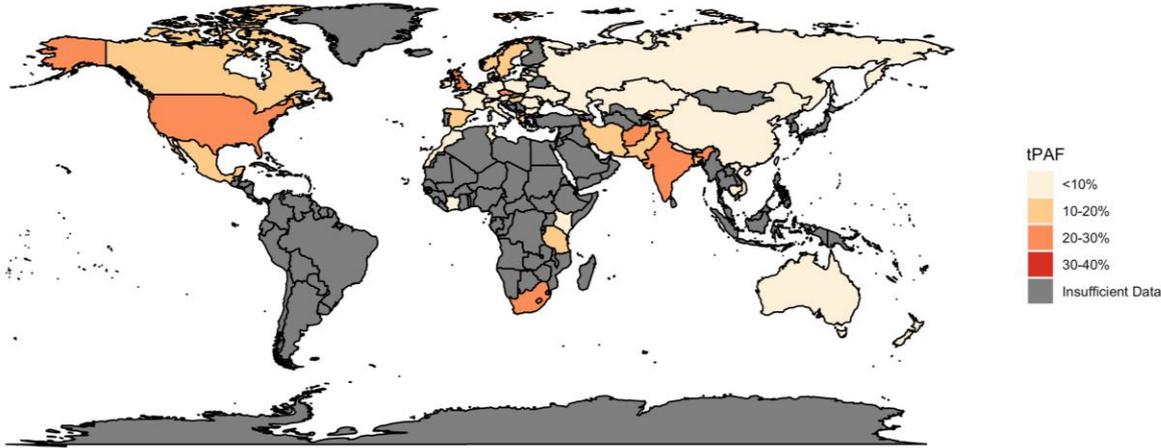
- The model projected HIV and HCV tPAF estimates for 56 and 55 countries with *sufficient data*, accounting for 10.6 million PWID, approximately two-thirds of the world's PWID population.
- Across all countries with *sufficient data* and population size estimates:
  - tPAF for HIV: 7.8% (95%CrI: 2.2–15.5%) – 50 countries
  - tPAF for HCV: 11.2% (95%CrI: 7.7–15.5%) – 49 countries

# Results

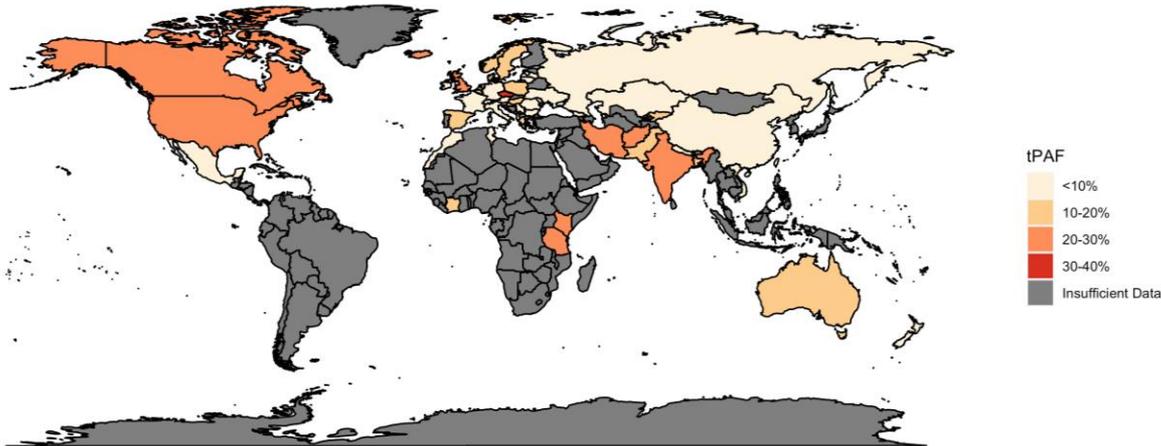


- tPAFs for HIV ranged from 2.2% in Eastern Europe to 21.6% in North America.
- tPAFs for HCV ranged from 2.8% in Eastern Europe to 26.2% in North America.
- The median tPAFs for HCV were also above 20% in Sub Saharan Africa and South Asia.
- For both HIV and HCV, the tPAFs in high income countries (HIV: 17.2%; HCV: 19.4%) were over double those in low/middle income countries (HIV: 8.3%; HCV: 6.5%).
- However, tPAFs are largely dominated by countries with large PWID populations: the US and China and Russia, respectively.

HIV

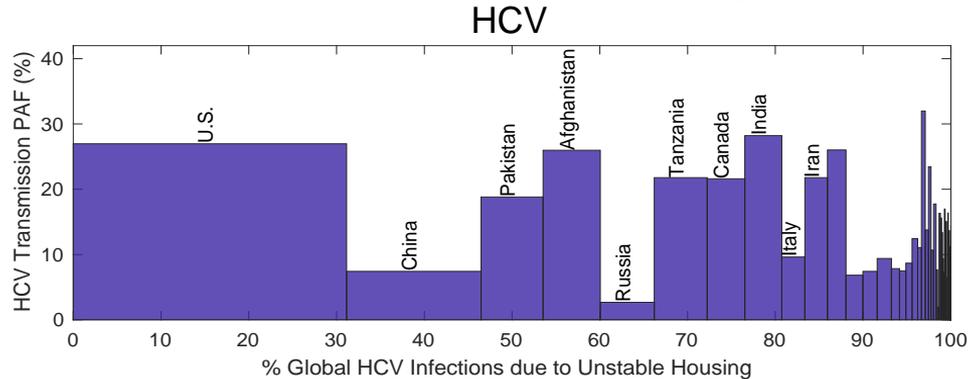
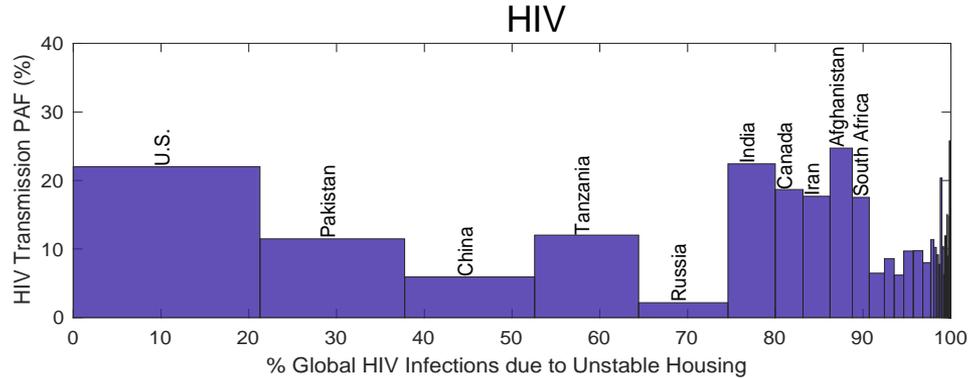


HCV

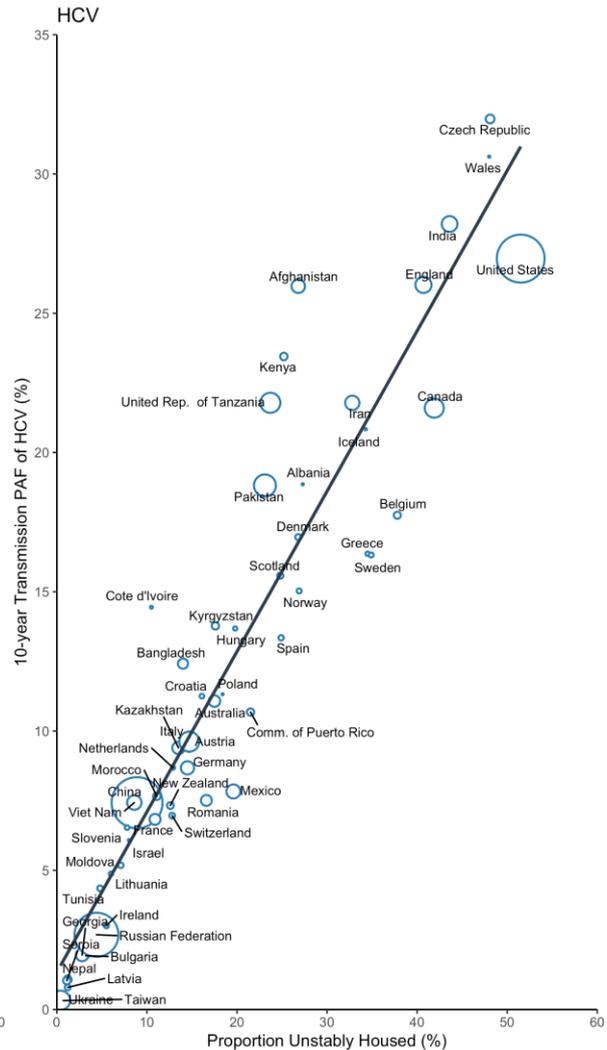
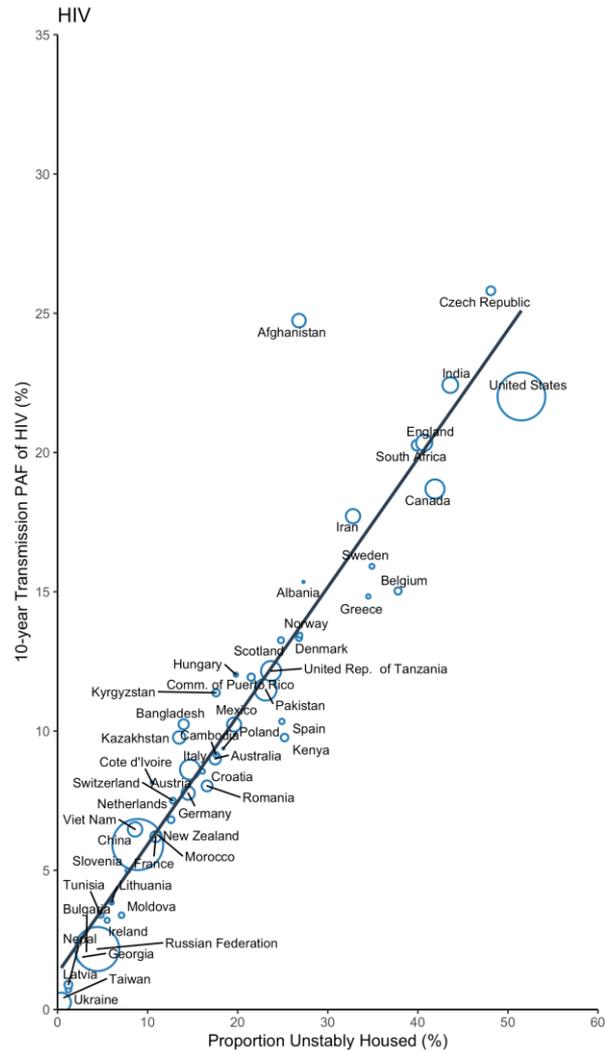


- tPAFs for HCV were typically higher than those for HIV because of the higher RR estimate for the effect of unstable housing on HCV transmission risk.
- The highest tPAFs for HIV and HCV were estimated in Afghanistan, Czech Republic, India, US, England and Wales
  - tPAFs > 20% for HIV
  - tPAFs > 25% for HCV

# Contribution to the global number of infections attributable to unstable housing



- 6 Countries with highest tPAFs (Afghanistan, Czech Republic, India, US, England, Wales) contributed:
  - 29% of the global HIV infections attributable to unstable housing
  - 44% of the global HCV infections attributable to unstable housing.
- US contributes over a fifth of HIV infections attributable to unstable housing
- US contributes a third of HCV infections attributable to unstable housing



# Between Country Heterogeneity

- Strong positive association between a country's median transmission PAF of unstable housing and the proportion of PWID that are unstably housed.
- Explained >88% of variability in tPAF estimates.

# Discussion

- Globally, unstable housing is projected to contribute an estimated 8% and 11% of new HIV and HCV infections among PWID over the next 10 years, respectively.
- These global estimates mask national and regional variation, which appears highly correlated to the level of unstable housing in each setting.
- For example, in Czech Republic, India, US, England and Wales, where at least 40% of PWID are unstably housed, unstable housing is projected to contribute more than 20% of new HCV and HIV infections.
- In contrast, in Taiwan, Georgia, Latvia, Ukraine and Nepal, where <3% PWID are unstably housed, unstable housing contributes at most 2% of new HIV/HCV infections.

# Discussion

- Unstable housing is interlinked with many other social determinants of health, including incarceration, poverty, unemployment.
- Need to understand mechanisms for the elevated transmission risk associated with unstable housing and how it interacts with other structural factors.
- Need to develop effective interventions to reduce these elevated risks
- Important to understand and quantify the other possible effects of unstable housing not modelled here
  - poorer access to and outcomes from HIV and HCV prevention and treatment
- Efforts to achieve HIV and HCV elimination goals should not overlook the importance of implementing interventions and policies to reduce housing instability among PWID.
- In settings where unstable housing and other structural factors contribute considerably to transmission (eg, USA and UK), HIV and HCV elimination targets will be missed unless the effect of these structural drivers are mitigated.

## The contribution of unstable housing to HIV and hepatitis C virus transmission among people who inject drugs globally, regionally, and at country level: a modelling study



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### Summary

**Background** A considerable proportion of people who inject drugs are unstably housed. Although unstable housing is associated with HIV and HCV infection among people who inject drugs, its contribution to transmission is unknown. We estimated the global and national proportions of incident HIV and HCV infections among people who inject drugs attributed to housing instability from 2020 to 2029.

**Methods** In this modelling study, we developed country-level models of unstable housing and HIV and HCV transmission among people who inject drugs in 58 countries globally, calibrated to country-specific data on the prevalences of HIV and HCV and unstable housing. Based on a recently published systematic review, unstably housed people who inject drugs were assumed to have a 39% (95% CI 6–84) increased risk of HIV transmission and a 64% (95% CI 43–89%) increased risk of HCV transmission. We used pooled country-level estimates from systematic

*Lancet Public Health* 2022;  
7: e136–45

Published Online  
January 7, 2022  
[https://doi.org/10.1016/S2468-2667\(21\)00258-9](https://doi.org/10.1016/S2468-2667(21)00258-9)

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# Acknowledgements

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## Funders:

- NIAID/NIDA
- NIHR