The contribution of injecting drug use as a risk factor for hepatitis C virus transmission globally, regionally, and at country level: a modelling study

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**Hepatitis C virus epidemic**

- Highly effective direct acting antivirals (DAAs) have been developed as treatment for hepatitis C virus (HCV) infection
- An estimated **71 million** people are infected with HCV globally\(^1\)
- The WHO has set targets to eliminate HCV by 2030
  - Includes reducing incidence by 80% from 2015 levels

- HCV is highly prevalent (>30%) among people who inject drugs (PWID)\(^2\)
- Proportion of adults that are PWID in most countries is low (<0.5%)\(^2\)
- Generally assumed role of IDU to HCV transmission important mostly in high-income countries\(^3\)
- In low- and middle-income countries it is thought most HCV transmission is due to other routes\(^3\)
  - Eg. Unsterile medical injections and unscreened blood transfusions

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1: Global prevalence and genotype distribution of hepatitis C virus infection in 2015: a modelling study. Blach, 2017
2: 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. Degenhardt, 2017
3: Epidemiology of hepatitis C virus infection. Alter, 2007
Aim

• We aimed to estimate the percentage of infections prevented if HCV transmission due to IDU were removed from 2018-2030:
  – Country-level
  – Regionally
  – Globally
Methods

• A dynamic, deterministic HCV transmission model simulated country-level HCV epidemics among:
  – PWID
  – the general population

• Accounted for:
  – population growth
  – ageing
  – demographics
  – disease progression
  – injecting drug use
  – vertical transmission
  – historical treatment numbers
Model parameterization

• Demographic information: UN datasets
• Key parameters and bounds from various systematic reviews:
  – HCV prevalence among general population¹
  – HCV prevalence among PWID²
  – Proportion of adults that are PWID²
• Countries included if data were available on all three key parameters
• Model accounted for uncertainty in parameters

¹ Global prevalence and genotype distribution of hepatitis C virus infection in 2015: a modelling study. Blach, 2017
² 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. Degenhardt, 2017
Key model assumptions

• Decreasing HCV epidemics among general population (around 1%) per year\textsuperscript{1} (due to evidence from countries with 2 surveys)
• Stable HCV epidemics among PWID\textsuperscript{2}
• Stable proportion of adults that are PWID\textsuperscript{2}
  – (except in Eastern Europe and Sub-Saharan Africa: increasing)

• These assumptions were investigated in many sensitivity analyses

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Analyses

• Models for each country projected the HCV epidemic to 2030 (baseline projections)
  – 1000 runs for each country

• The population attributable fraction of HCV transmission (incidence) due to IDU in each country, regionally, and globally, was estimated – the tPAF
  – This is the percentage of transmission that would be avoided if the extra transmission due to IDU removed

• To do this, the baseline model fits for each country were re-run with the transmission risk due to IDU set to zero from 2018 onwards
  – Compared vs baseline projections

• Generalised linear regression models used to determine what country-level factors are associated with the tPAF of HCV due to IDU
Contribution of IDU to HCV 2018-2030

• Successfully calibrated for all 88 countries with data (85% of world’s population)

*Countries in grey were not included in the model due to missing data*
Each country’s percentage of global HCV burden (2017) vs Contribution of IDU to HCV transmission 2018-2030 (tPAF)
Regional contribution of IDU to HCV 2018-2030

WHO region

- Global: 43%
- Africa: 14%
- Eastern Med: 16%
- Europe: 84%
- Americas: 74%
- South East Asia: 18%
- West Pacific: 58%
- High-income countries: 79%
- Low & middle-income countries: 38%

Population Attributable Fraction of IDU to HCV transmission 2018-2030

*Red lines are 95% credibility intervals*
Association with current percentage of infections among PWID

No other multivariable associations found with the tPAF

R squared = 0.87
Sensitivity analyses

• Various sensitivity analyses tested assumptions
• Most had very little effect on the tPAF
• Largest changes occurred when:
  – Assuming a stable general population HCV prevalence over time (33% tPAF)
  – Varying epidemic trajectories by region (30% tPAF)
Limitations

- Taking data from disparate sources can create imprecise results but overall trends should be robust.
- **Data!**
  - Data unavailable for many countries (particularly Africa)
  - Not necessarily high quality data
- Migration not included – lack of data
- Assumptions about directions of epidemics:
  - Only 3 countries had 2 robust, comparable general population estimates
  - Investigated in sensitivity analyses
Key results and conclusions

- **43% (25%-67%)** of incident HCV infections would be prevented from 2018-2030, globally, from removing all extra transmission due to IDU
- Varies regionally
  - 79% in high-income countries
  - 38% in low- and middle-income countries
- Unsafe injecting practices among PWID contribute substantially to incident infections globally
- Any intervention that can reduce transmission among PWID will have a pronounced effect on country-level incidence
  - OST, NSP, treatment as prevention
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