Modelling the Contribution of Incarceration to TB Transmission in Ukraine

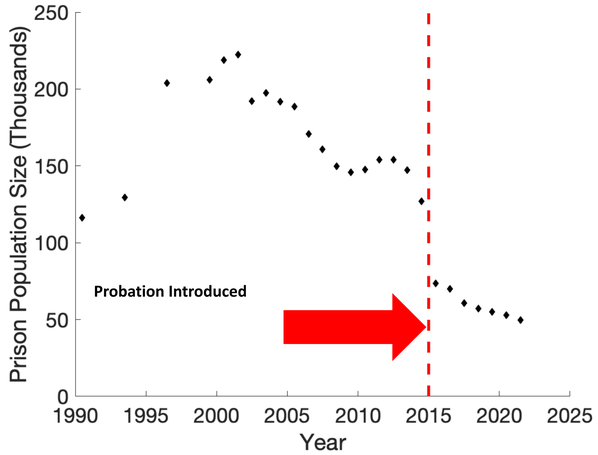
948

Jack Stone[1], Adelina Artenie[1], Frederick L. Altice[2], Peter Vickerman[1]

1. University of Bristol, Bristol, United Kingdom; 2. Yale University, New Haven, United States

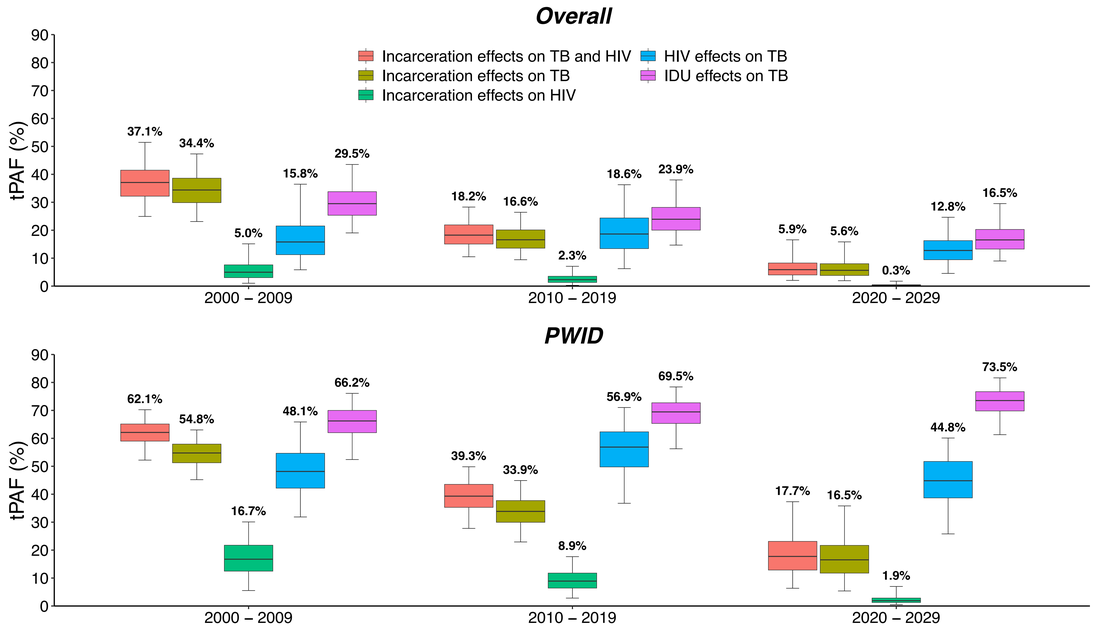
BACKGROUND

- The HIV epidemic in Ukraine has primarily been fuelled by injecting drug use (IDU)(1), with people who inject drugs (PWID) having high HIV prevalences(2).
- The HIV and TB epidemics are intertwined; 20% of new TB infections in Ukraine among people living with HIV (PLWH)(3).
- In Ukraine, half of prisoners have injected opioids(4) and over a third of PWID have been incarcerated(5).
- The risk environment before, during and immediately after incarceration changes for PWID(6); recent incarceration is associated with an 81% increased risk of HIV acquisition among PWID(7).
- Previous modelling suggests these changes in risk can contribute majorly to blood borne virus transmission, including 28–55% of new HIV infections among PWID in Ukraine(8).
- The concentration of PWID, as well as immune-compromised PLWH and others at risk of TB, leads to heightened TB prevalence(9) and transmission within prisons than the general population(6, 10).
- Higher transmission risk within prison also arises from overcrowding, poor ventilation and inadequate treatment, which are especially problematic in Eastern Europe(8).
- Burden of TB in Ukraine is strongly associated with years of incarceration, particularly for PWID with HIV(8).
- However, introduction of probation in Ukraine in 2015 has substantially reduced incarceration rates and likely to have reduced role of incarceration in disease transmission



Reductions in incarceration in Ukraine have reduced its contribution to new TB infections from 37% over 2000-2009 to 6% over 2020-2029

RESULTS



- In 2025, TB incidence estimated to be 22 (95%CrI 13-41) times higher among PWID than the general population and 72 (95%CrI 38-135) times higher in prisons than the community.
- Contribution of incarceration to TB transmission overall and among PWID has decreased over time
- Higher activation rates related to HIV infection and IDU contribute significantly to TB infections among PWID
- Since 2015, probation has averted:
  - 12% (95%CrI: 5-22) of all new TB infections;
  - 46% (95%CrI: 24-74) of new TB infections among PWID.

METHODS

- Developed a dynamic, deterministic model of incarceration and HIV and TB transmission for Ukraine, which incorporates:

1. Incarceration effects on TB & HIV
- Different injecting risks in prison than the community
- TB transmission rate different in prison
- Increased injecting risk following prison release
- Lower TB treatment success in prisons

2. HIV effects on TB (partially mitigated if on ART)
- Increased TB activation and TB mortality
- Lower TB treatment success (based on programmatic data)
- Reduced TB infectiousness

3. IDU effects on TB
- Increased TB activation and transmission rates among PWID.

- Model parameterized and calibrated using national TB data, UNAIDS estimates, and 7 bio-behavioural surveys among PWID or incarcerated persons from 2011-2019.
- Projected the contribution (transmission population attributable fractions or 'tPAFs') of incarceration, HIV and IDU to TB transmission over 10 years from 2000, 2010 and 2020
- tPAF calculated as the % of active TB infections averted if the above effects of incarceration, HIV or IDU were removed from 2000, 2010, or 2020.
- Estimated % of new TB infections averted since 2015 compared to counterfactual with no change in incarceration from 2015.

CONCLUSIONS

- HIV and IDU are substantial drivers of TB transmission in Ukraine
- Reductions in incarceration have reduced its contribution to TB transmission – particularly among PWID.
- **Decarceration policies, such as probation, can have significant public health benefits**.

ACKNOWLEDGEMENTS

This study was funded by NIDA R21 DA047902 and also supported by the Wellcome Trust [WT 226619/Z/22/Z].

REFERENCES

[1] Jolley et al. BMJ open 2012; [2] Degenhardt et al. Lancet Glob Health 2023; [3] WHO TB data; [4] Azbel et al. Plos One 2013; [5] Public Health Center of the MoH of Ukraine - 2020 IBBS; [6] Kamarulzaman et al. Lancet 2016; [7] Stone et al. Lancet Infect Dis 2018; [8] Altice et al. Lancet 2016; [9] Biadglene et al. Epidemiol infect 2015; [10] Culbert et al. J neuroimmune Pharmacol. 2016

Jack.Stone@bristol.ac.uk