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Table S3: Model parameters

Parameter	Mean and 95%CI of generated distribution	Sampling distribution and parameters (if not sampled, then blank)	Reference/notes
Average duration of injection until final cessation in years ($1/\mu_3$)	20 (5.8-34.2)	uniform (min=5, max=35)	See text. Assumed longer duration than self-reported current average duration injecting, consistent with modeling estimates from St. Petersburg ⁹
Proportion of PWID who are female (p_{female})	0.36 (0.31, 0.41) -Ekaterinburg 0.25 (0.21, 0.30) - Omsk	Beta (alpha=136, beta=244) in Ekaterinburg Beta (alpha=89, beta=261) in Omsk	Estimated from Ekaterinburg and Omsk data
Proportion of PWID in high-risk group (ever incarcerated) at entry to injecting (p_{prison})	0.15 (0.11, 0.19) -Ekaterinburg 0.10 (0.07, 0.13) - Omsk	Beta (alpha=45, beta=255) in Ekaterinburg Beta (alpha=35, beta=315) in Omsk	Estimated from Ekaterinburg and Omsk data
Opioid overdose mortality rate per year (μ_1)	0.020 (0.006-0.034)	uniform (min 0.005, max 0.035)	Estimated 2%/year in St Petersburg. ^{10,14}
Non-overdose mortality rate per year (μ_2)	1/50		Estimated assuming injection initiation at 20 years and life expectancy at 70 ²⁰
Injection-related infection rate per year in latent phase (β_{inj})	varied to fit model		
Sexual-related infection rate per year in latent phase (β_{sex})	varied to fit model		
Seed HIV prevalences in 1996 (by risk and sex in Ekaterinburg and risk only in Omsk due to minimal differences by sex)	varied to fit model		
Relative risk of injecting related HIV transmission if in high-risk group compared to low risk (RR^{high})	varied to fit model		
Relative risk of injecting related HIV transmission if female compared to male (RR^{female})	varied to fit model		
Rate from low risk to high risk group (r)	varied to fit model		
ART recruitment rate at baseline in the community (α_c)	varied to fit model		
Cofactor increase in HIV transmission probability during: Initial acute phase of high viremia (ϵ)	14.5 (3.7 – 25.5)	uniform (min=3, max=26)	21,22
Cofactor increase in HIV transmission probability during: pre-AIDS phase of high viremia (ι)	4 (1.2 - 6.8)	uniform (min=1, max=7)	21,22
Duration of initial period of high viremia in years ($1/\gamma$)	0.24		21
Duration of latent period of viremia in years ($1/\kappa$)	8.38		21,23
Duration of pre-AIDS period of high viremia in years ($1/\tau$)	0.75		21,23
Duration of AIDS period in years ($1/\theta$)	0.83		21,23
ART discontinuation rate per year when not on OAT (δ_c)	6.5% (3%-10%)	uniform (min 3%, max 10%)	assumed similar to European data ^{24,25}
Rate of leaving harm reduction intervention per year (ζ)	0.45 (0.36 –0.54)	uniform (min=0.36, max=0.54)	Assumed similar average duration on OAT as in other lower/middle income settings ²⁶

Figure S1: Number of HIV tests and new HIV diagnoses among drug users in Omsk Oblast (Federal AIDS Center data)¹

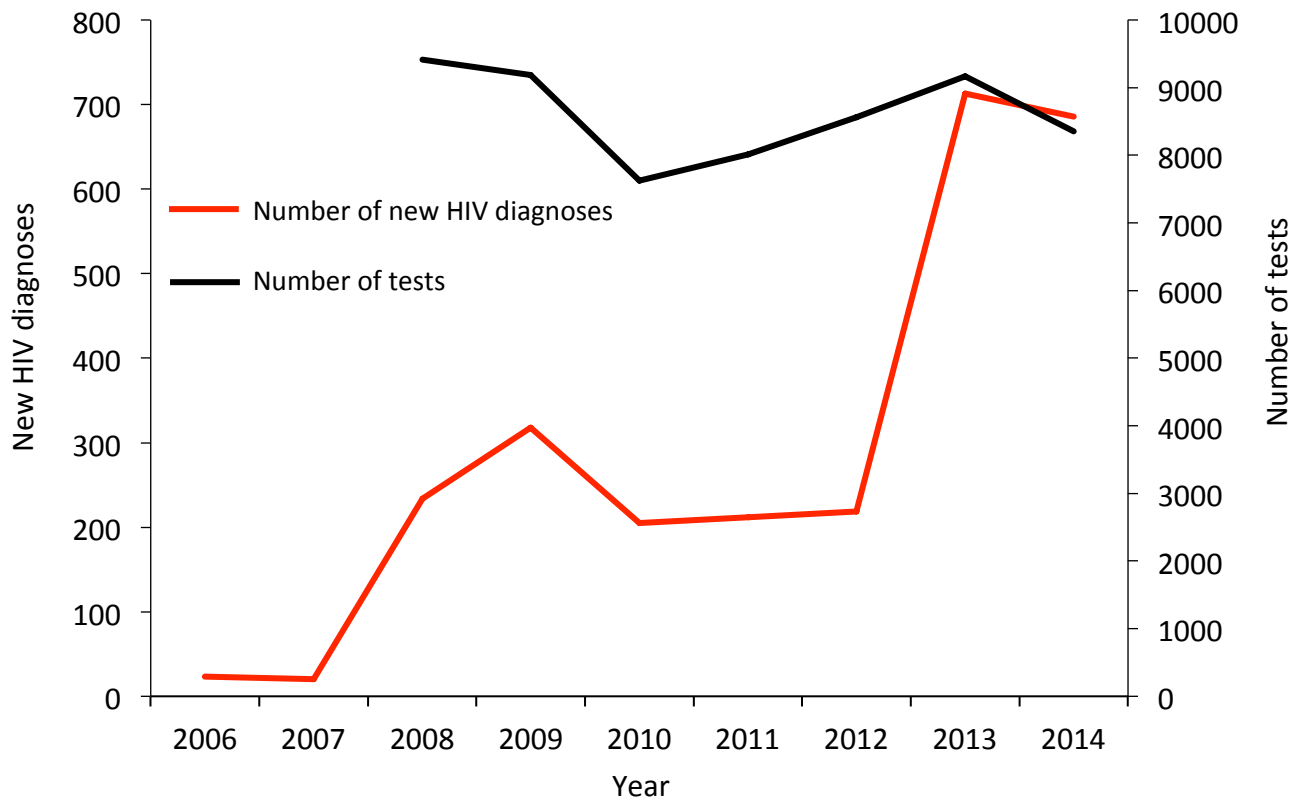


Figure S2. Model schematics for HIV progression and ART model components among PWID. The model is additionally stratified by the components in Figure S2. All stages are stratified by injecting risk (indicated by superscript i , where $i=0$ for low risk and 1 for high risk), sex (superscript j , where $j=0$ for males and 1 for females) and intervention status (indicated by subscript k , where $k=0$ for off and $k=1$ for on).

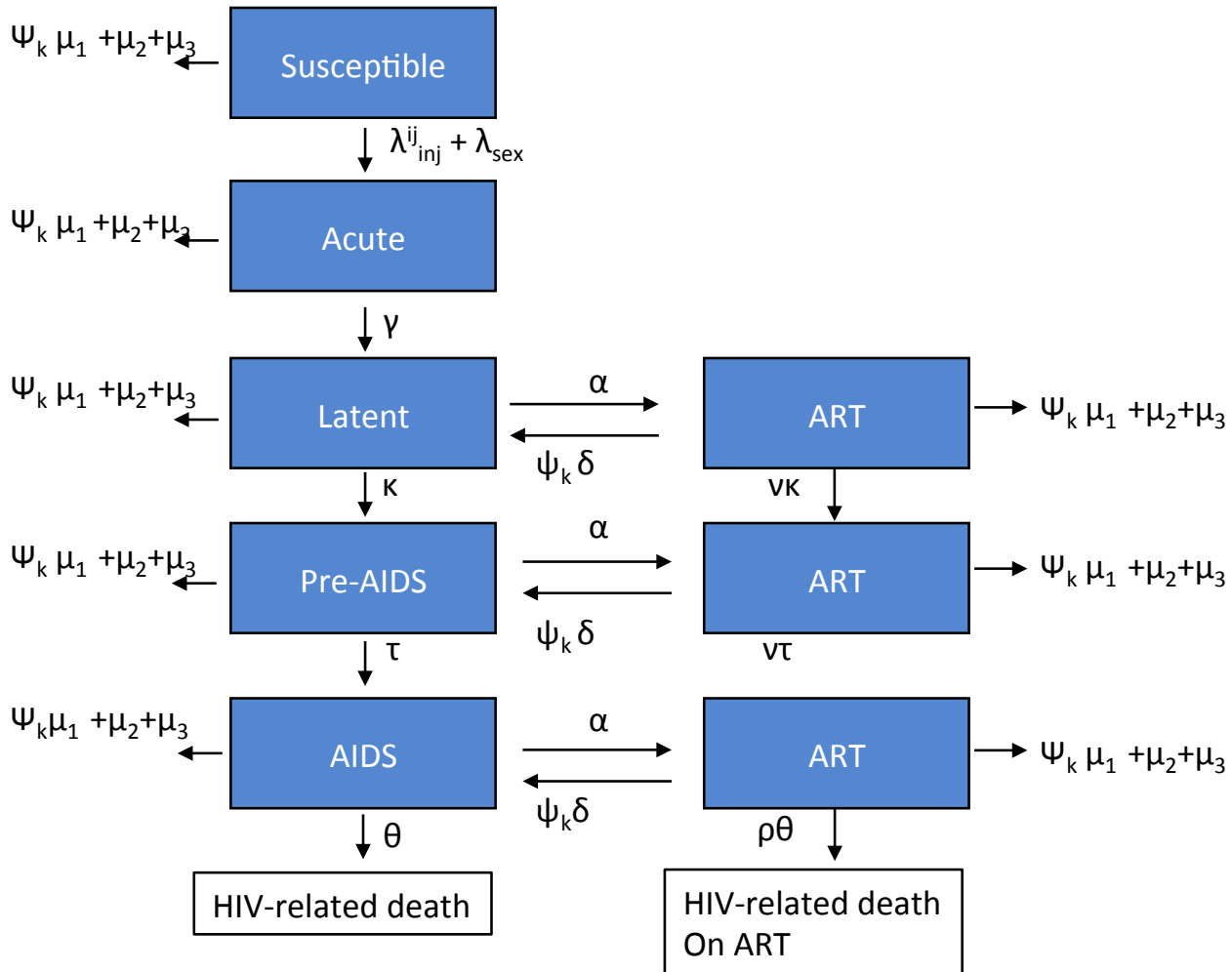


Figure S3. Model schematic for stratification of model based on (A) harm reduction program status and (B) risk. If recruited onto harm reduction with OAT, then a proportion of PWID die when transitioning on and off OAT (see text for details).

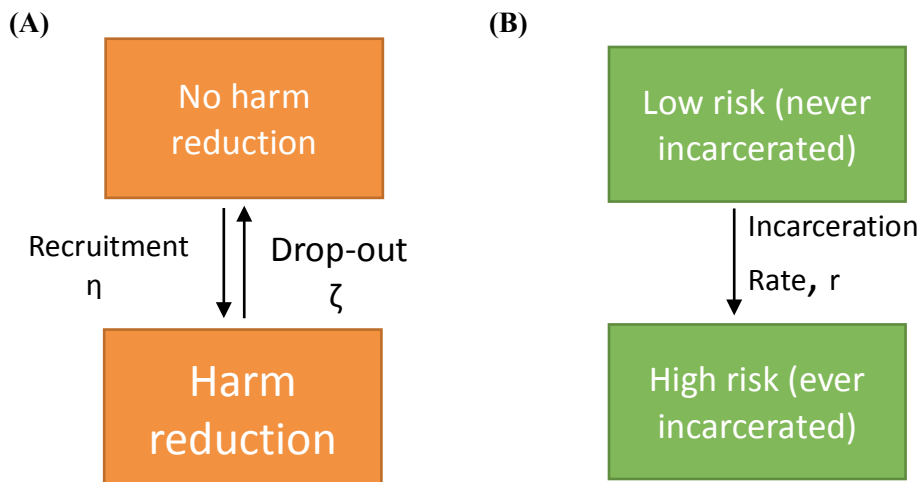


Figure S4. Calibration of HIV prevalence by sex in (A: males, B: females) Omsk and (C: males, D: females) Ekaterinburg. Observed data shown as circles (with 95% confidence intervals as whiskers). Solid line denotes median model projection, with dashed lines representing the 2.5%-97.5% interval.

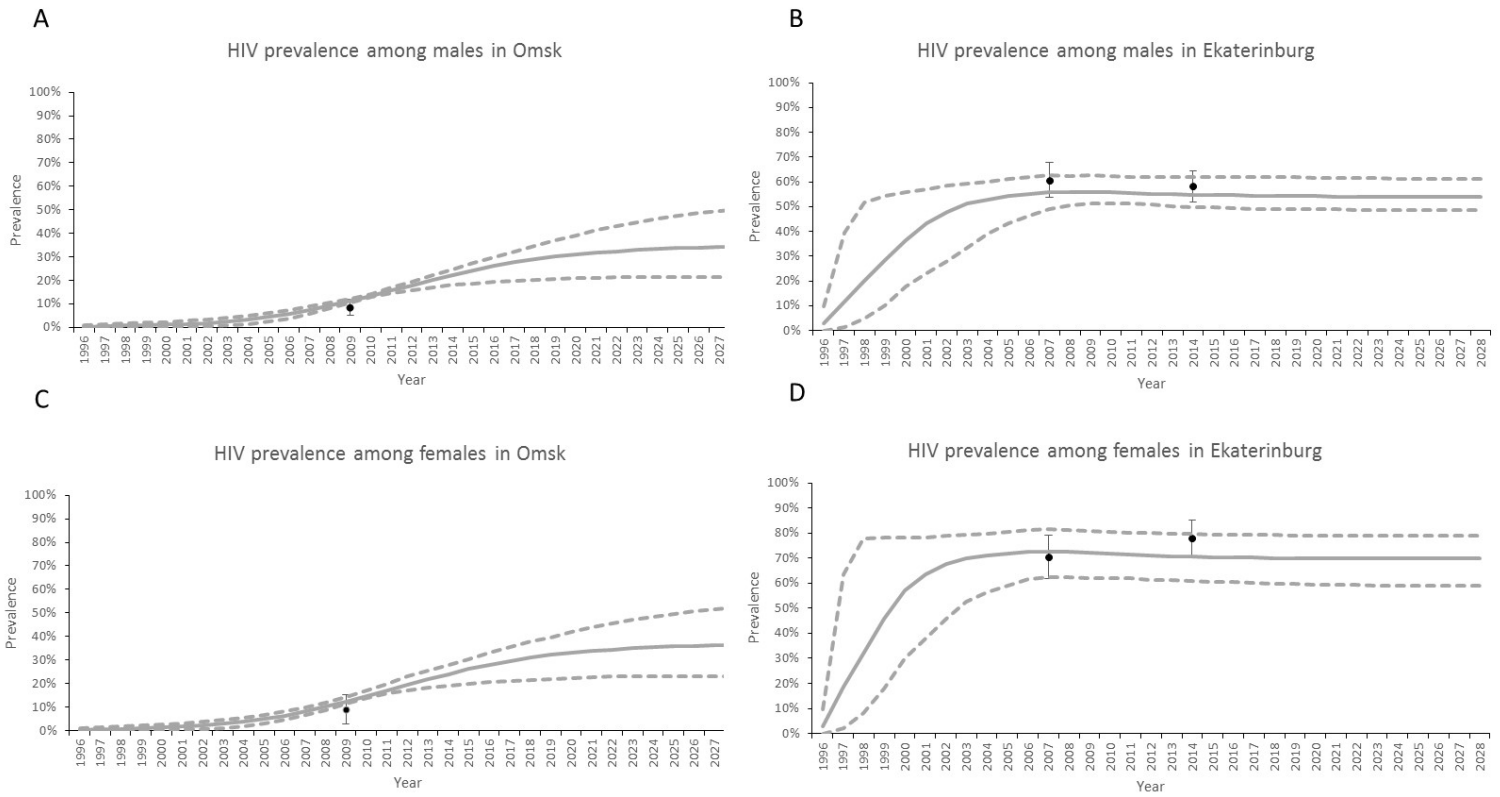


Figure S5. Calibration of HIV prevalence by history of incarceration in (A: never, B: ever) Omsk and (C: never, D: ever) Ekaterinburg. Observed data shown as circles (with 95% confidence intervals as whiskers). Solid line denotes median model projection, with dashed lines representing the 2.5%-97.5% interval.

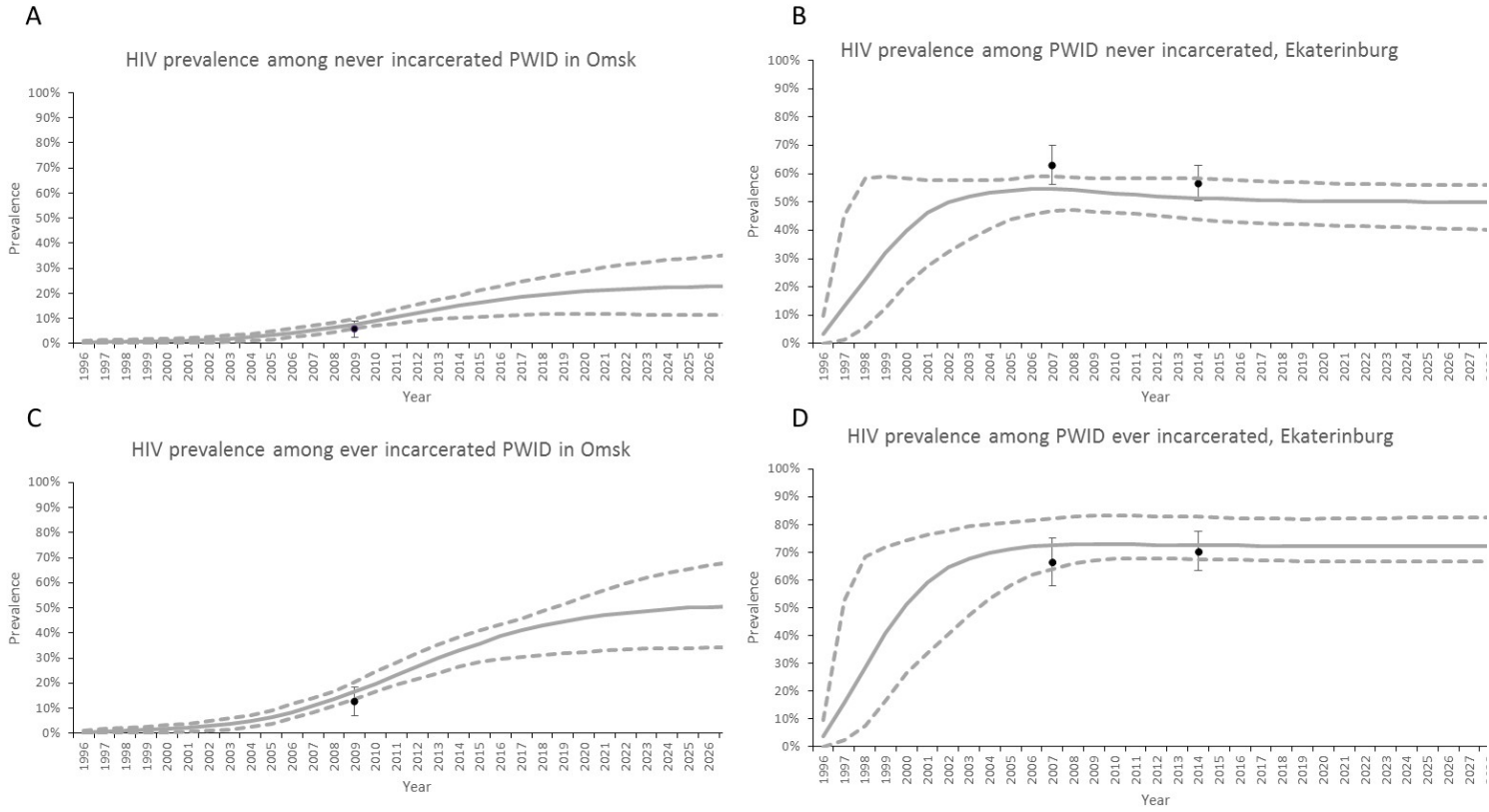
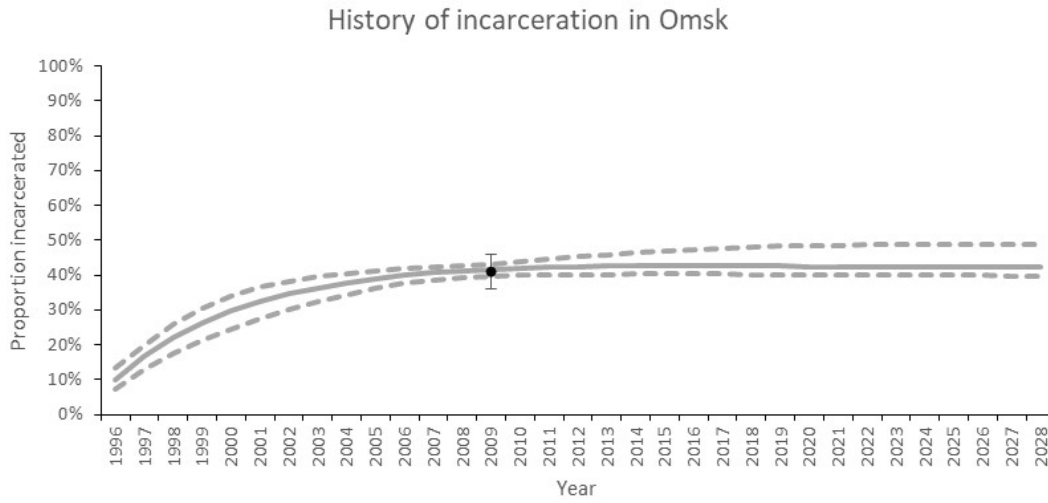


Figure S6. Calibration of proportion of PWID with a history of incarceration in (A) Omsk and (B) Ekaterinburg (dashed lines represent 95% CI). Observed data shown as circles (with 95% confidence intervals as whiskers). Solid line denotes median model projection, with dashed lines representing the 2.5%-97.5% interval.

A



B

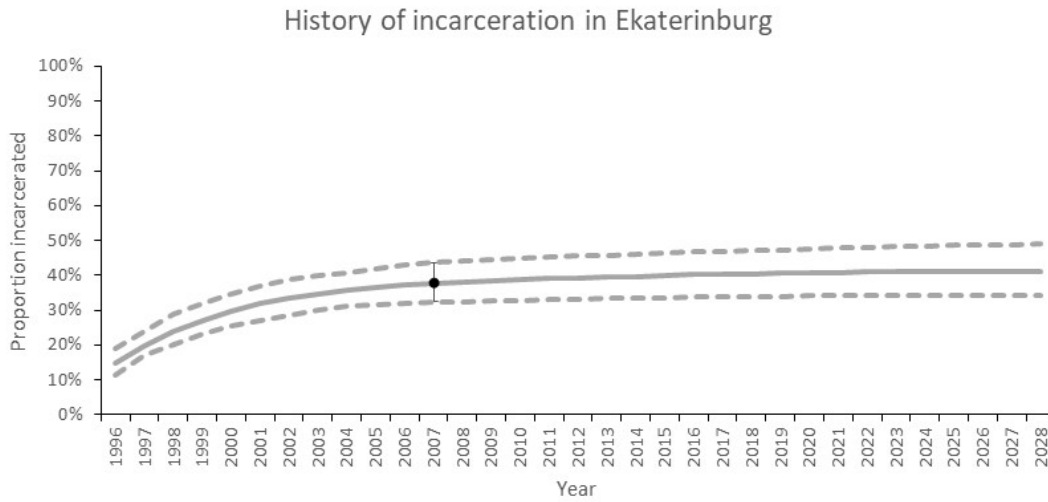


Figure S7. Calibration of proportion of new cases attributed to sexual transmission in (A) Omsk and (B) Ekaterinburg (dashed lines represent 95% CI). Observed data shown as circles (with 95% confidence intervals as whiskers). Solid line denotes median model projection, with dashed lines representing the 2.5%-97.5% interval.

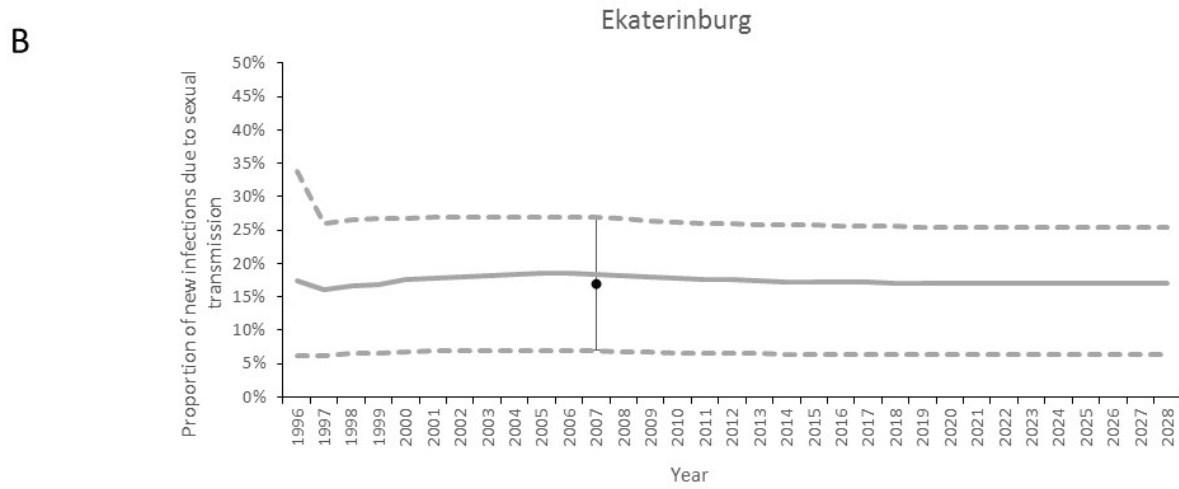
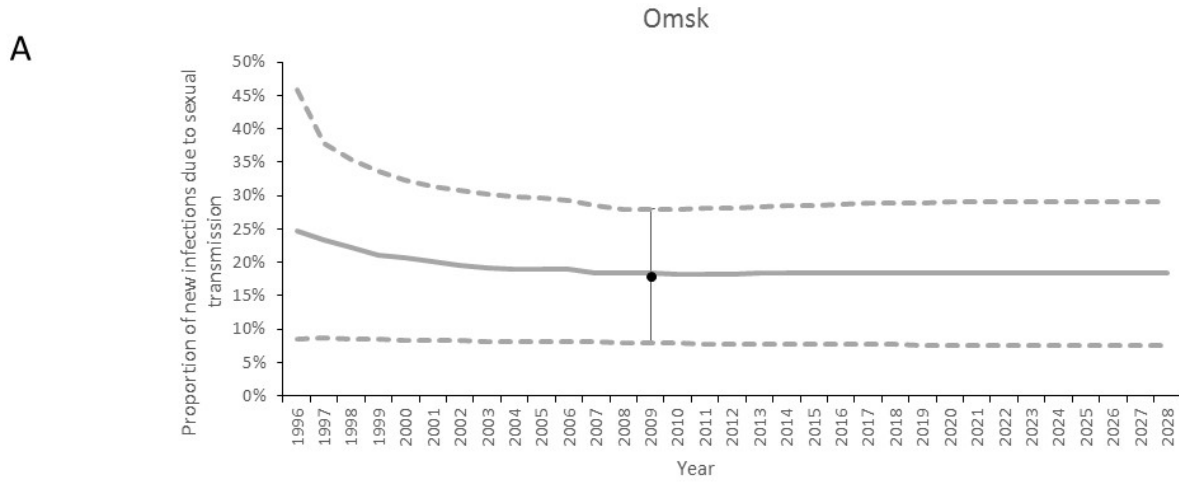


Figure S8. Model projections for the proportion of ART coverage among PWID in (A) Omsk and (B) Ekaterinburg in the following scenarios: base-case (blue), harm reduction scale-up (green), and harm reduction plus ART scale-up (orange). Observed data shown as circles (with 95% confidence intervals as whiskers). Solid lines denotes median model projections.

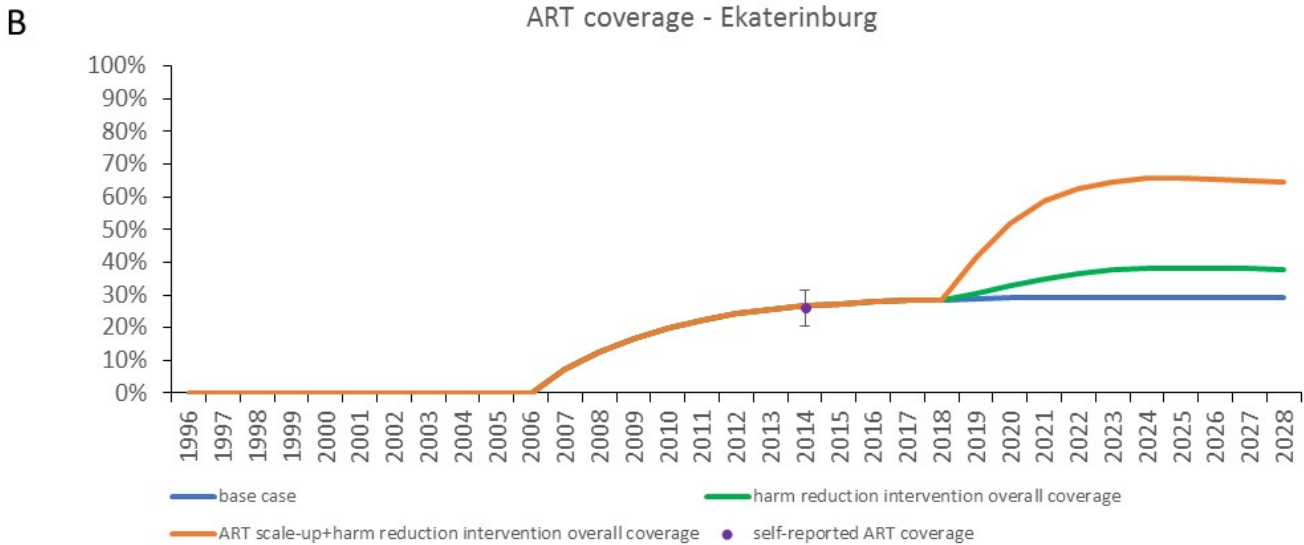
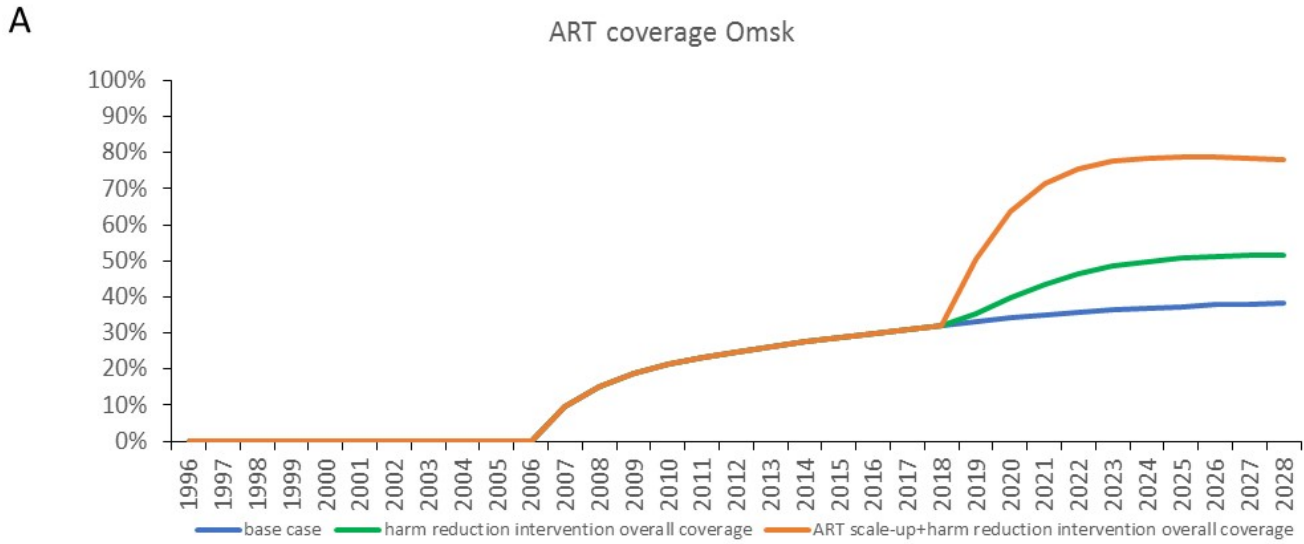


Figure S8. Model projections of PWID population sizes in Omsk (A) and Ekaterinburg (B) using a population scaled to 10,000 PWID in 1996.

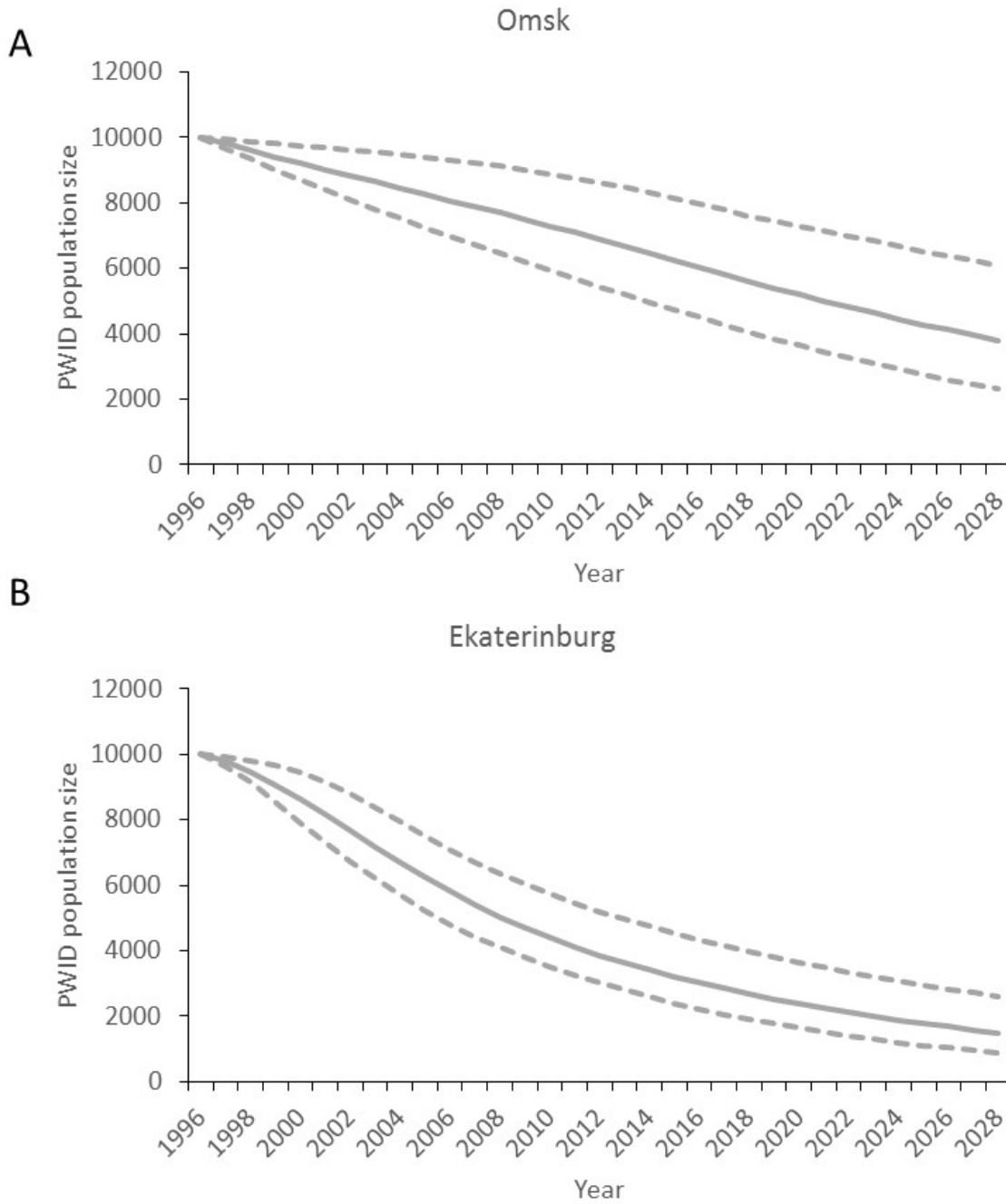


Figure S9. All-cause crude death rates per 100 population among PWID in Omsk (A) and Ekaterinburg (B). Solid lines represent median death rates and dashed lines represent 2.5 – 97.5 interval for base case rate.

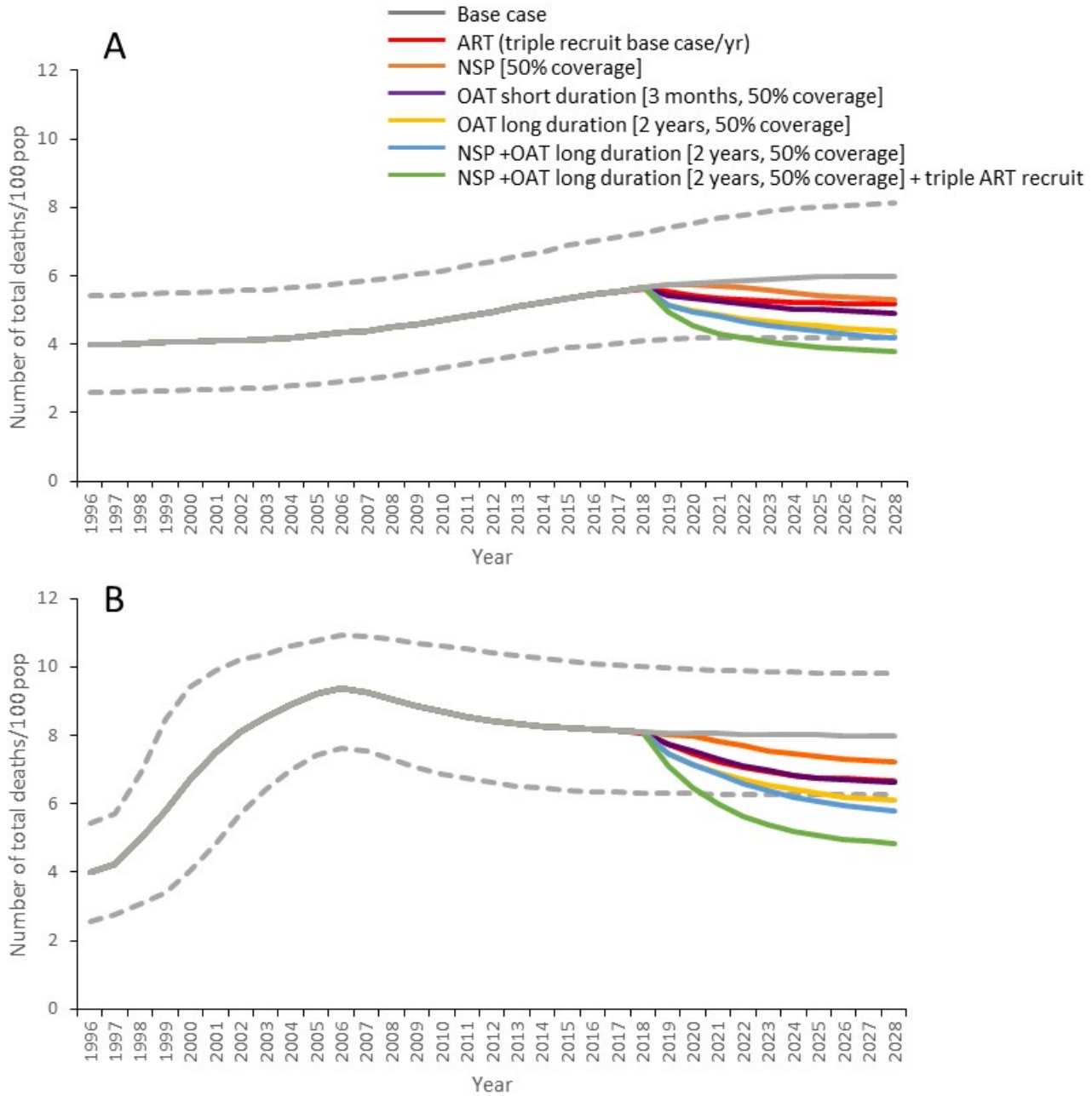


Figure S10. HIV-related crude death rates per 100 population among PWID in Omsk (A) and Ekaterinburg (B). Solid lines represent median death rates and dashed lines represent 2.5 – 97.5 interval for base case rate.

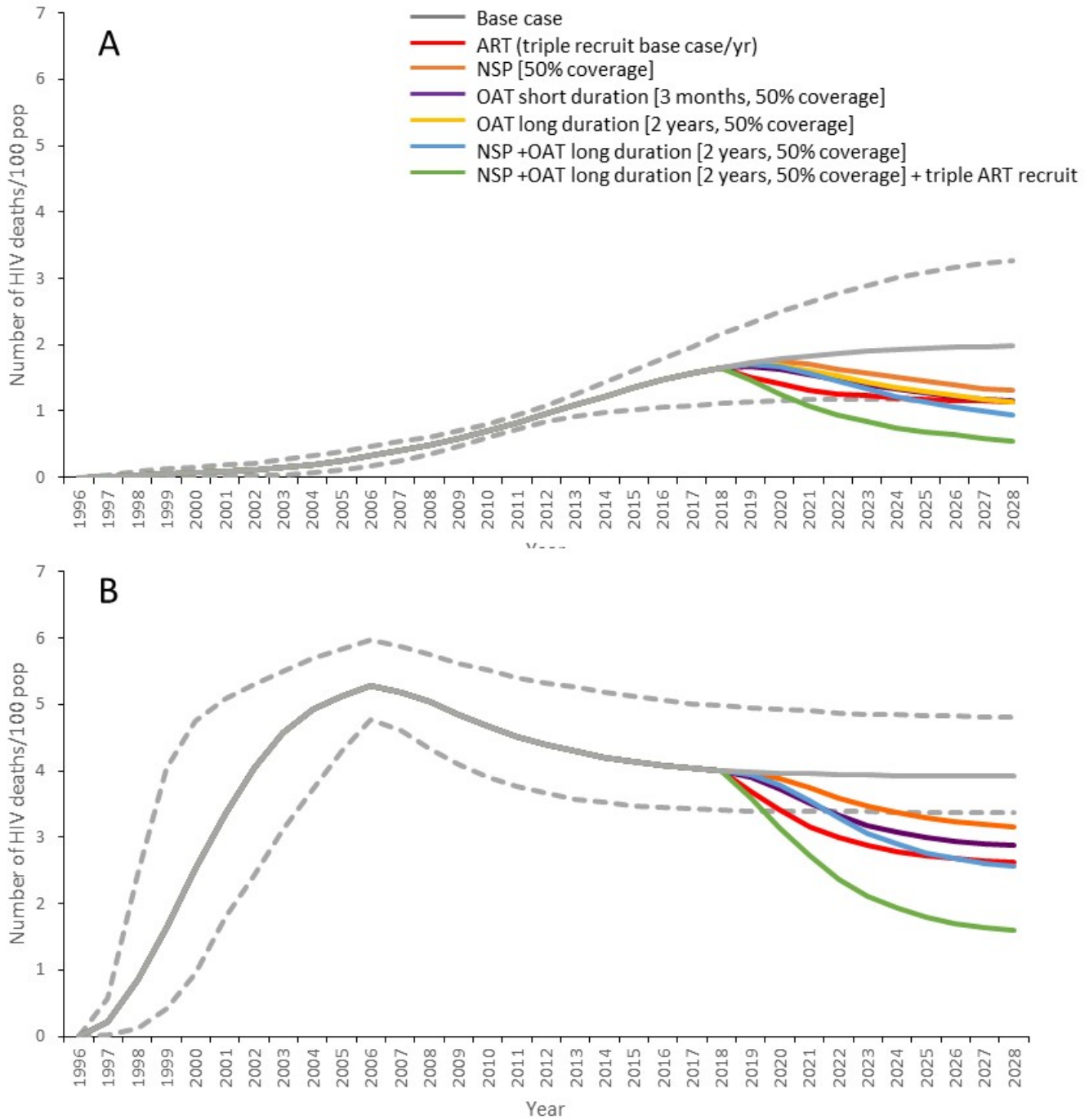


Figure S11. Overdose-related crude death rates per 100 population among PWID in Omsk only. Solid lines represent median death rates and dashed lines represent 2.5 – 97.5 interval for base case rate.

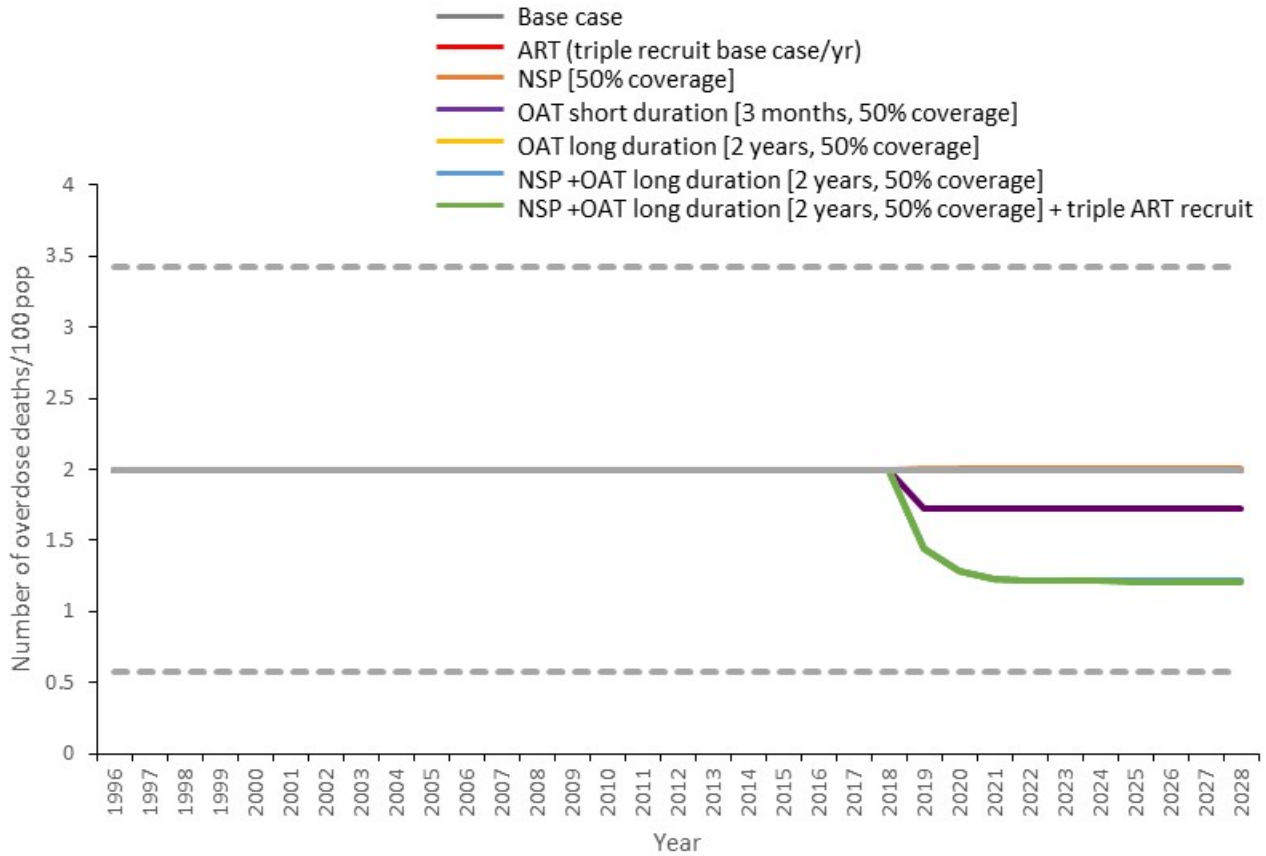


Figure S12: Model projections of impact of integrated harm reduction and HIV services on HIV prevalence among males (A) and females (C) in Omsk and males (B) and females (D) in Ekaterinburg. Median trajectories are shown and dashed lines represent 2.5-97.5 uncertainty bounds for the base case.

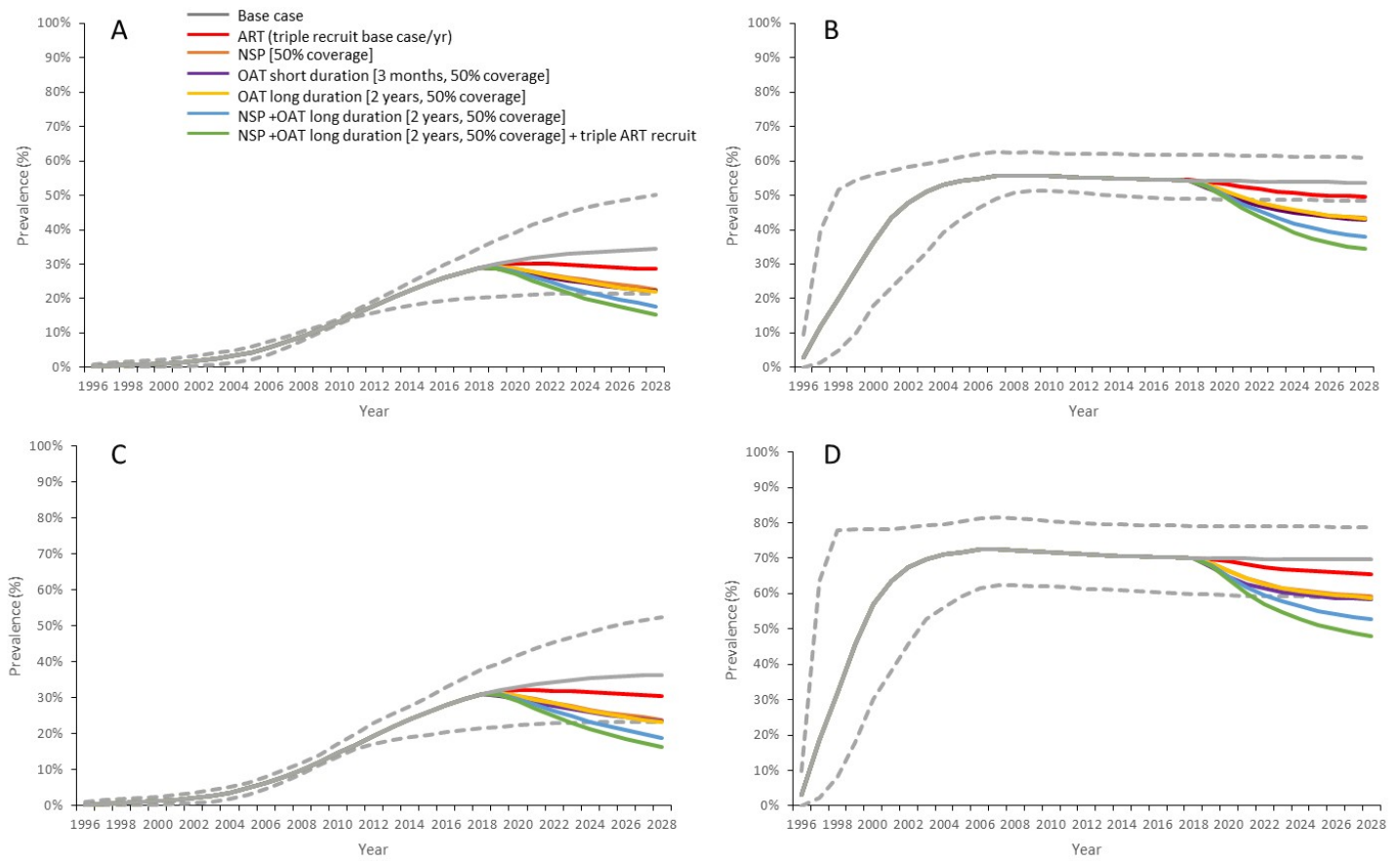
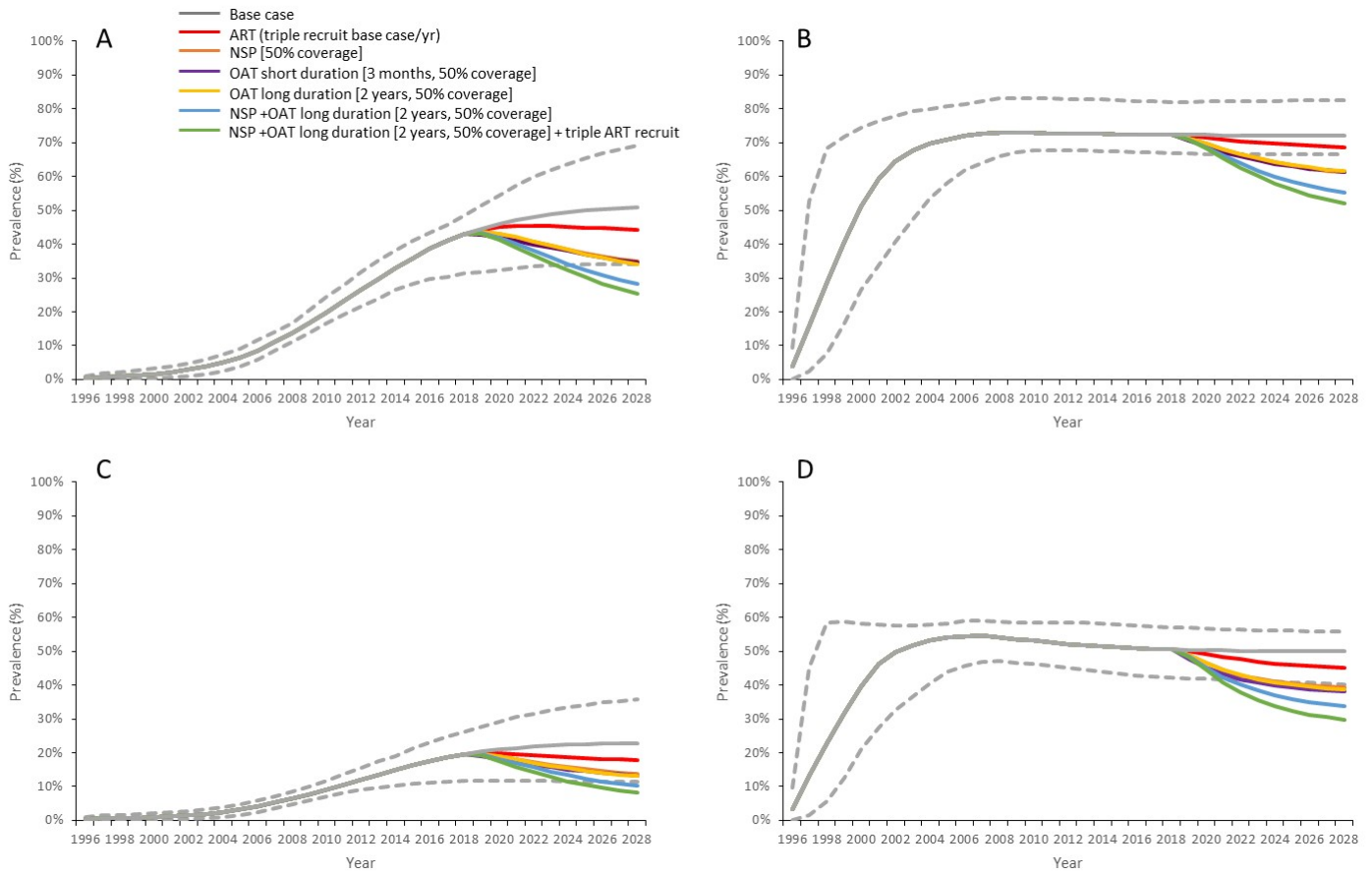


Figure S13: Model projections of impact of integrated harm reduction and HIV services on HIV prevalence among ever incarcerated (A) and never incarcerated (C) PWID in Omsk and ever incarcerated (B) and never incarcerated (D) PWID in Ekaterinburg. Median trajectories are shown and dashed lines represent 2.5-97.5 uncertainty bounds for the base case.



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