IMPACT OF HCV TESTING AND TREATMENT SERVICES ON HCV TRANSMSSION AMONG MEN WHO HAVE SEX WITH MEN AND WHO INJECT DRUGS IN SAN FRANCISCO: A MODELLING ANALYSIS

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BACKGROUND

With estimated prevalence levels that are 6.2 and 1.5 times greater compared to the general population[1], HIV-positive and HIV-negative **men who have sex with men (MSM)** represent, respectively, key target groups in the US national and global campaigns to eliminate HCV[2,3].

10-20% of MSM are estimated to have ever injected drugs (MSM-IDU)[4-6]; this group has a 30% higher average HCV prevalence compared to MSM who never injected drugs[1].

So far, HCV transmission modelling studies among MSM have not considered injection drug use as driver of HCV transmission in this population and whether HCV services are adequately reaching **MSM-IDU.**

CONTEXT AND OBJECTIVES

CONTEXT:

- San Francisco introduced **the first city-focused strategic plan to eliminate HCV in the US in 2016—*End Hep C SF*—**to provide key prevention, education, testing, treatment and linkage activities prioritizing communities hardest hit by HCV, including MSM and people who inject drugs.
- Meanwhile, the **COVID-19 pandemic led to broad disruptions i**n the provision of HCV testing and treatment in San Francisco and in the US[7-10].

OBJECTIVES:

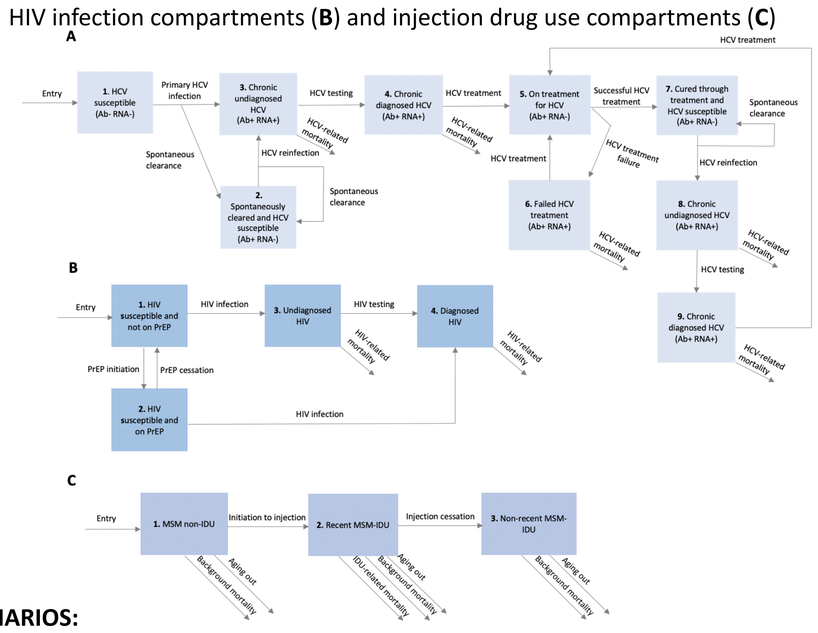
Use epidemic modelling to:

- Evaluate progress achieved towards HCV elimination for MSM-IDU in San Francisco
- Assess whether current HCV testing and HCV treatment rates are likely to achieve the WHO HCV elimination target of reducing HCV incidence by 80% until 2030

METHODS

Model: A dynamic, deterministic, compartmental model of HCV and HIV transmission among MSM

Figure 1: Model schematic illustrating the HCV infection compartments (**A**), HIV infection compartments (**B**) and injection drug use compartments (**C**)



SCENARIOS:

- **Status quo (SQ)**: No rebound in COVID-19 related disruptions* in HCV and HIV testing and treatment and PrEP use
- **Scenario 1:** Rebound in COVID-19 related disruptions in HCV and HIV testing and treatment and PrEP use by the end of 2025 (i.e., slow recovery)
- **Scenario 2:** Rebound in COVID-19 related disruptions in HCV and HIV testing and treatment and PrEP use by the end of 2022 (i.e., rapid recovery)
- **Scenario 3:** Scenario 2 + scale-up of high-coverage needle and syringe programs (HCNSP) among recent MSM-IDU (from 74% to 100%) over 2022-2026 and then sustained
- **Scenario 4:** Scenario SQ and all HCV testing and HCV treatment is removed over 2023-2030 (remove standard-of-care (SOC)).
- **Scenario 5:** No COVID-19 related disruptions

**Assumptions: a 59% decrease in the rates of HCV testing and treatment over Mar–Dec 2020[7,8], a 31% decrease in the rates of HIV testing and treatment over Mar–Jun 2020[9] and a 35% decrease in PrEP initiation over Mar 2020–Mar 2021[10], compared to prior levels*

Model calibrated using an approximate Bayesian computation Sequential Monte Carlo (ABC SMC) method to surveillance, research and clinical data among MSM in San Francisco through:

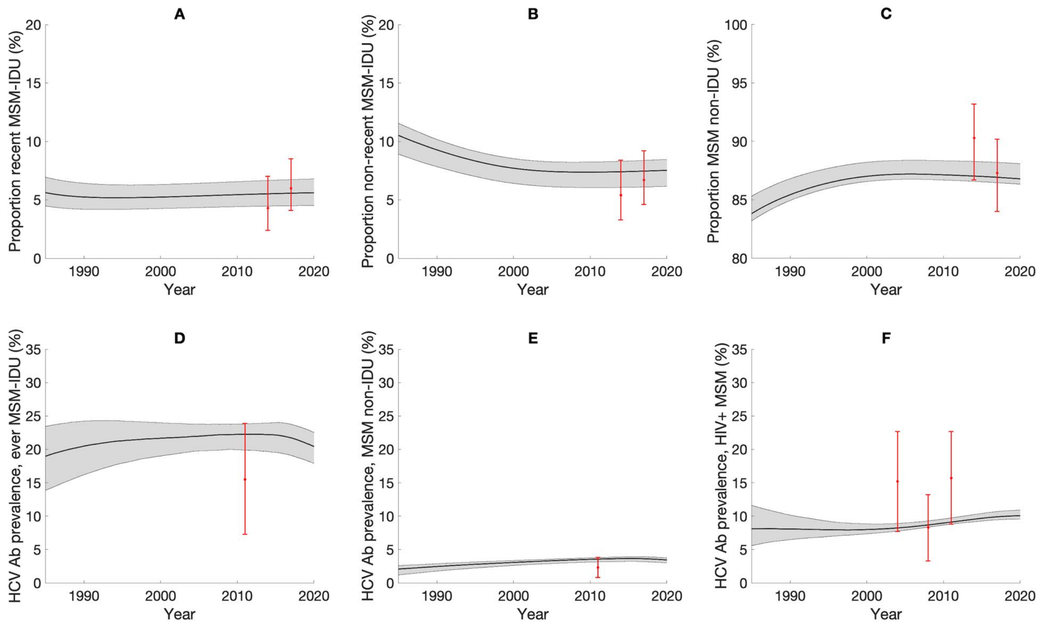
- The National HIV Behavioural Surveillance survey (NHBS)
- Street intercept surveys done by the San Francisco AIDS Foundation (STOP AIDS)
- Medical record data at the community health center Strut

Table 1: Data used to calibrate the model

Name	Estimate (95% CI)	Date of estimate	Data source
MSM population size	69,974 (65,523–74,323)	2017	Pooled estimate informed by several studies[11]
HCV Ab prevalence among ever MSM-IDU	15.5% (7.3% - 23.9%)	2011	Published NHBS estimate[6]
HCV Ab prevalence among MSM non-IDU	2.3% (0.8% - 3.8%)	2011	Published NHBS estimate[6]
HCV Ab prevalence among HIV+ MSM	15.2% (7.7%-22.7%)	2004	Published NHBS estimate[12]
	8.3% (3.3% - 13.2%)	2008	Published NHBS estimate [12]
	15.7% (8.8-22.7%)	2011	Published NHBS estimate[6]
HCV Ab prevalence among HIV- ever MSM-IDU	9.5% (2.7% - 22.6%)	2011	Published NHBS estimate[6]
HIV prevalence among ever MSM-IDU	47.3% (35.6% - 59.3%)	2011	Unpublished NHBS estimate
	44.1% (27.2% - 62.1%)	2014	Unpublished NHBS estimate
	32.8% (21.3% - 46.0%)	2017	Unpublished NHBS estimate
HIV prevalence among MSM non-IDU	18.8% (15.1% - 23.0%)	2011	Unpublished NHBS estimate
	17.4% (13.4% - 22.0%)	2014	Unpublished NHBS estimate
	17.3% (13.8% - 21.3%)	2017	Unpublished NHBS estimate
Proportion of HCV diagnosed MSM who were ever treated	63.6% (45.1% - 79.6%)	2018	Unpublished estimate derived from NHBS and STRUT (pooled data)
Proportion of HIV-positive MSM who are diagnosed	78.3% (69.8% - 86.8%)	2004	Published NHBS estimate[13]
	82.0% (74.8 - 89.1%)	2008	Published NHBS estimate[13]
	92.7% (86.1% - 96.8%)	2011	Unpublished NHBS estimate
	95.7% (88.9% - 99.1%)	2014	Unpublished NHBS estimate
	95.7% (89.4% -98.8%)	2017	Unpublished NHBS estimate
Proportion of HIV negative MSM on PrEP	1.4% (0.4% - 3.2%)	2011	Published NHBS estimate[14]
	9.8% (6.6% - 13.7%)	2014	Published NHBS estimate[14]
	41.8% (37.1% - 46.7%)	2017	Pooled data based on published NHBS estimate[14] and unpublished STOP AIDS estimate
	39.4% (29.4% - 50.0%)	2018	Unpublished STOP AIDS estimate
	45.3% (36.5% - 54.4%)	2019	Unpublished STOP AIDS estimate
Proportion of recent MSM-IDU	4.3% (2.4% - 7.0%)	2014	Unpublished NHBS estimate
	6.0% (4.1% - 8.5%)	2017	Unpublished NHBS estimate
Proportion of non-recent MSM-IDU	5.4% (3.3% - 8.4%)	2014	Unpublished NHBS estimate
	6.7% (4.6% - 9.2%)	2017	Unpublished NHBS estimate
Proportion of MSM non-IDU	90.3 % (86.7% - 93.2%)	2014	Unpublished NHBS estimate
	87.3% (84.0% - 90.2%)	2017	Unpublished NHBS estimate

RESULTS

Figure 2: Model fit to selected calibration data



Estimated* proportion of MSM by injection status:

- **Recent MSM-IDU: 5.1%** (95% CrI: 4.3%-6.2%)
- **Non-recent MSM-IDU: 7.8%** (95% CrI: 6.4%-8.5%)
- **MSM non-IDU: 87.1%** (95% CrI: 86.4%-88.3%)

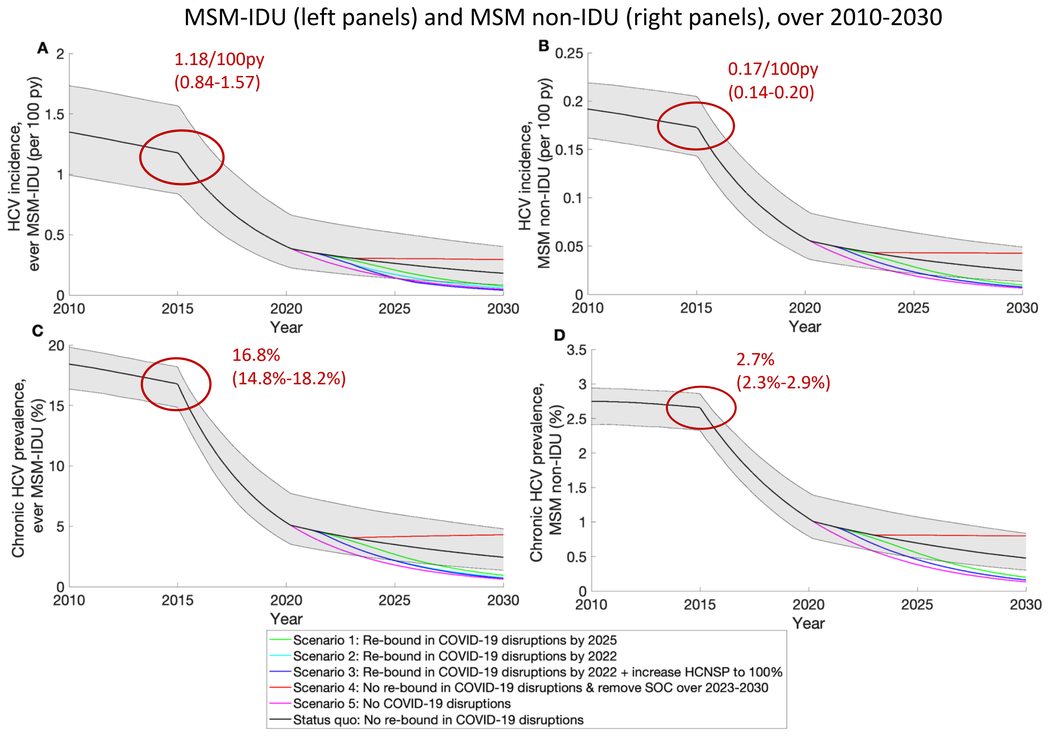
Estimated* proportion of incident HCV infections attributed to IDU:

- **Among all MSM: 43.3%** (95% CrI: 33.8% - 51.8%)
- **Among ever MSM-IDU: 85.7%** (95% CrI: 80.2% - 89.5%)

**based on 2022 projections*

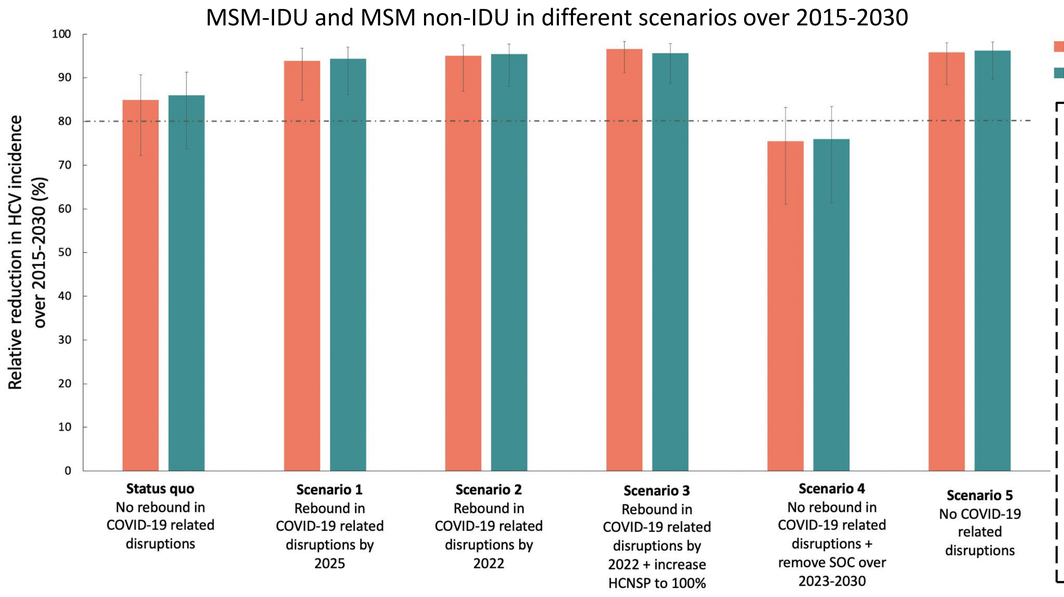
Note: *Black lines represent the median model projections and the shaded area represents the 95% credible intervals. Calibration data points with their 95% confidence intervals are indicated in red.*

Figure 3: Projected HCV incidence and chronic HCV prevalence among ever MSM-IDU (left panels) and MSM non-IDU (right panels), over 2010-2030



Note: *The shaded area reflects the 95% CrI for the scenario in which we assume no re-bound in COVID-19 related disruptions. All lines show median projections.*

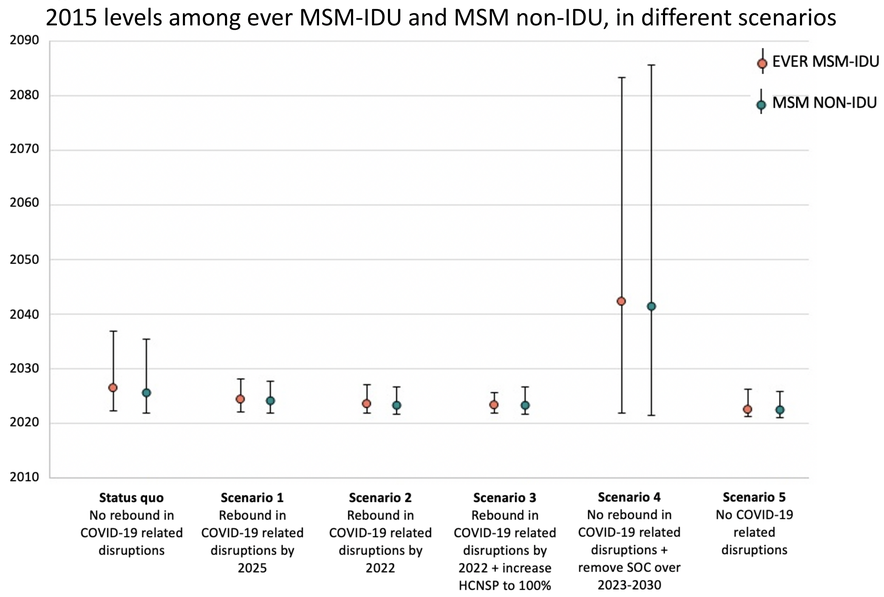
Figure 4: Modelled relative reduction in HCV incidence among ever MSM-IDU and MSM non-IDU in different scenarios over 2015-2030



- Scenarios SQ, 1-3 and 5 indicate very large and similar declines in HCV incidence over 2015-2030 (~85%-95%)
- Most of the declines in HCV incidence over 2015-2030 are estimated to be attributed to the impact of HCV testing and treatment (Table 2)
- Scenario 4: ~70% reduction in HCV incidence and only 20% of model runs projecting an 80% decrease in incidence by 2030

Note: *Bars show the median projections, with whiskers showing the 95% credibility.*

Figure 5: Estimated year when HCV incidence decreases to 80% compared to 2015 levels among ever MSM-IDU and MSM non-IDU, in different scenarios



Note: *Dots represent the median value and whiskers represent 2.5th and 97.5th percentiles.*

Table 2: Estimated contribution of HCV testing and HCV treatment to the decline in HCV incidence among MSM

	EVER MSM-IDU	MSM NON-IDU
Full contribution of HCV testing and treatment, 2015-2022	86% (80.5% - 94.9%)	92.2% (87.1% - 100%)
Contribution of scaled-up HCV testing and treatment, 2015-2022	65.4% (58.9% - 72.7%)	69.6% (63.2% - 75.4%)
Full contribution of HCV testing and treatment, 2015-2030	75.8% (66.7% - 89.5%)	84.5% (75.7% - 98.8%)
Contribution of scaled-up HCV testing and treatment, 2015-2030	54.1% (46.9% - 64.6%)	59.3% (51.9% - 68.9%)

CONCLUSIONS

- Although MSM-IDU represent only a small fraction (13%) of MSM, injection drug use accounts for nearly half (43%) of incident HCV cases.
- HCV incidence is estimated to have decreased considerably since 2015 among ever MSM-IDU and MSM non-IDU, and is projected to continue declining. This decline is attributed in large part to ongoing levels of HCV screening and treatment. Even if we assume that the reductions in HCV/HIV services due to COVID-19 related disruptions do not rebound at all, we project that the elimination target will be achieved before 2030.
- Going forward, it is essential that:
  - Existing HCV interventions are sustained
  - Expand data collection to monitor HCV incidence and chronic prevalence (very limited data so far) and access to HCV testing/treatment to strengthen projection modelling and programmatic response
  - Examine whether HCV services are serving other high-risk groups in San Francisco, including PWID-MSM who seem to have greater socioeconomic disadvantage and lower engagement with services than MSM-IDU[15]

References: [1]Jin et al *Lancet Gastroenterol Hepatol* 2022 ; [2]U.S. Department of Health and Human Services 2020. Viral Hepatitis National Strategic Plan for the United States: A Roadmap to Elimination (2021–2025); [3]WHO. Global health sector strategy on viral hepatitis 2016-2021 2016; [4]Ibañez et al AIDS 2005; [5]Ghanem et al AIDS Behav 2011; [6]Raymond HF et al Sex Transm Dis 2012; [7]Facente SN et al Public Health Rep 2022; [8]Hoenigl M et al Clin Infect Dis 2022; [9]EndHepC SF. Ending the Epidemics. Collective strategies for addressing HIV, hepatitis C and sexually transmitted infections in San Francisco 2020; [10]Huang YA et al Clin Infect Dis 2022 ; [11]Facente SN et al PLoS One 2018; [12]Raymond HF et al Sex Transm Dis 2011; [13]Raymond HF et al JAIDS 2013; [14]Chen YH AIDS Behav 2019; [15]Artenie et al Health Science Reports 2022.

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