

# ESTIMATING THE HCV TREATMENT REACH IN PEOPLE WHO INJECT DRUGS (PWID) NEEDED TO MEET 2030 WHO ELIMINATION TARGETS

Stevens W<sup>1</sup>, Marx SE<sup>2</sup>, Jiao S<sup>2</sup>, Collins MA<sup>2</sup>, Kaur J<sup>2</sup>, Jeffries D. 1

1. Medicus Economics, LLC, Boston, Massachusetts, USA; 2. AbbVie Inc., North Chicago, Illinois, USA

AbbVie funded this study and participated in the study design; study research; collection, analysis and interpretation of data, and writing, reviewing and approving of this publication. All authors had access to the data, and participated in the development, review, and approval, and in the decision to submit this publication. No honoraria or payments were made for authorship. Medical writing services were provided by Medicus Economics, LLC, and funded by AbbVie.

Stevens W is an employee of Medicus Economics, LLC. Medicus Economics has received funding from AbbVie Inc. for this project. Jeffries D is a contractor of Medicus Economics, LLC. Marx SE, Jiao S, Collins MA, and Kaur J are full-time employees of AbbVie and may hold AbbVie stock and/or stock options.

For additional information or to obtain a PDF of this poster



Scan QR code or utilize the following link to download an electronic version of this presentation and other AbbVie 2022 INHSU scientific presentations: <https://abbvie1.outsystemsenterprise.com/GMAEvent/Publications/Assets.aspx?ConferenceId=459>

QR code expiration: September 19, 2023

To submit a medical question, please visit [www.abbviemedinfo.com](http://www.abbviemedinfo.com)

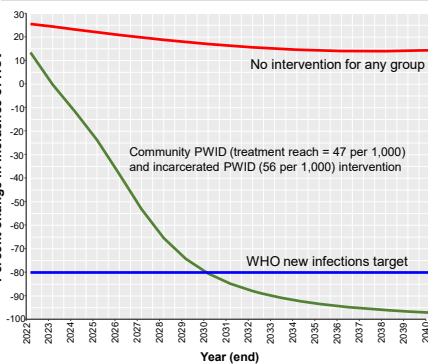
## Background and Objective

- New treatments known as direct-acting antivirals (DAAs) have revolutionized HCV care, with cure rates of over 95%, providing a unique opportunity for HCV elimination.<sup>1</sup> Since DAAs became available in 2013, they have been shown to reduce the risk of liver failure and liver cancer<sup>2</sup> and improve patients' quality of life.<sup>3</sup> In 2016, WHO proposed eliminating HCV as a public health threat by 2030, targeting an 80% reduction in new chronic infections from 2015 levels.<sup>4</sup>
- Some governments are turning to epidemiologic models to inform the levels of treatment with DAAs required to meet these targets.<sup>5</sup> Yet, many countries are on track to miss the targets because they are not fully informed on where best to invest in elimination,<sup>6</sup> despite HCV elimination being highly cost-effective.<sup>7</sup>
- In many countries the 'force of infection' has shifted to a small number of high-risk populations as the primary avenue of infection,<sup>8</sup> preventing incidence rates of HCV from being controlled. The most significant of these populations in the United States are people who inject drugs (PWID),<sup>9</sup> with a seroprevalence above 50%.<sup>10</sup> Simultaneously many parts of the United States are experiencing an epidemic of prescription and illicit opioid use with corresponding large increases in HCV infection.<sup>11</sup>
- This study expands on an already validated HCV transmission model to estimate treatment levels in PWID that would enable the US to reach the WHO incidence elimination goal by 2030.

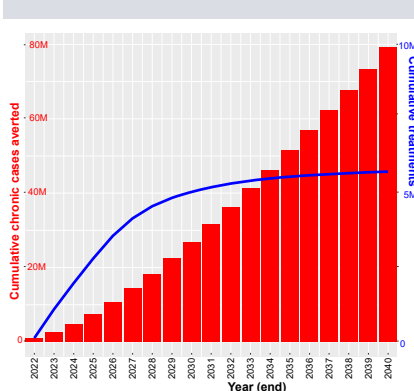
**Table 1:** Selected input parameters used in the model

Demographic, HCV infection and HCV treatment model parameters		
Input parameters	Value	References
Mean age at first injection	22.4 years	Hines et al (2020) <sup>16</sup>
Duration of injecting career	16.2 years	Hines et al (2020)
Rate of relapse to IDU by age category		
15-19	0.81	Evans et al (2009) <sup>17</sup>
20-25	0.78	Evans et al (2009)
26-29	0.012	Evans et al (2009)
30-64	0.043	Evans et al (2009)
Mortality rates		
Annual mortality rates for standard population (per 1000 person years)		
Less than 20 years	0.74	Xu et al (2020) <sup>18</sup>
20 -29-year-old	1.28	Xu et al (2020)
30 -39-year-old	2.49	Xu et al (2020)
Over 40 years	4.91	Xu et al (2020)
Annual mortality rates for PWID (per 1000 person years)		
Less than 20 years	4.24	Vlahov et al (2008) <sup>19</sup>
20 -29-year-old	7.88	Vlahov et al (2008)
30 -39-year-old	6.33	Vlahov et al (2008)
Over 40 years	14.86	Vlahov et al (2008)
Spontaneous clearance	0.297	Ayoub (2018) <sup>20</sup>

**Figure 2:** Estimated percent change (from 2015) in the incidence of HCV in the United States, 2022-2040, with and without treatment reach of 47 per 1000 and 56 per 1000 in the community PWID and prison populations, respectively.



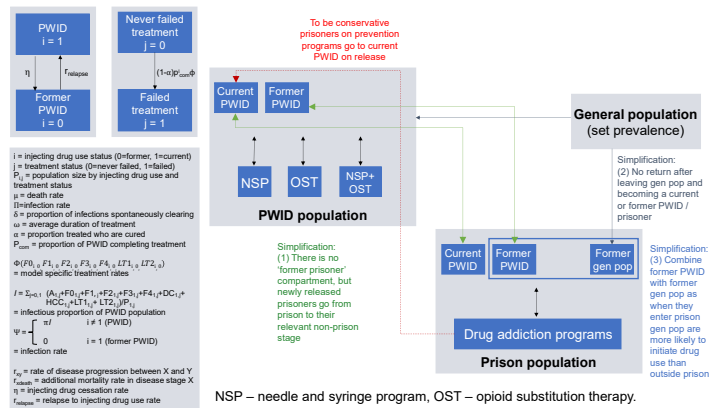
**Figure 3:** Cumulative chronic HCV cases averted, and DAA treatments delivered across all populations. (M=millions)



## Methods

- The model simulates the transition of subjects through the susceptible compartments and onto the acute and chronic stages. As subjects age, their mortality rate changes. This enables the model to reflect population loss more accurately through mortality. The model analyzes the role of various elimination strategies on treatment, incidence, prevalence, and transmission rates.
- We first undertook a review, looking at HCV transmission models published between 2000 and 2021, where we identified the model in Scott et al (2017)<sup>12</sup> as the most appropriate model to use as the basis, with the addition of treatment subgroups as used in the model published by Martin et al. (2013).<sup>13</sup> One advantage of drawing on these two model structures is that it is consistent and simple in terms of how it models infection - while also having high resolution through the disease stages. As such we can use inputs derived from and for different high-risk groups such as prisoners using the same underlying structure outlined for the PWID population.
- In essence each of the inputs that ultimately drives force of infection and incidence in the community PWID group, would have its 'equivalent' in the prisoner PWID iterations of the model. Importantly both model structures for Scott et al (2017) and Martin et al (2013) have been used to model transmission in other high-risk groups.<sup>14,15</sup>
- The model is an open deterministic compartmental model of HCV transmission and liver disease progression (Figure 1 below). METAVIR scores are used to classify stages of liver disease, and individuals are distinguished as either: acutely infected (A); chronically infected with liver fibrosis in stage F0-F4; chronically infected with decompensated cirrhosis (DC); chronically infected with hepatocellular carcinoma (HCC); first year or more than one year post liver transplant (LT1 and LT2 respectively); chronically infected and in treatment achieving sustained virologic response (SVR) (T0 to T4—treated from liver fibrosis stage F0 to F4 respectively); or susceptible (S0 to S4—infection naïve or previously achieving spontaneous clearance or SVR through treatment from liver fibrosis stage F0 to F4 respectively).

**Figure 1:** Model based on Scott et al (2017) but extended to combine two high-risk groups and a general population group that interact in real time.



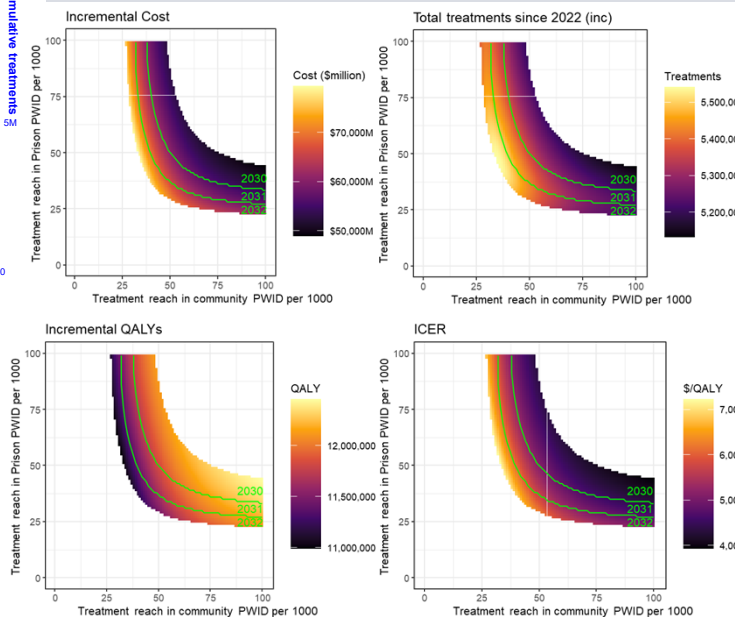
## Results

- The model suggests there are several potential solutions to achieve the 2030 incidence elimination target for the US.
- For example, treatment reach of 56 and 47 per thousand incarcerated and community PWID respectively would achieve the WHO target with just under 6 million treatments, generating approximately 12 million QALYs at a cost of just over \$5,000 for each QALY gained. Treatment reach is assumed to be the maximum treatment allocation for each HCV stage per year.
- An early escalation of treatment achieves a much higher return in terms of the ratio of cases averted to total treatments delivered rising from 2.4 in 2026 to 15.3 by 2040.
- LIMITATIONS: Models are by their nature uncertain, this one is no exception; in particular, the fitting data for projections is sparse, resulting in many possible solution sets, and the model assumes random mixing between susceptible and infected individuals; this is unlikely to be the case in the real world.

## Conclusions

- The 2030 WHO elimination targets can only be reached in the US if treatment is scaled up to include these high-risk populations: PWID and incarcerated persons.
- Our model allows for policy makers to investigate a range of treatment reach choices based on a series of parallel but essential limits and goals, such as number of treatments, total health gain, total cost and relative cost-effectiveness.
- Our model suggests that there are a host of solutions, and shows the vast majority to be highly cost-effective, and that the earlier the initiation of this scale-up, the more cost-effective it would be.

**Figure 4:** Mapped potential solutions for treatment-reach mix for community- and prison-based PWID populations by incremental cost, total number of treatments, QALYs gained and cost-effectiveness ratio (\$/QALY).



## References

- Dusheiko G, Wildenrath H. New protease inhibitors and direct-acting antivirals for hepatitis C: interlaminar long goodbye. *Gut*. 2012 Dec 1;61(12):1647-52.
- Younossi Z, et al. Estimating manifestations of hepatitis C: a meta-analysis of prevalence, quality of life, and economic burden. *Gastroenterology*. 2016 Jun;150(6):1599-608.
- Sanyal AJ, et al. Systematic review with meta-analysis: occurrence of hepatocellular carcinoma following direct-acting antiviral therapy. *Alimentary pharmacology & therapeutics*. 2018 Jul;42(2):127-37.
- World Health Organization. Global health sector strategy on viral hepatitis 2016-2021. Towards ending viral hepatitis. World Health Organization; 2016.
- Fornen LK, et al. Estimating life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: international comparisons for 195 countries and territories. *The Lancet*. 2018 Nov 10;392(10199):2052-90.
- Raizen H, et al. Global ending of hepatitis C virus elimination in high-income countries. *Liver International*. 2020 Mar;20(3):522-9.
- Pedraza A, et al. Global hepatitis C elimination: an investment case. *The Lancet Gastroenterology & Hepatology*. 2020 Oct 15;16(10):967-79.
- Scott N, et al. Model of the economic benefits of global hepatitis C elimination: an investment case. *The Lancet Gastroenterology & Hepatology*. 2020 Oct 15;16(10):940-7.
- Davis GL, et al. Aged of hepatitis C virus (HCV)-infected persons in the United States: a multiple cohort model of HCV prevalence and disease progression. *Gastroenterology*. 2010 Feb 1;138(2):513-21. Centers for Disease Control and Prevention. Solutions for viral hepatitis - United States, 2013. Available from <https://www.cdc.gov/hepatitis/solutions.html>
- Havens JR, et al. Individual and network factors associated with prevalent hepatitis C infection among rural Appalachian injection drug users. *American journal of public health*. 2013 Jan;103(1):e44-50.
- Zibell M, et al. Increases in acute hepatitis C virus infection related to a growing opioid epidemic and associated injection drug use. *United States, 2004 to 2014*. *American journal of public health*. 2018 Feb;108(2):175-81.
- Scott N, et al. Treatment scale-up to achieve global HCV incidence and mortality elimination targets: a cost-effectiveness model. *Gut*. 2017 Aug 15;66(8):1207-15.
- Martin NK, et al. Hepatitis C virus elimination targets require health system interventions to enhance the care cascade. *International journal of drug policy*. 2013 Nov;24(11):1031-6.
- Scott N, et al. Hepatitis C virus epidemics in key populations (notably people who inject drugs, prisoners and MSM): the use of direct-acting antivirals as treatment for prevention. *Current opinion in HIV and AIDS*. 2015 Sep 1;10(5):374-81.
- Hines LA, 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. *The Lancet Global Health*. 2020 Jan 1;8(1):e76-91.
- Evans AS, et al. Predictors of injection drug use cessation and relapse in a prospective cohort of young injection drug users in San Francisco, CA (UIC Study). *Drug and alcohol dependence*. 2009 May 1;93(1):152-7.
- Kyu H, et al. COVID-19 vaccination and Non-COVID-19 mortality risk—seven integrated health care organizations, United States, December 14, 2020–July 31, 2021. *Morbidity and Mortality Weekly Report*. 2021 Oct 10;70(43):1520.
- Vlahov D, et al. Mortality risk among recent-onset injection drug users in New York City. *Substance Use & Misuse*. 2008 Jun 1;43(3):413-20.
- Ayoub JR, et al. Hepatitis C virus infection spontaneous clearance: Has it been underestimated? *International Journal of Infectious Diseases*. 2018 Oct 1;75:80-6.