UNIVERSITÉ DE GENÈVE

Impact of Screening and Treatment for Hepatitis C Virus (HCV) Infection in Switzerland

A Comprehensive Mathematical Model of the Swiss HCV Epidemic

Summary

Janne Estill*, Maryam Sadeghimehr*, Olivia Keiser and Barbara Bertisch

Institute of Global Health, University of Geneva

*Contributed equally

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Impressum

Summary

Background and objective

An estimated 40,000 people were chronically infected with Hepatitis C virus (HCV) in Switzerland in 2016. HCV is one of the leading causes of liver disease, but a considerable proportion of the infected people may remain unaware of their infections until the onset of severe symptoms. A few years ago, the new effective therapy with direct acting antivirals (DAA) became available, and since October 2017, all HCV infected patients in Switzerland are eligible to be treated.

The aim of our project was to estimate the effect of various screening strategies on identifying the currently undiagnosed patients, and to project the number of annual new diagnoses, treated patients achieving sustained virological response (SVR), liver related deaths among HCV infected people, and the size of the HCV viremic population, between 2018 and 2029. We compared the following screening interventions with the current practice of screening (baseline scenario): intensified testing of current injection drug users (IDU); screening of former IDU; screening of people originating in high prevalence regions (South Europe, Asia, Africa); screening of people born 1951-1985; and universal screening of the entire population.

Methods

We developed a mathematical model of HCV disease progression that simulates individual patients from HCV infection until death. The progression of the disease is represented using health states that account for the current stage of liver disease (F0-F4, decompensated cirrhosis, hepatocellular carcinoma, transplanted liver) and stage of the infection and care (acute, chronic undiagnosed, diagnosed, on treatment, SVR/cured). Patients are assigned demographic and behavioral baseline characteristics. Transition times between health states are sampled from hazard functions, which were parameterized based on a comprehensive literature search and consulting experts. Because of uncertainty in input parameters, we conducted four alternative analyses, combining two assumptions about the rate of fibrosis progression (dynamic age- and stage-dependent vs. constant) and past diagnosis rate among IDU (low increasing vs. constant high).

The outputs of the model were converted into the assumed HCV infected population of Switzerland by giving each simulated patient a weight based on his/her baseline characteristics, corresponding to the representativeness of this simulated patient among the true infected population. We used the

notification database of the Federal Office of Public Health and the data collected by the Swiss Hepatitis C Cohort Study to estimate the distribution of the characteristics among the individuals diagnosed by 2016. We estimated the size of the undiagnosed population in 2016 by assuming a total infected population of 40,000 individuals. We assumed that the distribution of the characteristics was the same among the individuals infected in a particular year regardless of being diagnosed or not by 2016, and that the number of annual new cases of HCV would continue in the future on the same level as in the recent years. We also conducted sensitivity analyses where we either increased or decreased the total size of the infected population, or the proportion of individuals with high-risk behavior among the undiagnosed, or increased the liver related mortality rate.

Results

In this summary, we present the results comparing the future strategies from the main analysis assuming dynamic fibrosis progression and low diagnosis rate among IDU in the past (see Section 6 and Appendix E of the full report for the other analyses).

The expected number of new diagnoses in 2018 was about 700 in the baseline scenario, which represents a substantial drop from 2017 due to the decreasing number of undiagnosed patients in the easy-to-identify population groups (Figure i). Afterwards, the annual new diagnoses continued to slightly decrease. More intensive screening of current IDU did not considerably change the number of new diagnoses. With origin based screening, the new diagnoses were slightly above the baseline scenario, with similar pattern across the years. The number of diagnoses in 2018 was considerably higher with birth cohort screening (3,000) and universal screening (3,900). After the first years, the diagnoses decreased rapidly.

The model predicted in the baseline scenario that over 7,000 patients would achieve SVR in 2018. Afterwards, the number decreased fast, with only about 200 patients achieving SVR in 2029. The differences in annual number of SVR across the scenarios followed those of the new diagnoses. In particular universal and birth cohort screening scenarios will be able to cure over 1,000 patients more than the baseline scenario in the first years.
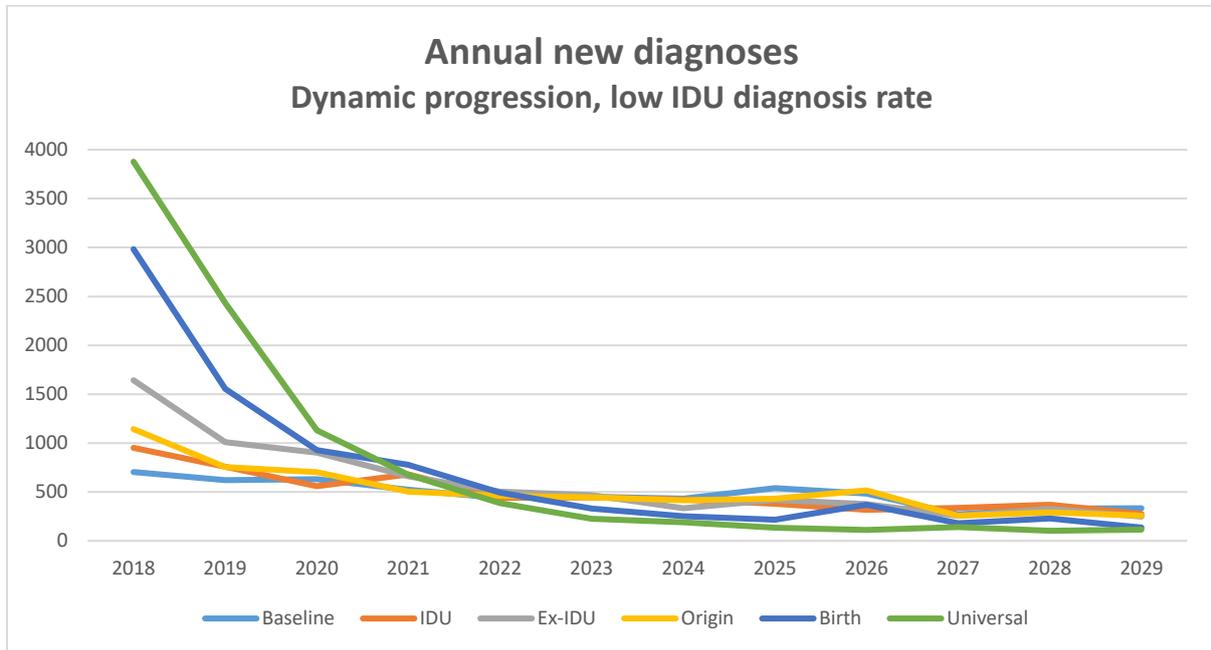
Figure i. Annual new diagnoses 2018-2029 according to the model. *Different curves present different screening scenarios.*

No differences between scenarios were seen in liver related mortality ([Figure ii](#)). About 100 to 250 HCV infected patients are expected to die of liver related cause during every year over the next decade, with a slowly decreasing trend.
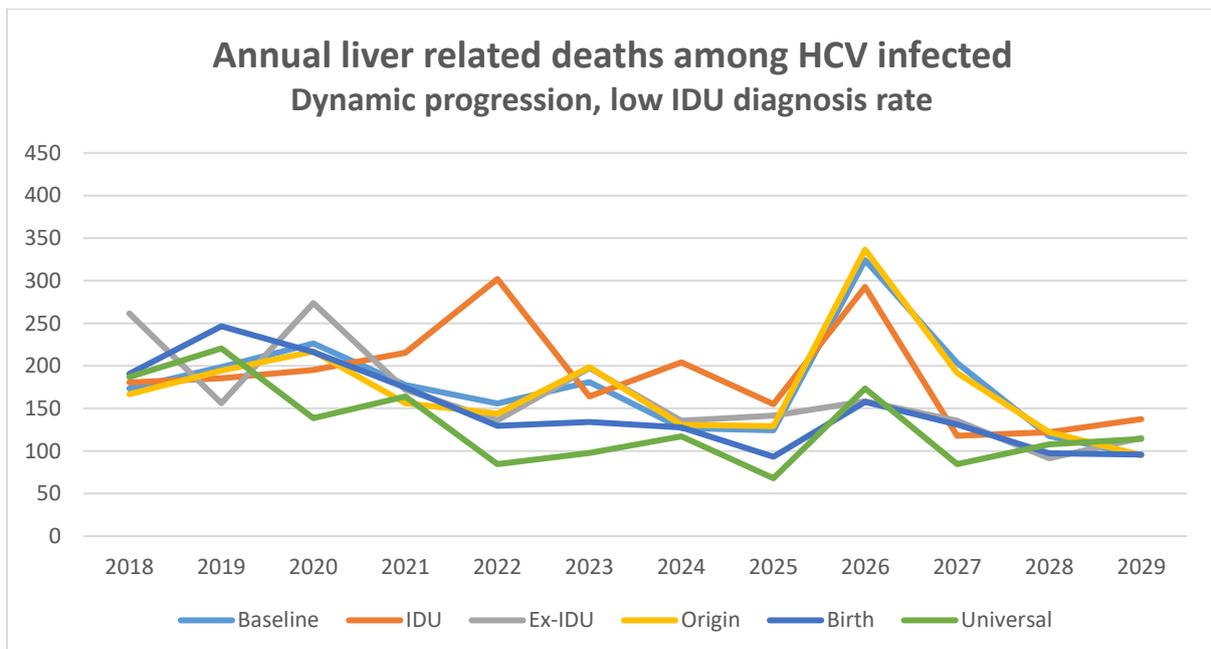

Figure ii. Annual liver related deaths among hepatitis C virus (HCV) infected patients 2018-2029 according to the model. *Different curves present different screening scenarios.*

The number of chronically infected viremic patients decreased continuously in all scenarios (Figure iii). In all scenarios except birth cohort and universal screening, about 5,000 viremic individuals were still living in Switzerland in 2029. With birth cohort screening, this number decreased to below 2,000, and with universal screening, below 1,000. Of the viremic patients, only about 150-350 belonged to the groups with high risk of onward transmission in all scenarios.
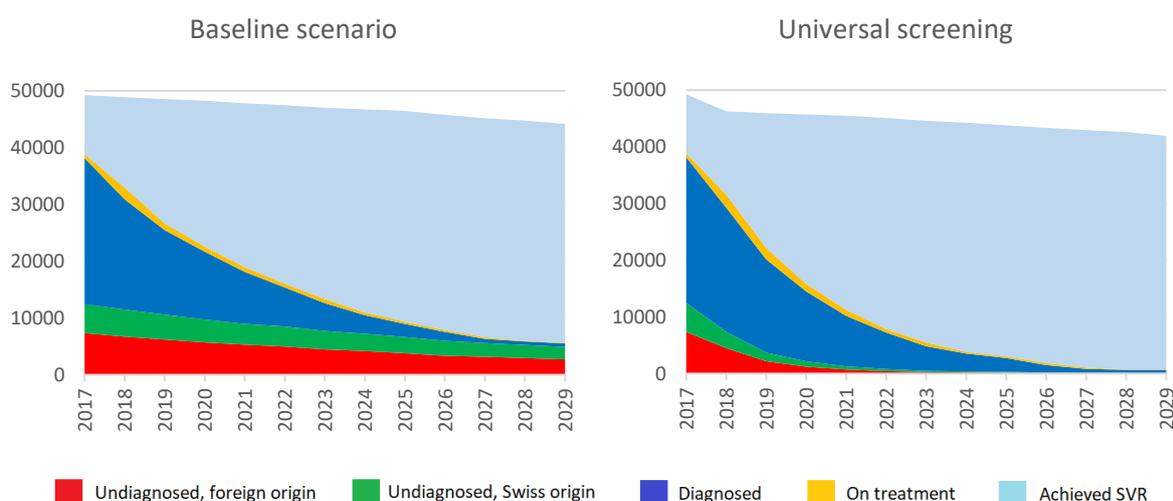

Figure iii. Distribution of undiagnosed, diagnosed, currently treated and cured among the infected population 2017-2029 according to the model (baseline and universal scenarios). *Spontaneously cleared patients are not shown.*

Conclusion

We compared six strategies of screening for hepatitis C virus between 2018 and 2029. We found that the size of the viremic population is likely to decrease in the future continuously, but with universal screening or screening of a broad birth cohort would yield the clearly lowest number of viremic patients by 2030.

The study had however several limitations. The results are consequences of the assumptions and input parameters, which in many cases were uncertain. The probably most important limitation concerned the assumptions about the currently unknown HCV infected population. The model we used is also not a transmission model, meaning that the future new infections were based on an assumption and not produced by the model.

Our study supports the continuation of testing population groups based on risk behavior, but at the same time shows that this alone will not be sufficient to reach all HCV infected individuals in the next

12 years. More information is needed about the characteristics of the currently undiagnosed population, in order to allow more detailed evaluations of the various screening strategies.