

Exploring HCV eradication through diagnosis and treatment strategies

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INTRODUCTION

- The World Health Organization aims to eradicate hepatitis C virus (HCV) by 2030^{1,2}.
- To achieve this, improved HCV diagnosis and treatment coverage are required¹.
- We explore the relationship between diagnosis and treatment over the next 5 years to understand how to achieve the greatest reduction in HCV prevalence.
- We use the UK, Italy, and France as case studies.

METHOD

- We created a state-transition model of HCV disease progression based on previously published models^{3,4}.
 - The model ran on annual cycles where people can transition to another state at the end of the year.
 - As our focus was on the number of chronic HCV cases and not complications due to HCV, complications (e.g. hepatocellular carcinoma, decompensated cirrhosis) were combined into a “catch-all” state.
 - All treatment in the model was assumed to be direct acting antiviral (DAA).
- Our model included a dynamic incidence affected by population level disease characteristics.
 - This allowed us to understand how changing diagnosis and treatment would affect disease burden.
 - The incidence was updated on yearly cycles using the following equation⁵:

$$P(\text{infected}_{t+1} | \text{susceptible}_t) = K \times \frac{N_t^{\text{infected}}}{N_t^{\text{infected}} + N_t^{\text{susceptible}}}$$

$$K = \frac{(\text{incidence rate})(N_{t_0}^{\text{infected}} + N_{t_0}^{\text{susceptible}})}{N_{t_0}^{\text{infected}}}$$

- We used the base case model to calibrate our K coefficient to data from the Polaris Observatory².
- We used data from the Polaris Observatory (Table 1)² and the published literature to parameterise the model.
- Following treatment protocols, in the base case we assumed that only people with stages [2,3,4] fibrosis were treated⁶.
- Primary model outcomes were total number of chronic HCV cases, and number of HCV cases cured after 5 years for each country.
- We performed one-way, two-way, and three-way sensitivity analyses to determine how primary outcomes changed.
 - In these analyses probabilities of diagnosis and treatment were changed between 0 – 100%.
 - We also varied treatment algorithms to simulate treating stage(s) [4], [3,4], [1,2,3,4], or [0,1,2,3,4] liver fibrosis.

RESULTS

Base case (Figure 1 – white points)

Under **base case** conditions (Table 1) the model predicts a reduction in the number of chronic HCV cases at 5 years

- In the UK, by 12.0%
- In Italy, by 10.5%
- In France, by 19.4%

One-way analysis – Diagnosis (Figure 1 – green lines)

Holding all other parameters constant, increasing to **100% diagnosis** reduces chronic HCV cases at 5 years

- In the UK, by 31.8%
- In Italy, by 25.3%
- In France, by 21.9%

One-way analysis – Treatment (Figure 1 – blue lines)

Holding all other parameters constant, increasing to **100% treatment** reduces chronic HCV cases at 5 years

- In the UK, by 21.4%
- In Italy, by 30.0%
- In France, by 40.7%

Two-way analysis – Figures 2 – 4

- The shape of the two-way analysis shown in Figures 2 – 4 indicates that adjusting treatment or diagnosis independently requires greater effort to achieve the same reduction than increasing both concurrently

Country	UK	Italy	France
Chronic HCV Cases (000s)	158	739	195
Prevalence (%)	0.24	1.22	0.29
Incidence (per 100.000)	6.5	12.3	7.9
Known HCV Infections (%)	35.9	43.8	69.1
Diagnosis chance (%)	8	7.5	16
Treatment chance (%)	33	16	22

Table 1: Base case data from the Polaris Observatory for the state-transition model²

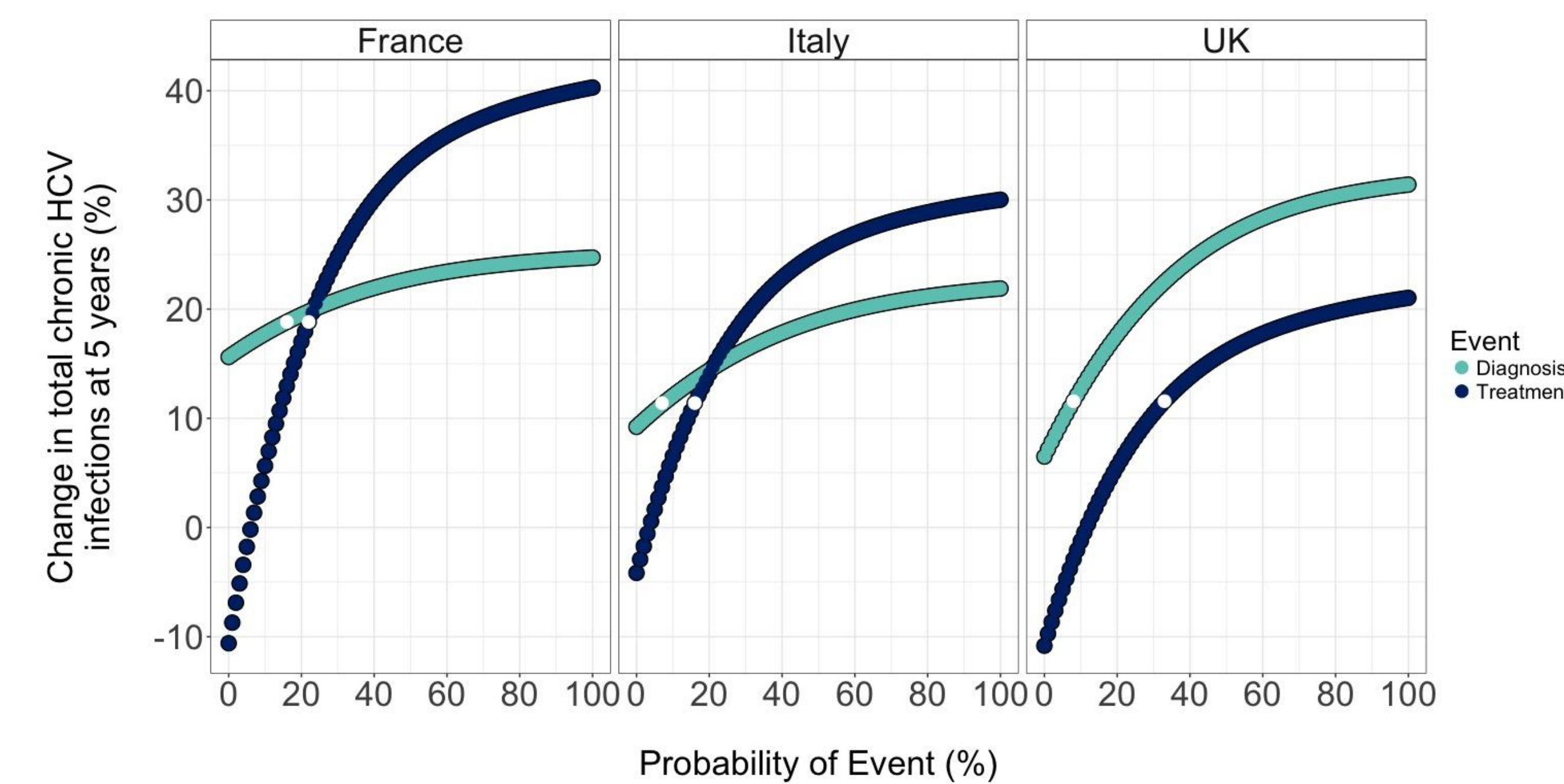


Figure 1: Reduction in Chronic HCV cases at 5 years: one-way sensitivity analysis. The white point shows the base case diagnosis and treatment probabilities for each country.

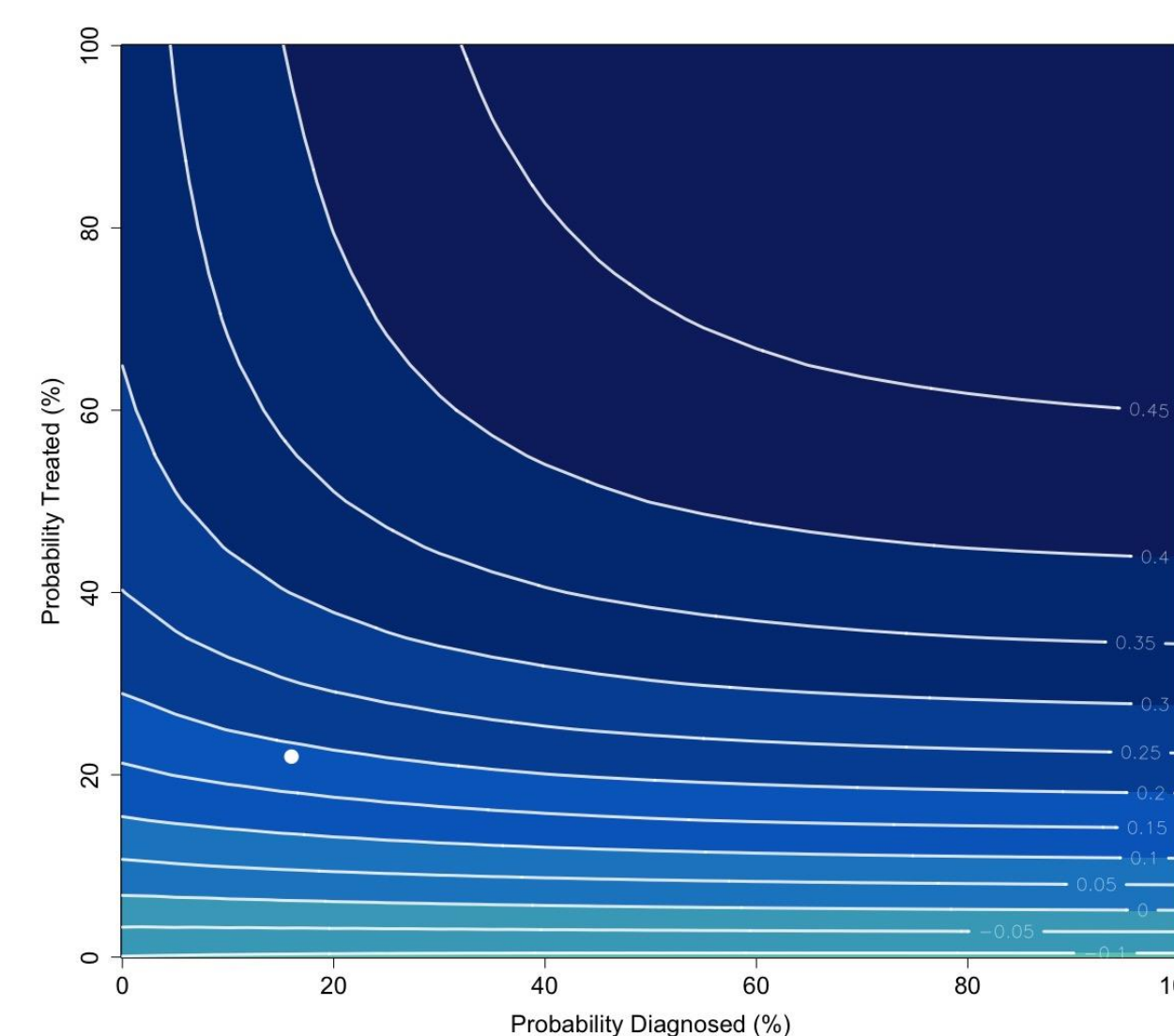


Figure 2: France

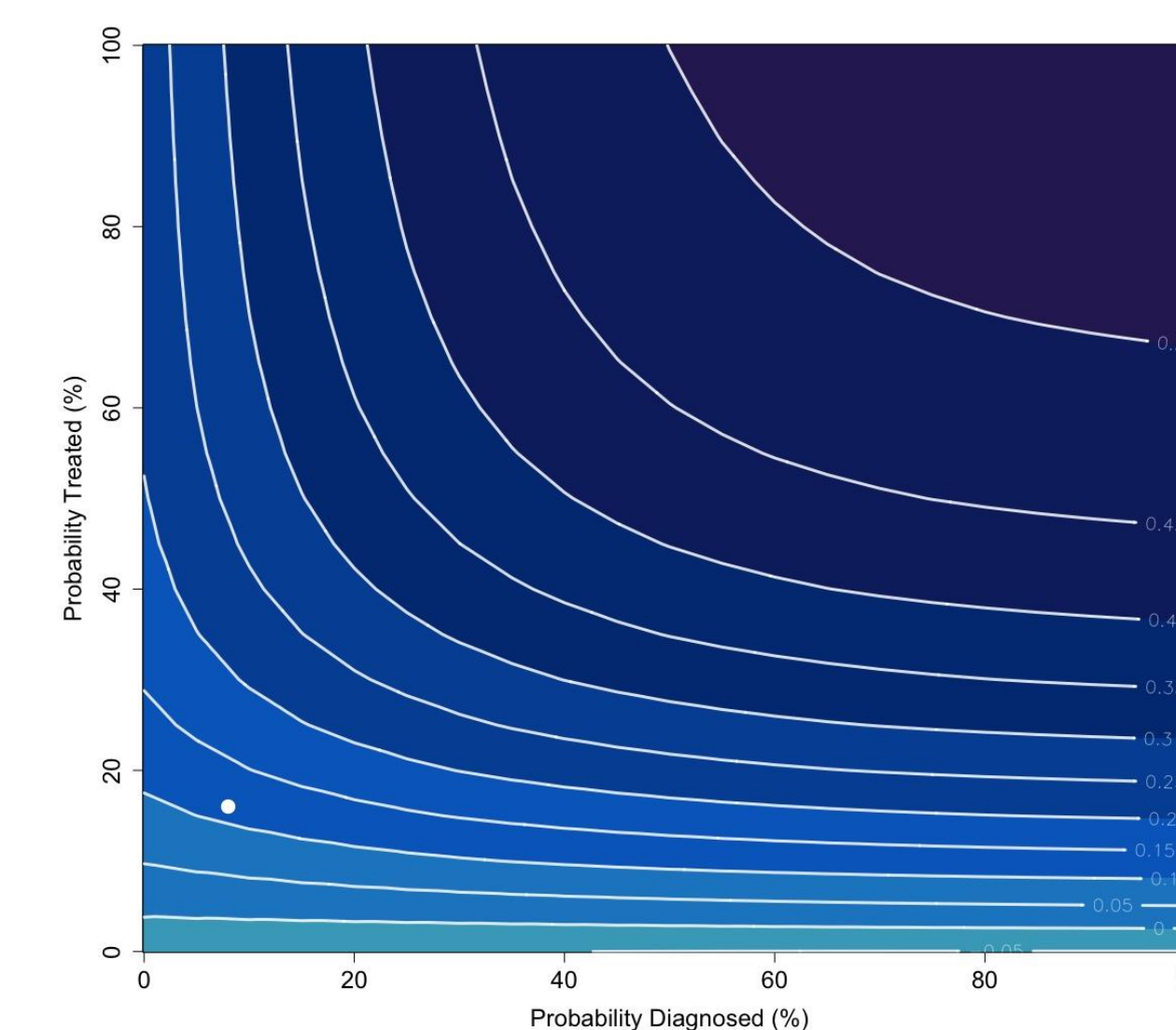


Figure 3: Italy

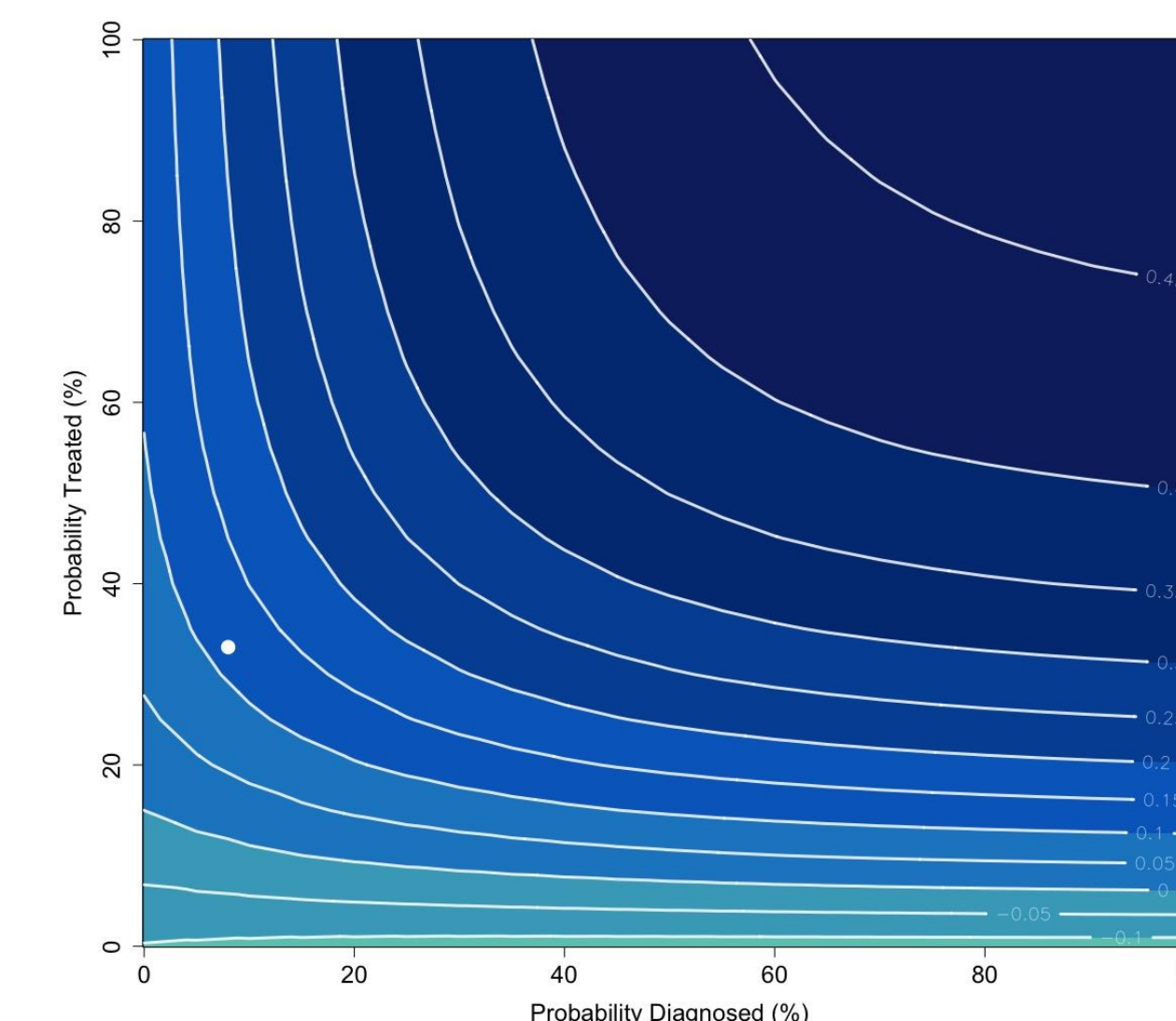


Figure 4: UK

Figures 2 – 4: Reduction in chronic HCV cases at 5 years: two-way sensitivity analysis. The white point shows the base case diagnosis and treatment probabilities for each country.

CONCLUSIONS

- Diagnosis and treatment of HCV both play critical roles in the WHO 2030 eradication goal^{1,2}.
- We show, that over a short time horizon, and depending on the current state of practice, even improving just diagnosis or treatment can have a large impact.
- However, given the shape of relationship between diagnosis and treatment, focusing solely on treatment or diagnosis is likely to lead to minor returns.
 - Therefore it is important to see the additional benefit of changing both diagnosis and treatment strategies together.
- Each country should consider how improving their diagnosis and treatment programmes concurrently could gain the most benefit in the short term, rather than focusing on treatment alone. This is because there is a large reservoir of undiagnosed chronic infection in many countries.
- Available data suggest that the HCV epidemic is today mainly sustained and fed by people who inject drugs (PWIDs).
 - If the WHO 2030 eradication goal is to be achieved, patient management approaches need to be optimised and tailored to these populations (e.g. with find-and-treat strategies with rapid diagnosis and same day treatment leading to better linkage to care)
- With information about costs of prevention and treatment programmes in each country, it would be possible to provide a formal optimisation of the best combined diagnosis and treatment strategy to maximise the benefit of the budget available.
- Future work will investigate the relationship between diagnosis, treatment, and HCV eradication in additional countries.

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