

Modelling Social and Economic Burden of Hepatitis C in Russia in Different Scenarios of Control Measures up to 2035

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BACKGROUND

- The registered prevalence of the hepatitis C (HCV) in Russia is around 700,000 people. Due to underdiagnosis, overall prevalence of HCV-positive population in 2022 may be up to 2.4 million.
- However, there is currently no stand-alone federal project or program dedicated solely to fighting HCV. Funding for HCV medications mainly comes from compulsory medical insurance and some regional programs, but the financing within this framework is limited in scope.
- As a result, direct-acting antivirals (DAAs) are used only in 1% of the registered patients each year.

OBJECTIVES

- The aim of this study was to forecast social and economic burden of HCV-infection in Russia in various scenarios of national HCV policy up to 2035.

METHODS

- We considered the following scenarios:
 - **«No change»** scenario of maintaining costs for HCV control in nominal values at the level of 2020 with random patient selection for treatment.
 - **«Rational»** scenario, which assumed increasing procurement funding threefold compared to 2020, prioritizing pan-genotypic drugs and patients with advanced liver disease.
 - **«Elimination»** scenario, aiming to treat all HCV-infected individuals by 2032 (and similar to the «Rational» scenario in other aspects).
- We proposed the following concept of anti-HCV therapy coverage impact on the main components of socioeconomic burden of HCV infection (Figure 1).

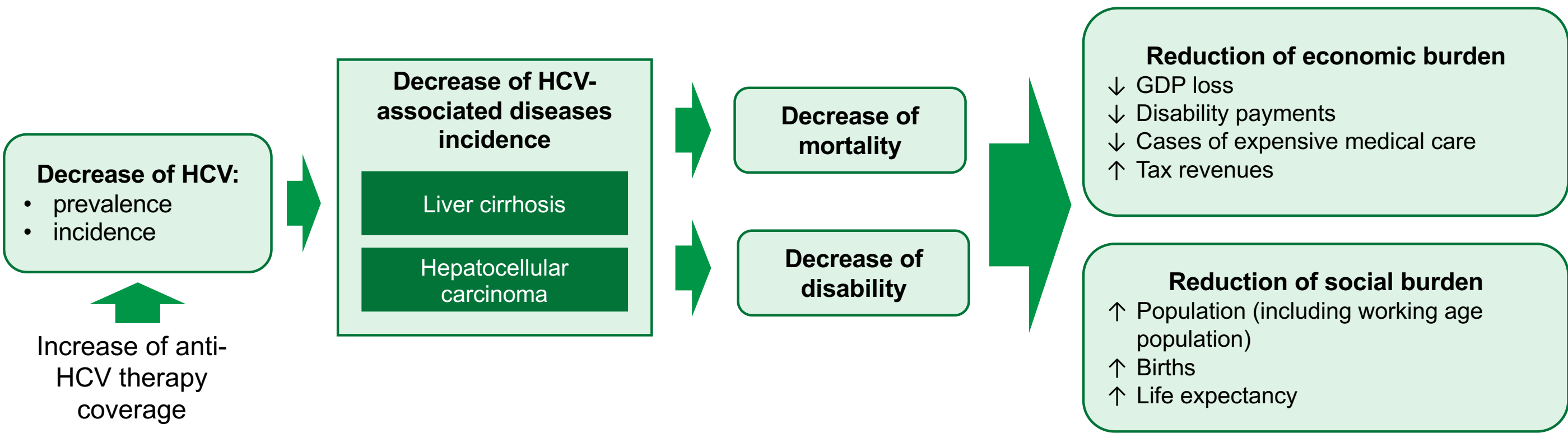


Figure 1. HCV therapy coverage impact on demographic and economic parameters

- A Markov model was developed to forecast epidemiology, as well as social and economic burden of HCV in different funding strategies (Figure 2). Transition probabilities between model states were determined based on literature data (Withöft et al (2007); Ekpanyapong et al (2019); Erman et al (2019); Mauro et al (2018); Nabatchikova et al (2020); WHO (2018); Miotto et al (2018)) as well as published statistics in Russia (Yushchuk et al (2013); Kaprin et al (2020); Pimenov et al (2018)).
- **Social burden** was defined as excess mortality and decrease in life expectancy at birth, natural population growth and population size.
- **Economic burden** included medical costs of treatment of HCV; direct non-medical costs of disability benefits, and indirect costs in form of GDP loss due to premature HCV-related mortality and disability.

Figure 2. Markov model of HCV progression (simplified). SVR: Sustained Virologic Response.

RESULTS

HCV epidemiology forecast:

- In **«No change»** and **«Rational»** scenarios, a linear increase in HCV prevalence is expected: from 1,644.3 cases per 100,000 population (**2.4 million people**) in 2022 to 2,396.9 cases per 100,000 population (**3.4 million people**) or 2,185.6 cases per 100,000 population (**3.1 million people**), respectively. The cumulated number of patients who received DAA therapy by 2035 will amount to **308,000 individuals** in «No change» scenario and **848,000 people** in the «Rational» scenario (Figure 3).
- In the **«Elimination»** scenario, due to a much broader coverage of DAA therapy (up to **3.3 million people** by 2035), HCV prevalence will decrease dramatically within the first 10 years to 68.7 cases (**98,000 people**) and **practically to zero** by 2035 (2.1 cases per 100,000 population or 3,000 people, Figure 3).

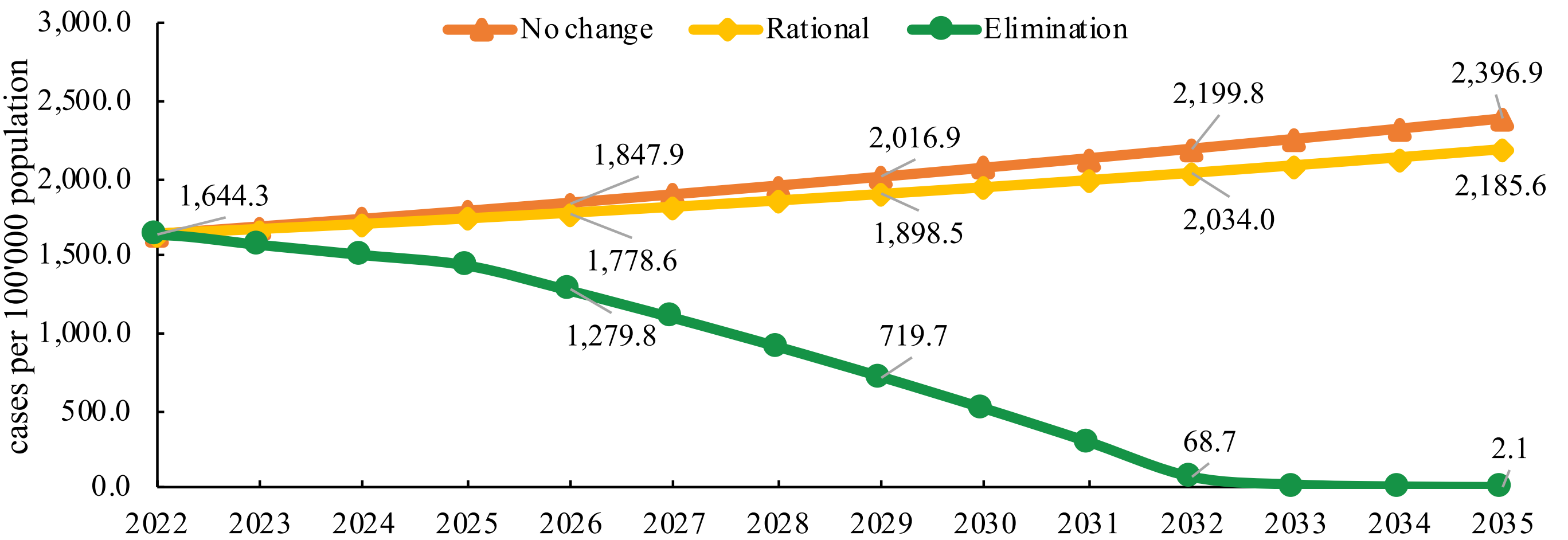


Figure 3. HCV prevalence in different scenarios of centralized financing.

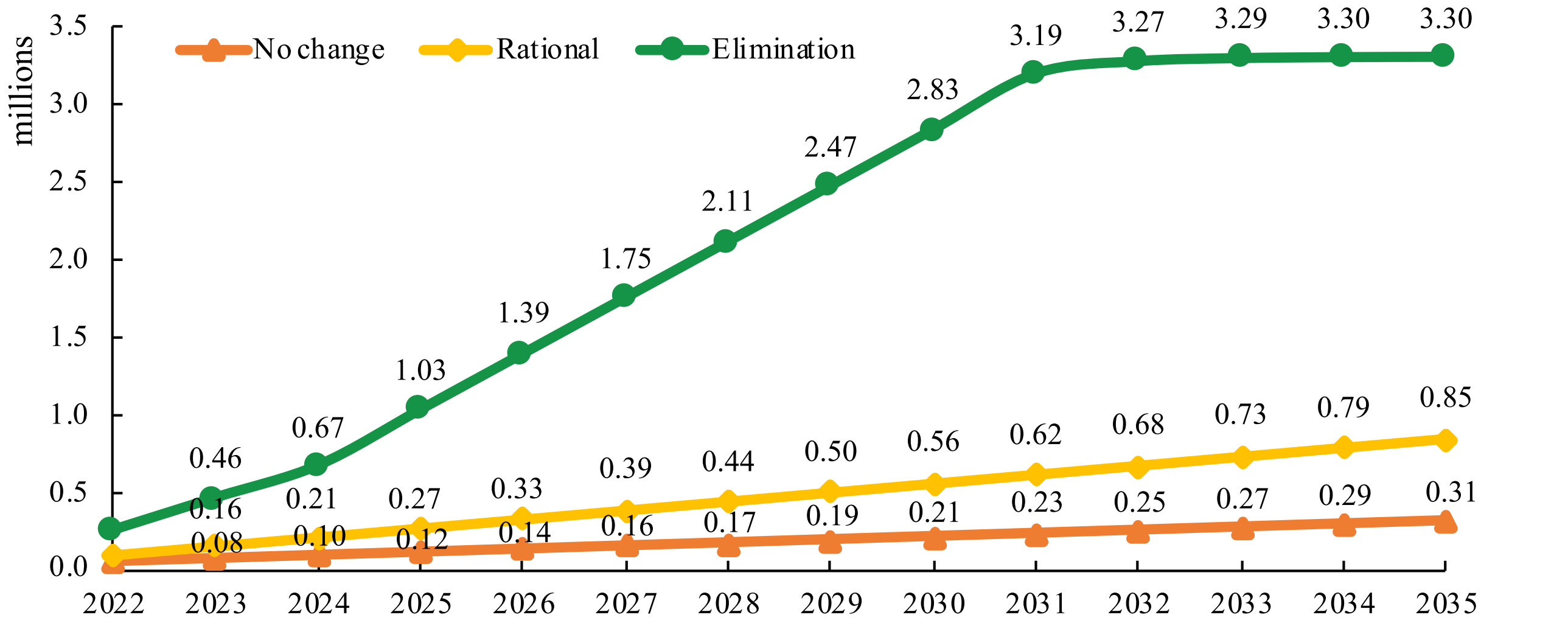


Figure 4. Number of patients, who received DAA-therapy in different scenarios of centralized financing, millions

Social burden:

- Social burden in terms of population mortality is estimated to decrease considerably in both scenarios, compared to the «No change» scenario (Table 1). **«Elimination»** scenario would result in **lowest number of deaths** due to improved therapy strategies and increased financing.

Scenario	Years			Total for the period of modelling
	2023-2024	2025-2032	2033-2035	
No change	36,567	185,148	88,246	309,961
Rational	24,296	110,028	51,601	185,925
Elimination	18,177	42,063	9,545	69,786

Table 1. HCV-related mortality in various financing scenarios, people.

- Birth rate decreases due to premature mortality in women of reproductive age. Compared to the «No change» scenario, number of births could be increased by **193 births** in case of **«Rational»** scenario and by **429 births** in case of **«Elimination»** scenario by 2035.
- Both scenarios with increased funding are projected to **improve life expectancy** at birth relative to «No change» (Table 2).

Scenario	2024	2032	2035
No change	73.6	75.5	76.4
Difference with «No change» scenario:			
Rational	+0.07	+0.14	+0.17
Elimination	+0.12	+0.30	+0.38

Table 2. Life expectancy at birth in different scenarios, years

Economic burden:

- We estimate additional cost of DAAs procurement up to 2035 in current prices as **2.70 billion US\$** in **«Rational»** scenario and **15.13 billion US\$** in **«Elimination»** scenario (Table 3).
- Economic burden of HCV over 2023 - 2035 is estimated to be **30.08 – 46.58 billion US\$** in current prices.
- The main component of the economic burden of HCV is **indirect economic losses** due to premature disability and mortality of the population. Additional DAAs procurement funding decreases total economic burden of HCV since it is fully offset by increase in GDP production.
- The **lowest economic burden** is forecasted in the **«Elimination»** scenario, which is most economically effective.

Cost	No change	Rational	Elimination
Direct medical	2.37	4.37	16.78
DAAs procurement	1.35	4.05	16.48
Outpatient treatment	0.04	0.10	0.28
Inpatient treatment	0.99	0.22	0.02
Direct non-medical	1.11	0.68	0.04
Disability benefits	1.11	0.68	0.04
Indirect economical	43.10	28.65	13.27
GDP loss	43.10	28.65	13.27
Including wages	21.22	14.11	6.53
Total	46.58	33.69	30.08

DAAs – Direct-Acting Antivirals, GDP – Gross Domestic Product.

Table 3. Economic burden of HCV during 2023 – 2035 period, billion US\$ in current prices.

CONCLUSIONS

- The implementation of **«No change»** scenario will lead to a linear increase in the prevalence of HCV within the population. The mortality of the adult population from HCV-associated causes will increase to **30,601 people** per year, and HCV-positive population will grow up to **3.4 million individuals**. The economic burden of the disease over the period 2023-2035 will amount to over **46.58 billion US\$** including 43.10 billion US\$ in GDP losses.
- The HCV **elimination** scenario leads to lowest social burden of HCV and also is characterized by the best cost-benefit ratio, since the increase in procurement of DAAs by **+15.13 billion US\$** by 2035 (an average of 1.16 billion US\$ per year over the analysis horizon) is offset by the positive impact from the reduction of indirect economic losses by **-29.84 billion US\$**, which will ultimately reduce the overall economic burden of HCV to **30.08 billion US\$** (including GDP losses of 13.27 billion US\$).

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