Global prevalence, cascade of care, and prophylaxis coverage of hepatitis B in 2022: a modelling study

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Summary

Background The 2016 World Health Assembly endorsed the elimination of hepatitis B virus (HBV) infection as a public health threat by 2030; existing therapies and prophylaxis measures make such elimination feasible, even in the absence of a virological cure. We aimed to estimate the national, regional, and global prevalence of HBV in the general population and among children aged 5 years and younger, as well as the rates of diagnosis, treatment, prophylaxis, and the future burden globally.

Methods In this modelling study, we used a Delphi process with data from literature reviews and interviews with country experts to quantify the prevalence, diagnosis, treatment, and prevention measures for HBV infection. The PRoGReSs Model, a dynamic Markov model, was used to estimate the country, regional, and global prevalence of HBV infection in 2022, and the effects of treatment and prevention on disease burden. The future incidence of morbidity and mortality in the absence of additional interventions was also estimated at the global level.

Findings We developed models for 170 countries which resulted in an estimated global prevalence of HBV infection in 2022 of 3·2% (95% uncertainty interval 2·7–4·0), corresponding to 257·5 million (216·6–316·4) individuals positive for HBsAg. Of these individuals, 36·0 million were diagnosed, and only 6·8 million of the estimated 83·3 million eligible for treatment were on treatment. The prevalence among children aged 5 years or younger was estimated to be 0·7% (0·6–1·0), corresponding to 5·6 million (4·5–7·8) children with HBV infection. Based on the most recent data, 85% of infants received three-dose HBV vaccination before 1 year of age, 46% had received a timely birth dose of vaccine, and 14% received hepatitis B immunoglobulin along with the full vaccination regimen. 3% of mothers with a high HBV viral load received antiviral treatment to reduce mother-to-child transmission.

Interpretation As 2030 approaches, the elimination targets remain out of reach for many countries under the current frameworks. Although prevention measures have had the most success, there is a need to increase these efforts and to increase diagnosis and treatment to work towards the elimination goals.

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Introduction

Hepatitis B virus (HBV) infection remains a major public health challenge and continues to be endemic in many countries despite the progress made in childhood vaccination. Without intervention, individuals living with chronic hepatitis B have an approximate 30–40% lifetime risk of developing cirrhosis or hepatocellular carcinoma.[1] In 2016, the World Health Assembly approved the WHO Global Health Sector Strategy on Viral Hepatitis, which aims to eliminate viral hepatitis as a major public health threat by 2030, proposing specific targets, including a 90% reduction in new chronic HBV and hepatitis C virus (HCV) infections, 80% antiviral treatment coverage for individuals with chronic HBV and HCV eligible for treatment, and a 65% reduction in mortality due to HBV and HCV.[2] These guidelines were updated in 2021 to absolute targets of 0·1% or lower for HBV prevalence in children aged 5 years or younger and an annual mortality rate of up to 4 per 100 000.[3]

Quantification of the national, regional, and global prevalence of HBsAg positivity and monitoring changes in disease burden are crucial steps in prioritising health-resource allocation, assessing the effectiveness of harm-reduction programmes, gauging the need for expanded prophylaxis programmes, and advocating for action or investment by stakeholders and governments. These data are particularly important in countries and regions where HBV vaccination coverage has not reached the WHO targets of at least 90% coverage of complete vaccination (three-dose HBV vaccine for infants) and timely birth dose vaccination (within 24 h of birth) to prevent mother-to-child transmission. As the risk of developing chronic HBV infection after exposure is inversely related to age at the time of acquisition, prevention of mother-to-child transmission by timely birth dose vaccination is an invaluable intervention to reduce incidence.

Although country-level and regional-level HBV prevalence have been reported in meta-analyses and literature reviews, there is a paucity of reliable nationally representative prevalence data due to the limitations of these approaches, which include compiling findings

Research in context

Evidence before this study

Previous reports of the global HBV prevalence use traditional systematic review and meta-analysis procedures and included studies of blood donors. However, most of these analyses used studies that focused on adults and retroactively fitted data, thereby not accounting for the effects of vaccination and treatment. Previous studies have attempted to report on the use of hepatitis B immunoglobulin, but none have quantified rates of use or the use of antiviral treatment in pregnant individuals at the country, regional, and global levels. Reports on the cascade of care are mostly on the local or national levels, but are rarely, if ever, combined into one report.

Added value of this study

We combined a traditional meta-analysis, national expert interviews, and modelling to estimate HBV infection (HBsAg positivity) prevalence, prophylaxis coverage, and proportions of people diagnosed and treated at the national, regional, and global levels in 2022. We used a dynamic transmission and disease burden model that considers the effects of prophylaxis and treatment on HBV infection prevalence, morbidity, and mortality. A Delphi process was used to strengthen the traditional systematic review process, involving consultation with 850 experts to obtain feedback on inputs and outputs for 98 national models. Another 52 models were developed on the basis of published data, while 20 were modelled using regional prevalence but country-specific demographic and vaccination data. Estimates for the remaining 30 countries were extrapolated from these 170 countries, which alone accounted for 99·7% of the world's population.

Implications of all the available evidence

The global prevalence of HBV has decreased since our 2016 publication as a result of continued vaccination programmes, mortality, and the increased availability of prevalence data. While countries continue to make progress towards the 2030 elimination targets, most will require substantial increases in diagnosis and treatment to meet these goals. These data provide estimates to aid policy makers in making region-specific and country-specific decisions to reverse the global trend of increasing HBV-related morbidity and mortality.

from low-quality or non-representative studies conducted in different age groups or at different timepoints.[4–8] Furthermore, providing an accurate cumulative incidence of chronic HBV infection requires the assessment of dynamic changes in vaccination programmes and HBV treatment uptake, which are not always reflected in meta-analyses or literature reviews that are based on older studies. Although one modelling study focused on the future disease burden of HBV and potential strategies to address the increasing public health problem at the global and regional levels, it did not ascertain the current HBsAg prevalence in the general population.[9] A more recent study quantified the past and current HBsAg prevalence as well as morbidity and mortality indicators.[8] However, this study relied on post-hoc adjustments for the effects of vaccination and did not include herd immunity, both of which would lead to overestimation of the prevalence of HBV infection.

To fill these gaps and quantify the national, regional, and global HBV prevalence in the general population, in 2018 we published a dynamic HBV transmission and disease burden Markov model, the PRoGReSs model, that considered the effects of all prophylaxis measures and treatment for 120 countries.[10] We estimated a worldwide prevalence of HBV infection of 3·9%, corresponding to around 292 million individuals living with HBV infection.[10] Around 1·8 million (1·4%) infections were in children aged 5 years, amounting to a prevalence of around 1·4% in this age group and less than 1% of mothers with a high viral load had received antiviral therapy to reduce mother-to-child transmission. Since the 2018 publication, there have been several developments that could substantially affect the global prevalence of HBV infection. Progress has been made in achieving high childhood vaccination coverage and implementing timely birth dose vaccination,[11] and some new mothers now were vaccinated as infants, both resulting in a lower incidence of HBV. Updated WHO guidance in 2020 also recommended that mothers with a high viral load (≥200 000 IU/mL) should be treated with tenofovir disoproxil fumarate during pregnancy to reduce mother-to-child transmission.[12]

To strengthen the response to the public health problem represented by hepatitis B, we aimed to quantify the current national, regional, and global prevalence of HBV infection in the general population and the population aged 5 years or younger. We also assessed the cascade of care by modelling the number of patients diagnosed, eligible for treatment, and treated in 2022, while updating estimates for prophylaxis coverage.

See Online for appendix

Methods

Search strategy and input data

For this modelling study, inputs were based on a combination of an updated literature review and a Delphi process that used expert input to fill gaps and confirm data when available (appendix pp 14–20). A comprehensive literature review was done by searching PubMed using the terms "[country name] AND [(hepatitis B) OR HBV] AND [prevalence]" and "[country name] AND ('prevalence'/exp OR prevalence) AND ('hepatitis B'/exp OR 'hepatitis B' OR 'HBV'/exp OR 'HBV')". The search was conducted from March 1, 2016, to November 1, 2022, as this built on our previous work.

Grey literature from ministries of health and related bodies, conference presentations, local journals, and personal communications with in-country experts were also included in the analysis. Titles and abstracts were reviewed for relevance, and only studies that included HBsAg prevalence were included. Studies published before 1990 were excluded, except those for Djibouti, Federated States of Micronesia, Papua New Guinea, Samoa, and Tuvalu as these were the most representative studies available at the time. Studies solely in populations that were non-representative of the general population (eg, blood donors, people who inject drugs, people with haemophilia, or specific ethnic groups) were systematically excluded from baseline prevalence estimates.

All country updates started with a literature search to identify any newly available data. The findings were verified using a Delphi interview process with over 850 national and regional experts to build consensus regarding the inputs and key findings. Experts either approved the inputs or rejected the literature search results and provided a better source of data. These sources included unpublished data or recommended data from countries with a similar health-care capacity and vaccination history (appendix pp 19–37).

Data from all published studies were extracted and entered into a quality scoring system using a multiobjective decision-analysis approach, resulting in a score of 1–3 for each study, with 1 representing the lowest quality studies (appendix pp 14–16). Each study was reviewed and scored independently on the basis of sample size, year of analysis, and generalisability, by three epidemiologists including the primary investigator. If different scores were given, the median of the 1–3 scores was utilized to identify the highest quality studies for consideration.

When age and sex distributions were unavailable for a country, two different methods were used. If the age and sex distribution from another country with a similar vaccination history was available, it was scaled up or down to match the overall prevalence in the year of that prevalence estimate (source countries are specified in the appendix [pp 20–25] with a superscript). For other countries, the modelled age and sex distribution before the implementation of vaccination in the same Global Burden of Disease Study (GBD) region was used. For extrapolated countries, where no prevalence data were available, the weighted averages of countries within the same GBD region before vaccination were applied (appendix pp 49–52).

In order of priority, data sources reviewed to estimate the proportion of people diagnosed with HBV infection (ie, HBsAg positive) were national notification or registry data, peer-reviewed literature, and expert opinion. The number of individuals treated annually was estimated with use of national databases, audit sales data, government reports, and estimates from major treatment centres and drug suppliers. The proportion of the population with HBV infection who were eligible for treatment was estimated by using local, regional, or international guidelines for eligibility and applying them to the modelled outputs. When local guideline data were unavailable, the most recent European Association for the Study of the Liver (EASL) guideline on the management of HBV infection was used.[13]

WHO–UNICEF country-level estimates were used as a baseline for estimates of the proportion of infants receiving their first dose of HBV vaccine within the first 24 h after birth (timely birth dose), as well as for those receiving a complete schedule of vaccination (at least three doses by 1 year of age).[14] The last year of available data was 2021, and these data were applied to 2022 as well. In countries with consistently high coverage and a single year reported as 0% coverage, it was assumed that this reflected non-reporting and not a change in strategy. The Pan American Health Organization (PAHO) conducted a robust review of the vaccination schedule in the region of the Americas, and this review supplemented the WHO–UNICEF report.[15] Data on the proportion of infants born to HBsAg-positive mothers who received both timely birth dose vaccination and hepatitis B immunoglobulin (HBIG) were assessed on the basis of country interviews, national immunisation guidelines, and WHO reports. WHO data were used in countries with missing interviews or national data.[16] However, a comparison of the reported prophylaxes data in the WHO report with data from countries we interviewed indicated that the use of HBIG was overestimated in the WHO report. The inputs for HBIG use are shown in the appendix (pp 33–37). Most estimates of the national rates of use of antivirals for pregnant women with high viral load as a method to prevent mother-to-child transmission were based on expert opinions. Prophylaxis coverage was never extrapolated using data from another country.

Prevalence modelling

The PRoGReSs model is a compartmental, deterministic, dynamic Markov disease progression model developed in Microsoft Excel (version 365) to quantify the annual prevalence of HBsAg positivity by age, sex, and disease stage for each country. A full description of the model is provided in the appendix (pp 4–20). Each country model was populated with historical, country-specific background population, mortality, and epidemiological HBV data. The model tracked the distribution of HBsAg positivity across age (1-year age cohorts), sex, year, disease stage (acute, chronic, cirrhosis, decompensated cirrhosis, hepatocellular carcinoma, and death), and viral load (categorical). The PRoGReSs model has been previously described in detail.[10] Individuals advanced through disease stages over time according to age-specific and sex-specific progression rates, including for spontaneous clearance and fulminant infection (appendix pp 4–9). Horizontal and vertical transmission of the disease was

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
Asia Pacific, high income												
Japan	0·6%	0·8% (0·7 to 0·8)	949 (819 to 955)	584 000 (62%)	387 000	188 000 (49%)	<0·1% (<0·1 to <0·1)	380 (310 to 430)	92%	<1%	99%	0%
South Korea	3·0%	2·7% (2·1 to 3·0)	1379 (1081 to 1546)	1 135 000 (82%)	460 000	262 000 (57%)	<0·1% (<0·1 to <0·1)	790 (560 to 1100)	98%	92%	100%	40%
Singapore	3·6%	2·2% (1·8 to 2·3)	131 (109 to 138)	1500 (1%)	55 600	700 (1%)	<0·1% (<0·1 to <0·1)	150 (110 to 190)	96%	91%	100%	0%
Asia, central												
Armenia	2·0%	1·6% (1·0 to 1·9)	44 (29 to 53)	6000 (14%)	12 900	100 (<1%)	<0·1% (<0·1 to 0·1)	190 (160 to 250)	93%	94%	1%	1%
Azerbaijan	2·7%	2·0% (1·5 to 2·4)	205 (153 to 252)	10 800 (5%)	53 600	1700 (4%)	0·3% (0·2 to 0·4)	2100 (1500 to 3500)	89%	98%	0%	0%
Georgia	2·9%	2·4% (2·1 to 2·7)	88 (77 to 102)	20 100 (23%)	23 400	50 (<1%)	0·2% (0·2 to 0·3)	600 (550 to 870)	85%	95%	74%	0%
Kazakhstan	3·5%	2·3% (1·6 to 3·2)	448 (301 to 615)	52 200 (12%)	125 000	3200 (3%)	0·2% (0·1 to 0·3)	4300 (3000 to 6500)	88%	93%	0%	0%
Kyrgyzstan	4·7%	5·3% (3·5 to 7·0)	350 (234 to 462)	55 300 (16%)	98 300	1100 (1%)	0·4% (0·3 to 0·6)	3600 (2500 to 6200)	89%	96%	0%	0%
Mongolia	11·1%	5·7% (5·2 to 6·0)	193 (178 to 203)	19 600 (10%)	71 700	4700 (7%)	0·4% (0·3 to 0·7)	1600 (1300 to 3100)	95%	99%	0%	0%
Tajikistan	8·0%	5·4% (4·4 to 6·8)	533 (435 to 677)	33 500 (6%)	146 000	5000 (3%)	0·2% (0·2 to 0·4)	3100 (2400 to 5400)	97%	99%	0%	0%
Turkmenistan	15·6%	8·2% (5·7 to 9·2)	529 (366 to 589)	14 000 (3%)	140 000	4500 (4%)	0·4% (0·2 to 0·7)	2900 (1900 to 5700)	97%	99%	0%	0%
Uzbekistan	3·2%	2·1% (0·8 to 3·0)	714 (293 to 1031)	151 000 (21%)	181 000	15 000 (8%)	0·1% (<0·1 to 0·2)	4800 (2000 to 8800)	98%	99%	0%	0%
Asia, east												
China	7·2%	5·6% (5·2 to 5·9)	79 747 (74 126 to 83 847)	19 131 000 (24%)	33 874 000	5 076 000 (15%)	<0·1% (<0·1 to 0·2)	80 000 (52 000 to 140 000)	99%	95%	100%	26%
North Korea	6·5%	5·3% (4·9 to 5·8)	1383 (1279 to 1513)	137 000 (10%)	526 000	0 (<1%)	1·3% (1·2 to 2·1)	26 000 (24 000 to 42 000)	41%	99%	0%	0%
Hong Kong	7·8%	4·5% (4·3 to 7·3)	337 (322 to 547)	188 000 (56%)	147 000	31 900 (22%)	<0·1% (<0·1 to 0·2)	230 (140 to 580)	95%	95%	100%	5%
Taiwan	10·0%	7·9% (7·6 to 10·7)	1893 (1819 to 2559)	1 281 000 (68%)	472 000	99 000 (21%)	<0·1% (<0·1 to 0·1)	720 (530 to 1300)	98%	93%	99%	99%
Asia, south												
Bangladesh	5·5%	4·2% (3·0 to 5·5)	7237 (5149 to 9493)	45 900 (<1%)	2 692 000	20 000 (<1%)	0·5% (0·4 to 0·7)	92 000 (64 000 to 120 000)	93%	0%	0%	0%
Bhutan	1·6%	1·5% (0·9 to 2·1)	12 (7 to 17)	1100 (9%)	3400	100 (3%)	<0·1% (<0·1 to 0·2)	55 (37 to 92)	98%	84%	0%	0%
India	3·0%	2·1% (1·9 to 2·3)	29 764 (27 006 to 32 843)	662 000 (2%)	8 382 000	5200 (<1%)	0·2% (0·2 to 0·2)	270 000 (250 000 to 320 000)	85%	73%	6%	0%

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	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
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Nepal	0·9%	1·2% (0·8 to 1·2)	359 (247 to 363)	28 700 (8%)	90 000	1200 (1%)	0·2% (0·2 to 0·3)	7600 (5500 to 9300)	91%	0%	0%	0%
Pakistan	2·2%	1·6% (1·1 to 6·0)	3796 (2676 to 14 136)	1 103 000 (29%)	1 065 000	131 000 (12%)	0·2% (0·2 to 0·9)	79 000 (54 000 to 310 000)	83%	<1%	100%	0%
Asia, southeast												
Cambodia	4·6%	3·0% (2·0 to 3·9)	497 (344 to 662)	26 500 (5%)	146 000	1500 (1%)	0·3% (0·2 to 0·5)	5900 (4500 to 10 000)	99%	90%	0%	0%
Indonesia	7·1%	6·4% (5·9 to 7·6)	17 544 (16 157 to 21 001)	528 000 (3%)	6 023 000	21 500 (<1%)	2·5% (2·4 to 3·0)	680 000 (630 000 to 810 000)	77%	73%	0%	0%
Laos	4·1%	3·5% (2·5 to 3·9)	260 (189 to 295)	11 600 (4%)	78 700	170 (<1%)	0·5% (0·4 to 0·6)	4800 (3600 to 5600)	87%	72%	0%	0%
Malaysia	3·6%	2·3% (2·0 to 2·6)	790 (678 to 897)	47 700 (6%)	303 000	6700 (2%)	<0·1% (<0·1 to 0·1)	2900 (2300 to 4400)	97%	99%	50%	0%
Myanmar	6·4%	4·8% (2·9 to 6·8)	2619 (1545 to 3664)	7800 (<1%)	880 000	180 (<1%)	1·3% (0·8 to 1·8)	69 000 (41 000 to 95 000)	37%	62%	0%	0%
Philippines	16·7%	4·9% (2·4 to 8·6)	5660 (2727 to 9977)	632 000 (11%)	1 877 000	4100 (<1%)	1·0% (0·6 to 2·0)	150 000 (81 000 to 290 000)	57%	39%	0%	0%
Sri Lanka	2·5%	2·2% (1·8 to 2·4)	486 (391 to 515)	35 800 (7%)	168 000	30 (<1%)	0·3% (0·3 to 0·4)	6200 (4900 to 6900)	96%	0%	0%	0%
Thailand	3·3%	2·6% (2·4 to 3·4)	1838 (1752 to 2434)	214 000 (12%)	791 000	12 000 (2%)	0·1% (<0·1 to 0·2)	4800 (3600 to 8500)	89%	96%	50%	0%
Timor-Leste	Ext	9·1% (7·8 to 10·4)	122 (105 to 140)	14 200 (12%)	36 100	70 (<1%)	1·7% (1·4 to 2·1)	3200 (2700 to 4100)	90%	84%	0%	0%
Viet Nam	7·9%	6·6% (5·8 to 9·2)	6520 (5740 to 8987)	2 717 000 (42%)	2 653 000	91 200 (3%)	0·9% (0·8 to 1·5)	80 000 (69 000 to 130 000)	83%	77%	0%	0%
Australasia												
Australia	0·9%	0·8% (0·4 to 1·4)	218 (115 to 362)	170 000 (78%)	77 100	23 800 (31%)	<0·1% (<0·1 to 0·1)	1300 (580 to 2600)	95%	91%	100%	0%
New Zealand	2·0%	1·7% (1·1 to 2·5)	87 (57 to 131)	58 100 (67%)	38 200	5800 (15%)	<0·1% (<0·1 to <0·1)	86 (63 to 140)	90%	1%	90%	90%
Caribbean												
Belize	4·0%	1·2% (0·5 to 1·4)	5 (2 to 6)	440 (9%)	1200	11 (<1%)	<0·1% (<0·1 to <0·1)	30 (13 to 34)	83%	77%	0%	0%
Cuba	1·1%	0·6% (0·2 to 1·2)	66 (27 to 132)	4800 (7%)	22 100	220 (1%)	<0·1% (<0·1 to <0·1)	3 (2 to 9)	99%	99%	87%	65%
Dominican Republic	3·2%	1·6% (1·1 to 1·9)	176 (121 to 212)	16 700 (9%)	47 400	600 (1%)	0·1% (<0·1 to 0·1)	1200 (860 to 1500)	83%	66%	0%	0%
Guyana	4·0%	2·5% (1·9 to 2·7)	20 (15 to 22)	2600 (13%)	4800	50 (<1%)	0·1% (<0·1 to 0·2)	110 (88 to 170)	99%	58%	0%	0%
Haiti	2·5%	1·9% (1·3 to 3·4)	217 (150 to 398)	12 600 (6%)	47 700	120 (<1%)	0·4% (0·3 to 0·8)	6900 (4700 to 12 000)	73%	0%	0%	0%

(Table 1 continues on next page)

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	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
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Jamaica	5·3%	3·8% (1·9 to 4·7)	107 (54 to 132)	1500 (1%)	27 300	260 (<1%)	0·2% (0·1 to 0·3)	500 (290 to 640)	89%	0%	0%	0%
Suriname	2·9%	1·8% (1·4 to 2·1)	11 (9 to 13)	1000 (9%)	2800	30 (<1%)	0·1% (0·1 to 0·2)	96 (75to 120)	86%	97%	50%	0%
Trinidad and Tobago	Ext	1·9% (1·5 to 2·3)	29 (22 to 35)	1700 (6%)	8000	230 (3%)	0·1% (0·1 to 0·2)	130 (120 to 200)	94%	0%	0%	0%
Europe, central												
Albania	7·1%	6·5% (4·6 to 9·4)	185 (132 to 268)	7400 (4%)	43 300	190 (<1%)	0·2% (0·1 to 0·4)	280 (230 to 650)	98%	99%	20%	0%
Bosnia and Herzegovina	Ext	2·5% (1·6 to 2·9)	80 (52 to 95)	3200 (4%)	21 800	640 (3%)	0·4% (0·2 to 0·4)	650 (420 to 770)	80%	94%	90%	43%
Bulgaria	3·9%	2·6% (1·7 to 4·2)	175 (117 to 284)	28 700 (16%)	55 100	2600 (5%)	<0·1% (<0·1 to <0·1)	170 (130 to 300)	89%	97%	10%	90%
Croatia	0·6%	0·6% (0·5 to 1·0)	23 (20 to 41)	9800 (43%)	6500	550 (8%)	<0·1% (<0·1 to <0·1)	18 (14 to 36)	90%	<1%	18%	81%
Czechia	0·6%	0·4% (0·2 to 0·5)	43 (21 to 54)	8900 (21%)	10 700	1500 (14%)	<0·1% (<0·1 to <0·1)	18 (7 to 22)	97%	<1%	100%	99%
Hungary	0·6%	0·4% (0·4 to 0·5)	44 (38 to 48)	2000 (5%)	9800	560 (6%)	<0·1% (<0·1 to <0·1)	400 (340 to 460)	<1%	<1%	97%	71%
Kosovo	2·4%	1·6% (1·4 to 1·9)	27 (22 to 32)	6300 (23%)	8200	470 (6%)	<0·1% (<0·1 to <0·1)	50 (38 to 94)	94%	94%	0%	0%
North Macedonia	Ext	1·7% (1·3 to 1·7)	36 (27 to 36)	8300 (23%)	9600	550 (6%)	0·1% (<0·1 to 0·2)	150 (110 to 230)	79%	97%	0%	0%
Poland	1·0%	0·9% (0·6 to 1·0)	339 (253 to 401)	196 000 (58%)	83 400	7500 (9%)	<0·1% (<0·1 to <0·1)	770 (470 to 1100)	88%	85%	97%	0%
Romania	4·4%	3·0% (2·7 to 3·2)	582 (540 to 636)	84 600 (15%)	175 000	8500 (5%)	0·1% (0·1 to 0·2)	1600 (1500 to 2300)	86%	97%	0%	6%
Serbia	Ext	1·6% (1·4 to 2·0)	119 (101 to 146)	27 300 (23%)	26 700	1500 (6%)	<0·1% (<0·1 to 0·1)	400 (310 to 530)	89%	99%	0%	0%
Slovakia	0·9%	0·8% (0·4 to 1·6)	45 (24 to 92)	7700 (17%)	10 800	1000 (9%)	<0·1% (<0·1 to <0·1)	50 (30 to 130)	97%	<1%	50%	20%
Slovenia	0·5%	0·5% (0·4 to 0·5)	10 (9 to 11)	2900 (29%)	3000	1100 (36%)	0·2% (0·2 to 0·2)	240 (180 to 270)	86%	<1%	100%	75%
Europe, eastern												
Belarus	4·8%	3·9% (2·6 to 5·1)	375 (251 to 484)	16 900 (5%)	105 000	690 (<1%)	0·2% (0·1 to 0·3)	910 (640 to 1400)	98%	98%	50%	0%
Estonia	0·5%	0·5% (0·4 to 0·6)	6 (5 to 7)	400 (7%)	2500	110 (4%)	<0·1% (<0·1 to <0·1)	27 (24 to 48)	84%	<1%	99%	0%
Lithuania	Ext	2·1% (0·9 to 2·5)	58 (24 to 69)	11 800 (20%)	20 600	430 (2%)	0·1% (<0·1 to 0·2)	210 (84 to 320)	90%	93%	0%	0%

(Table 1 continues on next page)

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	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
Moldova	9·7%	9·0% (7·3 to 10·3)	295 (240 to 337)	20 000 (7%)	136 000	30 (<1%)	0·6% (0·5 to 1·0)	1600 (1200 to 2500)	87%	94%	0%	0%
Russia	1·1%	1·1% (0·4 to 1·3)	1651 (638 to 1857)	497 000 (30%)	538 000	3000 (<1%)	<0·1% (<0·1 to <0·1)	3400 (1300 to 5900)	97%	97%	0%	0%
Ukraine	1·5%	1·3% (1·0 to 1·6)	505 (409 to 653)	43 700 (9%)	117 000	1800 (2%)	0·2% (0·2 to 0·3)	3900 (3200 to 5200)	77%	56%	0%	0%
Europe, western												
Austria	Ext	0·6% (0·4 to 0·6)	49 (32 to 58)	16 600 (34%)	15 800	4800 (31%)	<0·1% (<0·1 to <0·1)	220 (130 to 260)	85%	0%	0%	0%
Belgium	0·7%	0·5% (0·4 to 0·6)	61 (50 to 73)	27 900 (46%)	20 200	2200 (11%)	<0·1% (<0·1 to <0·1)	190 (140 to 290)	97%	<1%	80%	0%
Denmark	0·2%	0·2% (0·2 to 0·3)	14 (13 to 18)	13 600 (97%)	3300	790 (24%)	<0·1% (<0·1 to 0·1)	320 (270 to 460)	<1%	<1%	99%	48%
Finland	0·2%	0·2% (0·1 to 0·2)	10 (8 to 10)	8500 (89%)	2400	370 (15%)	<0·1% (<0·1 to <0·1)	70 (58 to 74)	<1%	<1%	97%	79%
France	0·3%	0·2% (0·1 to 0·4)	143 (71 to 265)	103 000 (72%)	44 700	22 500 (50%)	<0·1% (<0·1 to <0·1)	270 (140 to 610)	91%	<1%	100%	28%
Germany	0·3%	0·3% (0·2 to 0·5)	219 (152 to 404)	82 100 (37%)	82 700	26 100 (31%)	<0·1% (<0·1 to <0·1)	280 (190 to 650)	88%	<1%	100%	10%
Greece	2·3%	1·7% (1·5 to 1·9)	178 (151 to 201)	82 800 (46%)	47 300	23 300 (49%)	<0·1% (<0·1 to <0·1)	60 (47 to 95)	96%	1%	100%	80%
Ireland	0·1%	0·1% (0·1 to 0·1)	4 (3 to 5)	2400 (59%)	1200	380 (31%)	<0·1% (<0·1 to <0·1)	9 (5 to 14)	93%	<1%	95%	0%
Israel	1·8%	1·4% (0·9 to 1·9)	131 (85 to 174)	24 200 (18%)	38 000	1600 (4%)	<0·1% (<0·1 to <0·1)	650 (430 to 960)	96%	95%	20%	60%
Italy	0·6%	0·5% (0·3 to 0·6)	303 (187 to 383)	93 300 (31%)	91 700	42 600 (46%)	<0·1% (<0·1 to <0·1)	50 (18 to 79)	94%	<1%	100%	10%
Malta	Ext	0·5% (0·4 to 0·6)	3 (2 to 3)	870 (34%)	760	230 (31%)	<0·1% (<0·1 to <0·1)	8 (4 to 8)	97%	0%	0%	0%
Netherlands	0·2%	0·2% (0·1 to 0·3)	43 (22 to 60)	25 500 (59%)	13 600	5500 (41%)	<0·1% (<0·1 to <0·1)	37 (15 to 65)	93%	<1%	12%	50%
Norway	0·5%	0·3% (0·3 to 0·4)	16 (15 to 19)	14 600 (89%	4700	1400 (31%)	<0·1% (<0·1 to <0·1)	11 (11 to 15)	96%	<1%	100%	95%
Portugal	1·5%	1·1% (0·8 to 1·4)	112 (83 to 139)	7600 (7%)	41 400	2000 (5%)	<0·1% (<0·1 to <0·1)	71 (54 to 120)	99%	97%	0%	0%
Spain	0·7%	0·4% (0·3 to 0·6)	212 (163 to 298)	38 900 (18%)	62 900	12 000 (19%)	<0·1% (<0·1 to <0·1)	110 (88 to 180)	92%	<1%	14%	65%
Sweden	0·3%	0·3% (0·2 to 0·4)	31 (16 to 38)	20 400 (66%)	10 100	3500 (34%)	<0·1% (<0·1 to <0·1)	20 (7 to 22)	97%	<1%	100%	96%
Switzerland	0·4%	0·7% (0·3 to 0·9)	62 (26 to 76)	37 300 (60%)	17 600	3100 (18%)	<0·1% (<0·1 to <0·1)	80 (24 to 140)	73%	<1%	100%	10%

(Table 1 continues on next page)

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
UK	0·7%	0·6% (0·4 to 0·9)	422 (290 to 586)	78 700 (19%)	115 000	35 100 (31%)	<0·1% (<0·1 to <0·1)	2200 (1400 to 3400)	93%	<1%	16%	75%
Latin America, Andean												
Bolivia	Ext	0·2% (0·2 to 0·3)	29 (24 to 34)	4300 (15%)	6400	300 (5%)	<0·1% (<0·1 to <0·1)	850 (640 to 990)	70%	0%	0%	0%
Ecuador	0·6%	0·6% (0·2 to 1·1)	108 (39 to 191)	8200 (8%)	29 000	40 (<1%)	<0·1% (<0·1 to 0·1)	1000 (400 to 1900)	68%	61%	50%	10%
Peru	0·4%	0·4% (0·2 to 0·6)	147 (82 to 207)	24 900 (17%)	33 700	2100 (6%)	<0·1% (<0·1 to <0·1)	1900 (1100 to 2800)	88%	77%	46%	0%
Latin America, central												
Colombia	1·5%	0·6% (0·1 to 1·9)	308 (72 to 983)	37 400 (12%)	87 800	2900 (3%)	<0·1% (<0·1 to <0·1)	1100 (260 to 4100)	87%	88%	8%	<1%
Costa Rica	0·2%	0·2% (0·1 to 0·2)	9 (6 to 12)	1600 (17%)	1900	70 (4%)	<0·1% (<0·1 to <0·1)	16 (12 to 32)	99%	89%	0%	0%
El Salvador	1·1%	0·9% (0·3 to 1·3)	55 (20 to 85)	2900 (5%)	16 300	570 (3%)	<0·1% (<0·1 to <0·1)	280 (98 to 490)	79%	73%	0%	0%
Guatemala	1·8%	0·6% (0·2 to 1·1)	103 (40 to 192)	10 500 (10%)	26 300	1300 (5%)	<0·1% (<0·1 to <0·1)	1000 (360 to 1900)	79%	48%	20%	0%
Honduras	Ext	0·3% (0·2 to 0·5)	26 (16 to 48)	3200 (12%)	6400	280 (4%)	<0·1% (<0·1 to <0·1)	220 (154 to 550)	77%	72%	0%	0%
Mexico	0·2%	0·1% (0·1 to 0·2)	117 (90 to 211)	13 400 (11%)	32 300	1100 (3%)	<0·1% (<0·1 to <0·1)	1300 (1100 to 2400)	80%	60%	<1%	<1%
Nicaragua	1·5%	0·7% (0·2 to 1·5)	52 (11 to 101)	3500 (7%)	13 200	190 (1%)	<0·1% (<0·1 to 0·1)	590 (130 to 1200)	99%	0%	0%	0%
Panama	Ext	0·3% (0·2 to 0·5)	13 (9 to 21)	3800 (29%)	3600	120 (3%)	<0·1% (<0·1 to <0·1)	100 (68 to 210)	74%	86%	0%	0%
Venezuela	1·8%	1·3% (1·1 to 2·3)	359 (325 to 644)	30 000 (8%)	85 900	3000 (3%)	0·2% (0·2 to 0·4)	6200 (5600 to 13 000)	56%	37%	0%	0%
Latin America, southern												
Argentina	0·3%	0·2% (0·1 to 0·2)	78 (40 to 110)	33 600 (43%)	19 600	2000 (10%)	<0·1% (<0·1 to <0·1)	730 (370 to 1200)	76%	73%	10%	0%
Chile	0·2%	0·1% (0·0 to 0·2)	25 (9 to 38)	1600 (6%)	6300	650 (10%)	<0·1% (<0·1 to <0·1)	30 (10 to 50)	95%	98%	93%	0%
Latin America, tropical												
Brazil	0·8%	0·5% (0·2 to 0·7)	1039 (520 to 1420)	355 000 (34%)	246 000	37 600 (15%)	<0·1% (<0·1 to <0·1)	2500 (1300 to 3900)	68%	27%	15%	8%
Paraguay	Ext	0·5% (0·3 to 0·7)	34 (21 to 45)	5300 (16%)	8300	40 (<1%)	<0·1% (<0·1 to <0·1)	480 (300 to 660)	58%	<1%	0%	0%
North Africa and Middle East												
Afghanistan	3·2%	1·8% (1·3 to 2·7)	749 (518 to 1117)	85 700 (11%)	196 000	17 100 (9%)	0·3% (0·2 to 0·5)	23 000 (16 098 to 35 000)	81%	48%	0%	0%

(Table 1 continues on next page)

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	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
Algeria	2·2%	1·3% (1·0 to 1·7)	589 (429 to 741)	48 200 (8%)	151 000	900 (<1%)	<0·1% (<0·1 to 0·1)	3400 (2500 to 6200)	95%	99%	0%	0%
Bahrain	1·0%	0·9% (0·7 to 1·1)	13 (10 to 15)	490 (4%)	3100	270 (9%)	<0·1% (<0·1 to <0·1)	30 (15 to 45)	98%	99%	100%	25%
Egypt	1·0%	0·9% (0·7 to 0·9)	952 (777 to 1037)	54 700 (6%)	248 000	25 000 (10%)	<0·1% (<0·1 to <0·1)	5600 (4670 to 6300)	96%	93%	51%	49%
Iran	1·8%	1·5% (1·4 to 1·5)	1321 (1219 to 1354)	367 000 (28%)	396 000	24 900 (6%)	<0·1% (<0·1 to <0·1)	1400 (1100 to 2200)	98%	96%	50%	10%
Iraq	3·5%	2·9% (1·8 to 3·3)	1310 (789 to 1451)	7100 (<1%)	302 000	230 (<1%)	0·5% (0·3 to 0·6)	34 200 (21 000 to 38 000)	78%	48%	50%	0%
Jordan	3·0%	1·8% (0·9 to 2·1)	199 (97 to 241)	2900 (1%)	40 800	940 (2%)	0·1% (<0·1 to 0·2)	1700 (790 to 2600)	78%	2%	88%	3%
Kuwait	4·8%	1·5% (0·9 to 1·9)	65 (40 to 80)	7500 (12%)	20 400	1800 (9%)	<0·1% (<0·1 to <0·1)	100 (65 to 200)	94%	93%	0%	0%
Lebanon	1·7%	1·3% (1·2 to 1·4)	72 (67 to 76)	7600 (11%)	17 600	730 (4%)	<0·1% (<0·1 to <0·1)	310 (270 to 400)	77%	98%	22%	25%
Libya	2·2%	1·6% (1·4 to 1·7)	111 (97 to 117)	12 700 (11%)	36 900	3200 (9%)	0·2% (0·1 to 0·2)	1300 (1100 to 1400)	97%	0%	0%	0%
Morocco	0·7%	0·6% (0·5 to 0·9)	224 (172 to 329)	91 900 (41%)	48 600	6500 (13%)	<0·1% (<0·1 to <0·1)	990 (750 to 1700)	99%	42%	0%	0%
Oman	2·50%	2·5% (2·0 to 2·7)	112 (89 to 121)	9200 (8%)	26 800	500 (2%)	<0·1% (<0·1 to 0·1)	400 (310 to 760)	99%	99%	10%	8%
Occupied Palestinian Territory	4·0%	1·3% (1·0 to 1·6)	68 (50 to 84)	25 400 (37%)	17 600	1500 (9%)	<0·1% (<0·1 to <0·1)	280 (200 to 560)	99%	99%	0%	0%
Qatar	1·2%	1·1% (0·9 to 1·3)	30 (25 to 35)	8500 (28%)	6800	700 (10%)	<0·1% (<0·1 to <0·1)	80 (65 to 100)	98%	99%	100%	57%
Saudi Arabia	1·8%	1·6% (1·0 to 1·8)	576 (370 to 646)	58 700 (10%)	150 000	6000 (4%)	<0·1% (<0·1 to <0·1)	930 (650 to 15008)	97%	98%	65%	10%
Sudan	6·9%	4·3% (3·4 to 4·4)	2022 (1604 to 2067)	231 000 (11%)	422 000	36 700 (9%)	0·8% (0·6 to 0·8)	70 000 (54 000 to 71 000)	90%	0%	0%	0%
Syria	5·6%	5·1% (2·2 to 6·0)	1122 (491 to 1317)	128 000 (11%)	249 000	21 700 (9%)	3·5% (1·6 to 4·0)	83 000 (38 000 to 93 000)	65%	71%	0%	0%
Tunisia	5·3%	3·6% (3·3 to 3·8)	441 (412 to 472)	50 500 (11%)	103 000	9000 (9%)	0·1% (0·1 to 0·2)	1400 (1300 to 2500)	95%	74%	0%	0%
Türkiye	4·0%	2·3% (1·7 to 3·3)	1984 (1452 to 2838)	282 000 (14%)	565 000	80 000 (14%)	<0·1% (<0·1 to 0·1)	4700 (3700 to 9300)	96%	99%	50%	0%
United Arab Emirates	3·7%	0·9% (0·5 to 1·0)	88 (48 to 96)	3500 (3%)	27 600	40 (<1%)	<0·1% (<0·1 to <0·1)	95 (53 to 190)	95%	96%	0%	0%
Yemen	4·2%	2·8% (1·2 to 5·4)	949 (395 to 1810)	4100 (<1%)	227 000	130 (<1%)	0·5% (0·2 to 1·0)	28 000 (12 000 to 58 000)	87%	0%	0%	0%

(Table 1 continues on next page)

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
North America, high income												
Canada	0·7%	0·6% (0·3 to 1·0)	216 (125 to 366)	154 000 (71%)	78 100	18 000 (23%)	<0·1% (<0·1 to <0·1)	660 (270 to 1200)	62%	3%	100%	0%
USA	0·3%	0·5% (0·4 to 0·8)	1646 (1361 to 2575)	323 000 (20%)	499 000	144 000 (29%)	<0·1% (<0·1 to <0·1)	5300 (4100 to 8800)	91%	69%	79%	24%
Oceania												
Fiji	2·0%	1·7% (1·5 to 1·9)	16 (14 to 17)	380 (2%)	10 500	3 (<1%)	0·2% (0·2 to 0·3)	260 (210 to 360)	93%	99%	0%	0%
Kiribati	15·0%	8·0% (5·7 to 9·3)	11 (7 to 12)	80 (<1%)	5200	0 (<1%)	1·9% (1·3 to 2·6)	370 (260 to 530)	94%	91%	0%	0%
Marshall Islands	1·8%	4·9% (4·3 to 5·2)	2 (2 to 2)	1200 (57%)	1000	0 (<1%)	1·1% (0·8 to 1·2)	50 (43 to 63)	89%	80%	0%	0%
Federated States of Micronesia	10·0%	7·3% (6·5 to 7·9)	8 (7 to 9)	470 (6%)	3600	1 (<1%)	0·8% (0·8 to 0·9)	110 (110 to 110)	79%	65%	50%	50%
Papua New Guinea	11·9%	5·8% (5·2 to 7·5)	593 (530 to 756)	28 400 (5%)	299 000	60 (<1%)	3·1% (2·8 to 4·0)	44 000 (40 000 to 57 000)	37%	22%	20%	0%
Samoa	5·5%	4·3% (3·8 to 4·4)	10 (8 to 10)	140 (1%)	5300	1 (<1%)	1·0% (0·7 to 1·2)	340 (260 to 430)	89%	89%	0%	0%
Solomon Islands	10·0%	8·3% (5·6 to 10·7)	60 (41 to 77)	3400 (6%)	30 600	6 (<1%)	1·8% (1·4 to 2·7)	2200 (1700 to 3300)	87%	76%	0%	0%
Tonga	Ext	9·0% (8·1 to 10·1)	10 (9 to 11)	2700 (28%)	4900	1 (<1%)	0·8% (0·8 to 1·2)	110 (110 to 180)	99%	99%	0%	0%
Tuvalu	11·0%	7·8% (7·7 to 10·4)	1 (1 to 1)	50 (5%)	470	0 (<1%)	1·3% (0·9 to 2·2)	19 (14 to 33)	94%	99%	0%	0%
Vanuatu	8·0%	7·3% (3·6 to 11·2)	24 (12 to 37)	5100 (21%)	12 000	2 (<1%)	1·3% (0·6 to 1·9)	690 (330 to 1000)	90%	66%	0%	0%
Sub-Saharan Africa, central												
Angola	13·0%	8·2% (6·3 to 8·3)	2903 (2226 to 2949)	70 600 (2%)	1 078 000	11 500 (1%)	3·3% (2·5 to 3·3)	240 000 (180 000 to 240 000)	66%	0%	0%	0%
Central African Republic	11·6%	11·5% (10·1 to 12·0)	644 (562 to 670)	15 700 (2%)	229 000	2400 (1%)	5·4% (5·1 to 6·3)	64 000 (60 000 to 75 000)	78%	0%	0%	0%
Congo	8·7%	5·5% (4·3 to 6·2)	330 (256 to 373)	8000 (2%)	127 000	1400 (1%)	1·9% (1·5 to 2·1)	19 000 (15 000 to 22 000)	77%	0%	0%	0%
DR Congo	3·3%	2·8% (2·5 to 2·9)	2785 (2499 to 2904)	67 700 (2%)	921 000	9900 (1%)	1·2% (1·1 to 1·3)	270 000 (240 000 to 280 000)	86%	0%	0%	0%
Gabon	12·3%	7·1% (3·7 to 8·0)	169 (89 to 190)	4100 (2%)	35 500	380 (1%)	2·1% (1·1 to 2·4)	7700 (4100 to 8800)	75%	0%	0%	0%

(Table 1 continues on next page)

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
Sub-Saharan Africa, east												
Burundi	4·6%	2·3% (2·0 to 2·6)	302 (262 to 333)	12 400 (4%)	83 800	590 (<1%)	0·5% (0·4 to 0·5)	12 000 (10 000 to 13 000)	94%	0%	0%	0%
Comoros	Ext	5·0% (4·5 to 6·2)	42 (37 to 52)	3100 (7%)	8300	250 (3%)	0·8% (0·7 to 0·9)	1000 (890 to 1300)	91%	0%	0%	0%
Djibouti	7·3%	5·5% (4·3 to 6·4)	62 (49 to 72)	4600 (7%)	11 900	350 (3%)	1·7% (1·3 to 2·0)	2400 (1800 to 2700)	59%	61%	0%	0%
Eritrea	9·2%	4·6% (4·2 to 5·1)	171 (154 to 187)	12 600 (7%)	34 300	60 (<1%)	0·6% (0·5 to 0·7)	3500 (3100 to 3900)	95%	0%	0%	0%
Ethiopia	9·4%	6·3% (5·6 to 7·0)	7793 (6882 to 8675)	368 000 (5%)	1 334 000	930 (<1%)	0·7% (0·6 to 0·7)	140 000 (120 000 to 160 000)	96%	0%	0%	0%
Kenya	8·0%	4·4% (4·0 to 6·6)	2361 (2163 to 3567)	5800 (<1%)	473 000	1700 (<1%)	0·8% (0·7 to 1·3)	67 000 (62 000 to 1 001 000)	88%	0%	0%	0%
Madagascar	6·9%	3·8% (3·3 to 4·5)	1132 (978 to 1340)	3200 (<1%)	202 000	140 (<1%)	0·4% (0·4 to 0·5)	21 000 (19 000 to 25 000)	95%	0%	0%	0%
Malawi	3·2%	2·7% (2·3 to 2·8)	561 (476 to 579)	41 300 (7%)	105 000	3100 (3%)	0·4% (0·4 to 0·5)	15 000 (12 000 to 15 000)	93%	0%	0%	0%
Mozambique	10·0%	6·2% (5·2 to 6·6)	2035 (1722 to 2163)	244 000 (12%)	379 000	62 000 (16%)	0·9% (0·7 to 1·0)	56 000 (47 000 to 62 7000)	82%	0%	0%	0%
Rwanda	3·9%	2·3% (1·5 to 3·6)	320 (207 to 494)	131 000 (41%)	69 600	15 200 (22%)	0·3% (0·2 to 0·4)	6800 (4193 to 10 200)	88%	0%	0%	0%
Somalia	19·0%	5·2% (4·9 to 6·0)	910 (864 to 1049)	66 900 (7%)	164 000	4900 (3%)	1·5% (1·4 to 1·7)	58 000 (54 000 to 68 000)	77%	0%	0%	0%
South Sudan	Ext	6·8% (6·2 to 7·6)	744 (680 to 827)	54 700 (7%)	128 000	3800 (3%)	2·9% (2·7 to 3·2)	50 400 (47 000 to 57 000)	83%	0%	0%	0%
Tanzania	3·5%	2·8% (1·9 to 3·1)	1856 (1245 to 2023)	84 300 (5%)	270 000	550 (<1%)	0·4% (0·3 to 0·5)	52 000 (34 000 to 58 000)	96%	0%	0%	0%
Uganda	5·0%	2·4% (2·1 to 2·8)	1124 (1011 to 1322)	396 000 (35%)	266 000	5000 (2%)	0·3% (0·3 to 0·4)	30 000 (27 000 to 35 000)	91%	0%	0%	0%
Zambia	3·7%	1·8% (1·6 to 2·9)	363 (320 to 589)	26 700 (7%)	101 000	3000 (3%)	0·4% (0·3 to 0·6)	14 000 (12 000 to 23 000)	91%	94%	0%	0%
Sub-Saharan Africa, southern												
Lesotho	Ext	10·5% (8·8 to 10·8)	242 (202 to 249)	38 000 (16%)	66 600	60 (<1%)	1·7% (1·4 to 1·8)	5700 (4700 to 6000)	95%	0%	0%	0%
Eswatini	Ext	8·7% (7·7 to 9·4)	104 (93 to 113)	16 400 (16%)	29 700	970 (3%)	1·4% (1·2 to 1·5)	2300 (2000 to 2500)	91%	0%	0%	0%
South Africa	5·0%	4·7% (4·4 to 5·2)	2825 (2632 to 3096)	634 000 (22%)	575 000	3000 (<1%)	1·1% (1·0 to 1·2)	76 000 (71 000 to 83 000)	86%	<1%	0%	5%
Zimbabwe	15·4%	7·7% (7·0 to 8·6)	1261 (1142 to 1406)	7300 (<1%)	361 000	2200 (<1%)	1·1% (1·0 to 1·3)	32 000 (28 000 to 36 000)	90%	0%	0%	0%

(Table 1 continues on next page)

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
Sub-Saharan Africa, west												
Benin	6·0%	4·5% (3·5 to 7·3)	600 (471 to 976)	4600 (<1%)	131 000	310 (<1%)	1·7% (1·3 to 2·9)	43 000 (34 000 to 74 000)	84%	64%	0%	0%
Burkina Faso	8·8%	4·8% (4·1 to 5·1)	1090 (933 to 1158)	4900 (<1%)	272 000	640 (<1%)	0·9% (0·7 to 0·9)	37 000 (31 000 to 40 000)	91%	0%	0%	0%
Cameroon	11·9%	5·8% (5·4 to 6·1)	1618 (1516 to 1701)	31 000 (2%)	515 000	960 (<1%)	1·6% (1·4 to 1·6)	81 000 (75 000 to 86 000)	81%	0%	0%	0%
Cape Verde	Ext	10·5% (9·5 to 11·4)	62 (56 to 68)	480 (<1%)	13 500	20 (<1%)	0·6% (0·5 to 0·8)	350 (320 to 490)	97%	99%	0%	0%
Chad	12·2%	9·5% (8·1 to 10·0)	1688 (1438 to 1772)	12 900 (<1%)	625 000	50 (<1%)	3·9% (3·4 to 4·1)	150 000 (130 000 to 160 000)	89%	0%	0%	0%
Côte d'Ivoire	13·0%	7·7% (4·2 to 7·9)	2156 (1171 to 2211)	33 000 (2%)	502 000	1200 (<1%)	0·8% (0·4 to 0·8)	40 000 (21 000 to 428 000)	91%	66%	0%	0%
Gambia	6·0%	2·3% (1·9 to 2·3)	62 (52 to 62)	470 (<1%)	11 200	20 (<1%)	0·2% (0·1 to 0·2)	870 (720 to 920)	88%	35%	0%	0%
Ghana	12·3%	8·6% (5·3 to 9·8)	2865 (1774 to 3270)	20 000 (<1%)	710 000	800 (<1%)	1·1% (0·7 to 1·2)	57 000 (38 000 to 646 000)	98%	0%	0%	0%
Guinea	Ext	10·0% (8·5 to 10·2)	1380 (1185 to 1419)	10 500 (<1%)	274 000	100 (<1%)	3·4% (2·8 to 3·5)	85 000 (70 000 to 87 000)	60%	0%	0%	0%
Guinea-Bissau	18·7%	12·3% (11·6 to 12·9)	260 (245 to 272)	2000 (<1%)	51 400	90 (<1%)	1·6% (1·5 to 1·7)	5700 (5300 to 6100)	90%	0%	0%	0%
Liberia	6·1%	4·3% (3·8 to 5·4)	228 (204 to 287)	1700 (<1%)	45 100	80 (<1%)	0·7% (0·7 to 1·0)	6600 (5900 to 8600)	83%	0%	0%	0%
Mali	13·2%	7·0% (4·1 to 13·7)	1582 (916 to 3093)	68 100 (4%)	273 000	490 (<1%)	2·3% (1·1 to 5·6)	110 000 (50 000 to 270 000)	97%	0%	0%	0%
Mauritania	16·8%	9·2% (8·4 to 11·9)	434 (398 to 564)	2000 (<1%)	87 700	140 (<1%)	1·3% (1·2 to 1·7)	11 000 (10 000 to 14 000)	97%	0%	0%	0%
Niger	16·2%	10·9% (10·0 to 12·4)	2864 (2612 to 3256)	21 800 (<1%)	578 000	1000 (<1%)	3·4% (3·2 to 3·8)	200 000 (190 000 to 230 000)	82%	0%	0%	0%
Nigeria	8·1%	6·6% (5·1 to 10·3)	14 441 (11 128 to 22 480)	16 300 (<1%)	2 352 000	5100 (<1%)	3·6% (2·8 to 5·6)	1 500 000 (1 200 000 to 2 300 000)	56%	30%	0%	0%
Senegal	10·0%	5·3% (4·3 to 6·5)	917 (752 to 1128)	10 400 (1%)	192 000	960 (1%)	0·5% (0·4 to 0·7)	15 000 (13 000 to 20 000)	96%	74%	0%	0%
Sierra Leone	9·7%	6·1% (5·6 to 8·5)	526 (481 to 729)	4000 (<1%)	106 000	190 (<1%)	0·8% (0·7 to 1·1)	11 000 (10 000 to 15 000)	95%	0%	0%	0%

(Table 1 continues on next page)

estimated with consideration of historical and current prophylaxis measures. Country-specific historical data inputs included HBsAg positivity prevalence by age, HBeAg positivity prevalence among pregnant women, prophylaxis coverage rates by year, treatment, and diagnostic rates (appendix pp 21–37).

Model outputs have been validated against empirical data in a variety of settings, with age-specific and sex-specific prevalence estimates validated in China, Uganda, and Iran, and hepatocellular carcinoma incidence validated in Japan, South Korea, and Switzerland (appendix pp 41–48).

Uncertainty analyses

Uncertainty intervals (UI) were calculated and sensitivity analyses were done with Crystal Ball (version 11.1.3708.0), an Excel add-in developed by Oracle. Beta-PERT distributions were used for all uncertain inputs.[17] Beta-PERT was used to emphasise the most likely (base) values for the model, as these are the values focused on in the Delphi process and used in the validation exercises. For these distributions, the "base" parameter values for prevalence, transmission, and progression (referred to in the appendix [pp 6-9, 11, 21–26]) are those determined to be the most likely values. The "low" and "high" values represent, respectively, the lowest and highest values obtained from the data sources. Monte Carlo simulation was used to estimate 95% UIs with 1000 simulations run per country. It was assumed that prevalence uncertainty estimates in all countries were independent. The uncertainty range for each country was calculated on the basis of range inputs for prevalence, transmission rates, transition rates, and mortality rates. These country-level uncertainty ranges were then used to calculate regional and global uncertainty ranges. The country-level uncertainty in prevalence and its effect on regional and global prevalence was considered for these estimates.

The 2022 country-level prevalence estimates and 95% UIs were consolidated and defined as assumption variables for sensitivity analysis. Prevalence uncertainty was the largest driver of uncertainty and dominated the UIs of all other inputs used in the model. A sensitivity analysis was run to identify countries that accounted for the greatest variation in the base global prevalence through their estimated prevalence uncertainty.

Estimation of future burden

Country models were run to 2030 to examine the future burden of HBV-related morbidity and mortality. The 2022 values for new diagnoses, total populations eligible for and on treatment, and all prophylaxis measures were assumed to remain constant up to 2030.

Role of the funding source

The funder had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg-positivity in children aged ≤5 years		HBV prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
São Tomé and Príncipe	Ext	9·3% (8·2 to 10·1)	21 (19 to 23)	500 (2%)	4400	80 (2%)	0·8% (0·8 to 1·2)	310 (310 to 430)	95%	69%	0%	0%
Togo	10·6%	9·4% (8·2 to 11·0)	834 (725 to 976)	11 500 (1%)	167 000	150 (<1%)	1·7% (1·5 to 1·9)	25 000 (22 000 to 29 000)	90%	0%	0%	0%

Values in parentheses are 95% uncertainty interval or %. Countries are grouped by GBD region; see table 2 for global and regional estimates. Ext=extrapolated prevalence based on GBD region. GBD=Global Burden of Disease Study. HBIG=hepatitis B immunoglobulin. HBV=hepatitis B virus. *Number of individuals diagnosed with HBV infection out of the estimated HBsAg-positive population. †Number of HBsAg-positive individuals estimated to be eligible for treatment under international guidelines (diagnosed and undiagnosed). ‡Number of individuals receiving treatment out of the estimated treatment-eligible population (diagnosed and undiagnosed). §Proportion of all infants who receive three or more doses of HBV vaccine in first year of life. ¶Proportion of all infants who receive the first dose of HBV vaccine within 24 h after birth. ‖Proportion of infants of HBsAg-positive mothers who receive HBIG along with the birth dose and full regimen of vaccination (at least two further doses before 1 year of age). **Proportion of mothers with high viral load who receive antiviral therapy to reduce mother-to-child transmission.

Table 1: **Literature-reported and modelled prevalence of HBV infection, diagnosis, treatment, and prophylaxis coverage, by country in 2022**

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg positivity in children aged ≤5 years, 2022		Prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
Global	4·5%	3·2% (2·7 to 4·0)	257 518 (216 602 to 316 384)	36 041 000 (14%)	83 250 000	6 823 000 (8%)	0·7% (0·6 to 1·0)	5 600 000 (4 500 000 to 7 800 000)	85%	46%	14%	3%
GBD regions												
Asia Pacific, high income	1·4%	1·4% (1·1 to 1·5)	2465 (2014 to 2645)	1 725 000 (70%)	905 000	452 000 (50%)	<0·1% (<0·1 to <0·1)	1300 (980 to 1700)	94%	27%	99%	25%
Asia, central	6·6%	3·2% (1·8 to 4·3)	3104 (1790 to 4156)	363 000 (12%)	851 000	37 700 (4%)	0·2% (0·1 to 0·3)	23 000 (16 000 to 40 000)	94%	97%	2%	<1%
Asia, east	7·2%	5·6% (5·2 to 6·0)	83 399 (77 581 to 88 506)	20 747 000 (25%)	35 035 000	5 210 000 (15%)	0·1% (<0·1 to 0·2)	110 000 (71 000 to 200 000)	98%	95%	95%	26%
Asia, south	3·1%	2·2% (1·9 to 3·1)	41 169 (35 093 to 56 818)	1 841 000 (4%)	12 232 000	157 000 (1%)	0·2% (0·2 to 0·4)	450 000 (376 971 to 730 633)	85%	51%	19%	<1%
Asia, southeast	7·9%	5·2% (4·3 to 7·0)	36 436 (29 712 to 48 709)	4 247 000 (12%)	12 991 000	138 000 (1%)	1·5% (1·3 to 2·0)	1 100 000 (860 000 to 1 300 000)	73%	66%	2%	<1%
Australasia	1·0%	1·0% (0·6 to 1·6)	305 (173 to 494)	228 000 (75%)	115 000	29 600 (26%)	<0·1% (<0·1 to 0·1)	1400 (630 to 2800)	94%	75%	99%	12%
Caribbean	2·5%	1·6% (1·0 to 2·4)	732 (463 to 1099)	48 000 (7%)	187 000	1800 (<1%)	0·2% (0·2 to 0·4)	9800 (6900 to 17 000)	78%	37%	2%	<1%
Europe, central	1·9%	1·5% (1·2 to 1·9)	1718 (1364 to 2155)	396 000 (23%)	466 000	26 900 (6%)	<0·1% (<0·1 to 0·1)	4800 (3900 to 7000)	81%	65%	38%	18%
Europe, eastern	1·5%	1·4% (0·8 to 1·7)	2917 (1580 to 3436)	590 000 (20%)	927 000	6100 (<1%)	<0·1% (<0·1 to 0·1)	10 000 (7200 to 15 000)	93%	88%	9%	<1%
Europe, western	0·6%	0·5% (0·3 to 0·7)	2024 (1378 to 2826)	682 000 (34%)	617 000	189 000 (31%)	<0·1% (<0·1 to <0·1)	4700 (3100 to 7500)	89%	6%	58%	45%
Latin America, Andean	0·5%	0·4% (0·2 to 0·7)	285 (145 to 432)	37 500 (13%)	69 100	2400 (4%)	<0·1% (<0·1 to <0·1)	3800 (2100 to 5800)	79%	55%	41%	3%
Latin America, central	0·8%	0·4% (0·2 to 0·9)	1042 (588 to 2298)	106 000 (10%)	274 000	9500 (3%)	<0·1% (<0·1 to <0·1)	11 000 (7400 to 24 000)	79%	61%	4%	<1%
Latin America, southern	0·2%	0·2% (0·1 to 0·2)	108 (51 to 156)	37 000 (34%)	27 200	2800 (10%)	<0·1% (<0·1 to <0·1)	800 (440 to 1300)	82%	77%	16%	<1%
Latin America, tropical	0·8%	0·5% (0·2 to 0·7)	1072 (541 to 1465)	360 000 (34%)	254 000	37 600 (15%)	<0·1% (<0·1 to <0·1)	3000 (1600 to 4600)	68%	26%	14%	7%
North Africa and Middle East	2·9%	2·0% (1·4 to 2·4)	13 005 (9163 to 16 057)	1 488 000 (11%)	3 257 000	216 000 (7%)	0·3% (0·2 to 0·4)	260 000 (160 000 to 330 000)	91%	63%	16%	3%
North America, high income	0·3%	0·5% (0·4 to 0·8)	1862 (1485 to 2941)	477 000 (26%)	577 000	162 000 (28%)	<0·1% (<0·1 to <0·1)	5900 (4500 to 10 000)	89%	63%	83%	20%
Oceania	10·8%	5·8% (4·9 to 7·3)	787 (677 to 1000)	44 900 (6%)	399 000	80 (<1%)	2·7% (2·3 to 3·5)	50 000 (44 000 to 65 000)	46%	33%	16%	<1%
Sub-Saharan Africa, central	6·3%	4·6% (3·8 to 4·8)	6909 (5694 to 7166)	168 000 (2%)	2 417 000	25 800 (1%)	1·9% (1·6 to 2·0)	600 000 (500 000 to 630 000)	81%	0%	0%	<1%
Sub-Saharan Africa, east	7·3%	4·4% (3·8 to 5·1)	19 831 (17 100 to 23 343)	1 459 000 (7%)	3 641 000	101 000 (3%)	0·6% (0·6 to 0·8)	530 000 (460 000 to 640 000)	91%	4%	0%	<1%
Sub-Saharan Africa, southern	7·2%	5·6% (5·1 to 6·1)	4722 (4334 to 5181)	741 000 (16%)	1 099 000	6600 (1%)	1·1% (1·0 to 1·2)	120 000 (110 000 to 130 000)	88%	5%	0%	3%

(Table 2 continues on next page)

	HBV infection prevalence, %		HBsAg-positive population, thousands	Number diagnosed* (% of HBsAg-positive population)	Number eligible for treatment†	Number treated‡ (% of eligible population)	HBsAg positivity in children aged ≤5 years, 2022		Prophylaxis coverage, %			
	Literature prevalence in year of study	Modelled prevalence in 2022					Prevalence, %	n	Three doses of vaccine before 1 year of age§	Timely birth dose of vaccine¶	HBIG and full vaccination‖	Antiviral treatment of mothers**
(Continued from previous page)												
Sub-Saharan Africa, west	10·0%	7·1% (5·5 to 9·6)	33 626 (26 069 to 45 411)	256 000 (1%)	6 908 000	12 500 (<1%)	2·7% (2·1 to 3·9)	2 400 000 (1 900 000 to 3 500 000)	73%	22%	0%	<1%
WHO regions												
Africa	7·9%	5·4% (4·4 to 6·8)	64 778 (52 786 to 80 808)	2 610 000 (4%)	14 067 000	142 000 (1%)	1·7% (1·3 to 2·3)	3 600 000 (2 900 000 to 4 900 000)	82%	14%	0%	<1%
Eastern Mediterranean	2·9%	1·9% (1·4 to 3·6)	15 200 (10 867 to 27 749)	2 332 000 (15%)	3 782 000	271 000 (7%)	0·4% (0·2 to 0·6)	390 000 (260 000 to 690 000)	87%	35%	33%	2%
Europe	1·8%	1·2% (0·8 to 1·6)	11 554 (7294 to 15 236)	2 293 000 (20%)	3 354 000	334 000 (10%)	<0·1% (<0·1 to 0·1)	46 000 (32 000 to 75 000)	91%	57%	20%	5%
Americas	0·6%	0·5% (0·3 to 0·8)	5101 (3269 to 8394)	1 066 000 (21%)	1 388 000	216 000 (16%)	<0·1% (<0·1 to <0·1)	34 000 (22 000 to 61 000)	80%	54%	33%	8%
Southeast Asia	3·8%	3·0% (2·6 to 3·5)	61 391 (53 667 to 72 009)	1 678 000 (3%)	19 600 000	60 300 (<1%)	0·6% (0·6 to 0·8)	1 200 000 (1 100 000 to 1 500 000)	83%	65%	4%	<1%
Western Pacific	7·1%	5·1% (4·5 to 5·7)	99 494 (89 041 to 112 111)	26 062 000 (26%)	41 058 000	5 799 000 (14%)	0·3% (0·2 to 0·5)	380 000 (260 000 to 650 000)	90%	80%	60%	15%
World Bank classifications												
High income	1·0%	0·9% (0·7 to 1·2)	11 185 (8891 to 14 705)	5 020 000 (45%)	3 479 000	996 000 (29%)	<0·1% (<0·1 to <0·1)	22 000 (16 000 to 35 000)	89%	44%	70%	32%
Upper-middle income	4·9%	3·8% (3·4 to 4·1)	96 069 (85 791 to 104 731)	21 636 000 (23%)	38 561 000	5 253 000 (14%)	0·1% (0·1 to 0·2)	260 000 (190 000 to 380 000)	90%	75%	72%	18%
Lower-middle income	4·9%	3·3% (2·7 to 4·5)	114 198 (91 851 to 154 100)	7 183 000 (6%)	33 067 000	400 000 (1%)	0·9% (0·7 to 1·3)	3 700 000 (3 000 000 to 5 400 000)	81%	49%	6%	<1%
Low income	7·4%	4·8% (4·0 to 5·7)	35 620 (29 694 to 41 994)	2 165 000 (6%)	8 037 000	170 000 (2%)	1·2% (1·0 to 1·5)	1 600 000 (1 300 000 to 2 000 000)	87%	8%	0%	0%

Values in parentheses are 95% uncertainty interval or %. GBD=Global Burden of Disease Study. HBIG=hepatitis B immunoglobulin. HBV=hepatitis B virus. *Number of individuals diagnosed with HBV infection out of the estimated HBsAg-positive population. †Number of HBsAg-positive individuals estimated to be eligible for treatment under international guidelines (diagnosed and undiagnosed). ‡Number of individuals receiving treatment out of the estimated treatment-eligible population (diagnosed and undiagnosed). §Proportion of all infants who receive three or more doses of HBV vaccine in first year of life. ¶Proportion of all infants who receive the first dose of HBV vaccine within 24 h after birth. ‖Proportion of infants of HBsAg-positive mothers who receive HBIG along with the birth dose and full regimen of vaccination (at least two further doses before 1 year of age). **Proportion of mothers with high viral load who receive antiviral therapy to reduce mother-to-child transmission.

Table 2: **Literature-reported and modelled prevalence of HBV infection, diagnosis, treatment, and prophylaxis coverage, globally and by region in 2022**

Results

The updated literature review produced 5277 search results, among which 20 were either found to be more robust, and thus used to update the prevalence estimates from our previous analysis, or were in countries that were newly modelled for this analysis. Validation of all estimates, previous and new, with national experts is part of an ongoing project. Experts in 98 countries—20 more countries than the previous publication[10]—provided feedback as of publication of this Article.

The literature review has provided point estimates for 151 countries since the start of the project, which, if used directly without any adjustments or modelling, result in a global prevalence of 4·5% or 357·7 million infections, after excluding blood donors and other non-representative estimates. However, these literature estimates do not consider the year in which the study was done, the ageing and subsequent death of individuals living with HBV infection, or the effect of prevention strategies since the original study was published. Sufficient data were available (including data that could be extrapolated) to build models for 170 countries (table 1). In 2022, using these country-specific models, it was estimated that there were 257·5 million (95% UI 216·6–316·3) individuals living with HBV infection (HBsAg positive), corresponding to a global prevalence of 3·2% (95% UI 2·7–4·0; table 2). The country-specific models represent 99·7% of the global population and total estimated HBV infections. HBV prevalence estimates were not available for all countries, and the quality of the available studies varied across countries (appendix p 38). Figure 1 shows estimates for all countries, for all ages and for children

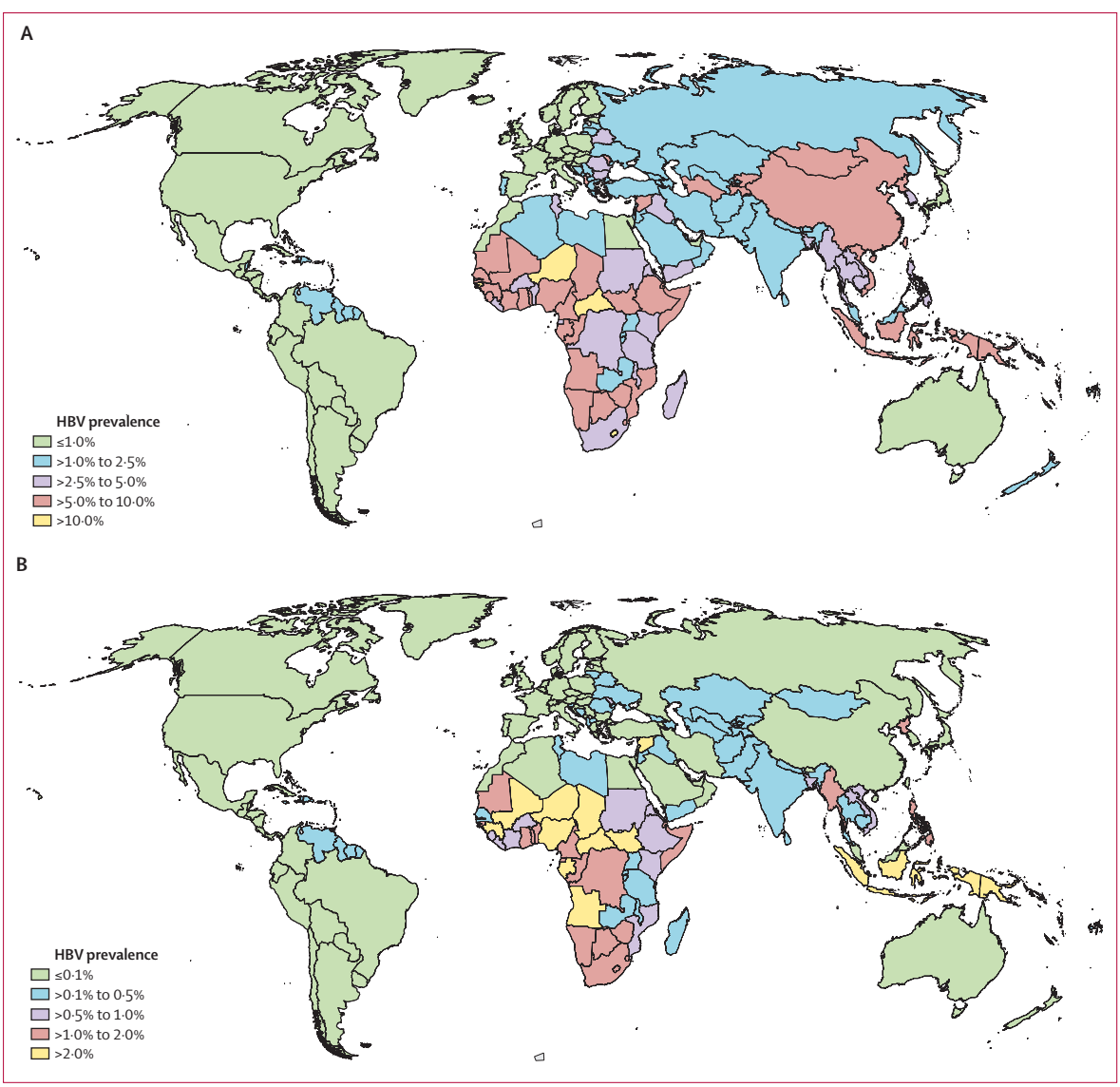

Figure 1: **HBV infection prevalence estimates, 2022**
HBV infection prevalence in all countries with modelled or extrapolated data for all ages (A) and for children aged 5 years or younger (B). HBV=hepatitis B virus.

aged 5 years or younger, after extrapolation to countries with missing data (<0·3% of total HBV infections) from the averages of modelled countries in the same GBD region.

Based on the modelled outputs, we estimated that around 83·3 million individuals (32% of the HBsAg-positive population) were eligible for treatment in 2022 (table 2) according to country-specific national treatment guidelines or EASL guidelines (when national treatment guidelines were not available). Although diagnostic testing for HBV infection has been available since the early 1970s, only 36·0 million individuals (14% of the HBsAg-positive population in 2022) were estimated to have been diagnosed (figure 2; table 2; appendix p 38). Of these 36·0 million, only 6·8 million (19% of those diagnosed and 8% of the total population eligible for treatment), were receiving antiviral treatment (figure 2; table 2; appendix p 38).

Globally, after weighting by number of births per country, an estimated 46% of infants received timely birth dose vaccination and 85% of those younger than 1 year received the full three-dose vaccination schedule against HBV in 2022 (table 2; appendix p 39), although there was large variability in rates of timely birth dose vaccination between regions. After weighting by estimated number of births to HBsAg-positive mothers, we estimated that 14% of infants born to HBsAg-positive mothers received HBIG, timely birth dose vaccination and at least two follow up doses in the first year of life (table 2; appendix p 39). After weighting by births to mothers with high HBV viral load, we estimated that 3% of these mothers received antiviral treatment to prevent mother-to-child transmission of HBV (table 2; appendix p 39). As a result of historical and current interventions, the prevalence among children aged 5 years or younger was estimated to be 0·7% (95% UI 0·6–1·0), corresponding to 5·6 million (4·5–7·8) children with HBV in this age group globally in 2022 (table 2).

17 countries accounted for over 75% of HBV infections among the general population globally (figure 3A), with China, India, Indonesia, Nigeria, and Ethiopia accounting for 58% of all HBsAg-positive individuals. Among children aged 5 years or younger, 16 countries accounted for over 75% of the estimated number of infections (figure 3B), with Nigeria, Indonesia, India, DR Congo, Angola, and Niger accounting for 57% of all infections.

The highest estimated prevalence of HBV infection, 4·8% (95% UI 4·0–5·7), was found in low-income countries (according to World Bank income classifications), which also had the lowest coverage of timely birth dose vaccination, HBIG treatment combined with full vaccination, and antiviral treatment of pregnant HBsAg-positive mothers (table 2). Low-income countries also had the highest HBV prevalence among children aged 5 years or younger (1·2% [95% UI 1·0–1·5]).

The impact of international prevention measures (including, but not limited to, timely birth dose vaccination, three-dose vaccination, HBIG treatment of infants, antiviral treatment of pregnant women, catch-up campaigns, and blood safety practices) is indicated by the trend in annual global incidence of chronic HBV infections, which is estimated to decrease from 1·4 million (95% UI 1·2–2·0; 19 cases per 100 000 population) in 2015 to 0·9 million (0·7–1·2; 11 cases per 100 000) in 2030 if 2021 levels of prophylaxis coverage are maintained (figure 4A).

However, the number of HBV-related deaths is projected to increase globally from 858 000 (95% UI 646 000–1 301 000; 12 cases per 100 000 population) in 2015 to 1 149 000 (860 000–1 718 000; 13 cases per 100 000) in 2030 (figure 4B). In the same period, the

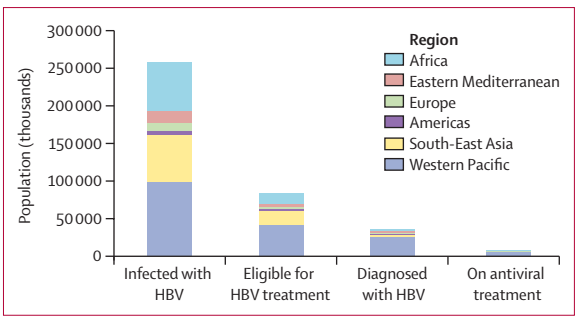

Figure 2: **Global and regional HBV infection cascade of care, 2022**
HBV=hepatitis B virus.

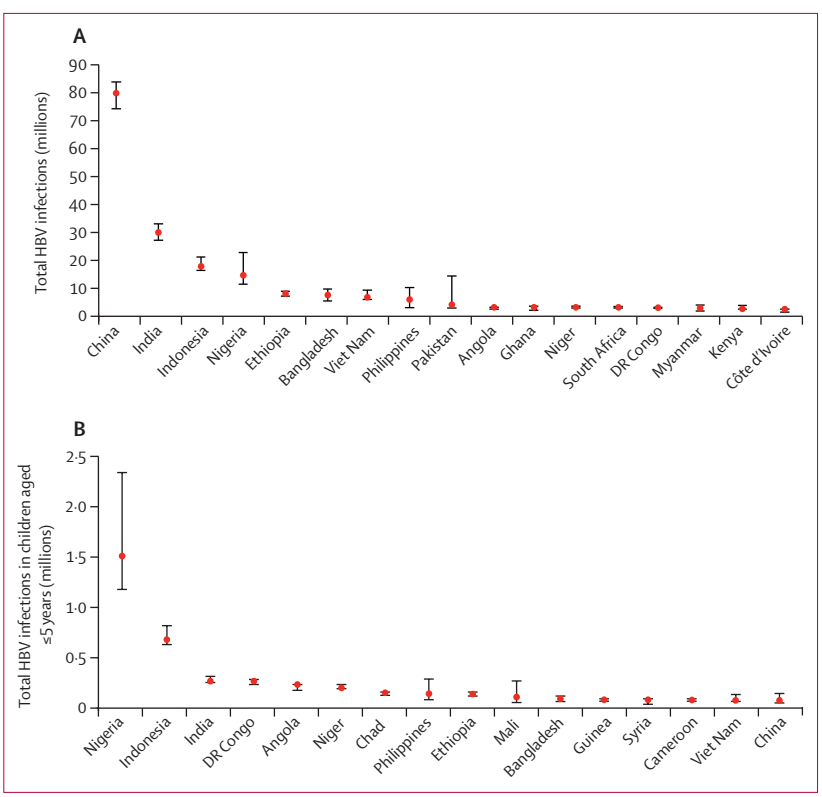

Figure 3: **Countries accounting for 75% or more of total HBV infections, 2022**
(A) All ages. (B) Children aged 5 years or younger. Error bars are 95% uncertainty intervals. HBV=hepatitis B virus.

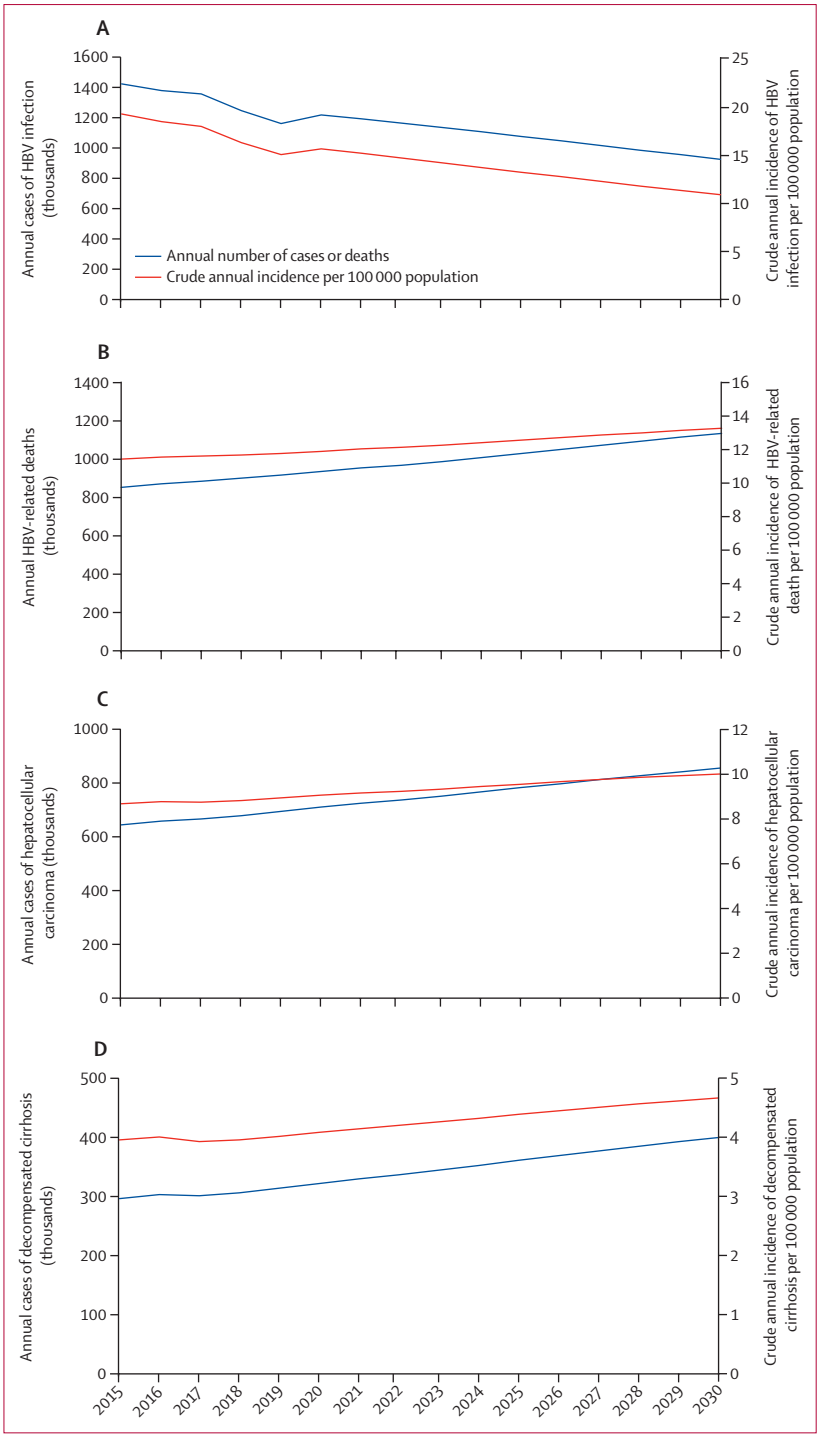

Figure 4: **Global incidence estimates of chronic HBV infection and HBV-related morbidities and deaths, 2015–30**

(A) Chronic HBV infection. (B) HBV-related deaths. (C) Hepatocellular carcinoma. (D) Decompensated cirrhosis. HBV=hepatitis B virus.

number of incident cases of hepatocellular carcinoma is predicted to increase from 644 000 (451 000–1 087 000; 9 cases per 100 000) to 857 000 (594 000–1 431 000; 10 cases per 100 000; figure 4C), and incident cases of decompensated cirrhosis are estimated to increase from 296 000 (165 000–439 000; 4 cases per 100 000) to 403 000 (219 000–597 000; 5 cases per 100 000; figure 4D) if current levels of HBV diagnosis and treatment remain constant.

The uncertainty analysis shows which countries had the largest impact on the estimated total number of individuals positive for HBV globally in 2022, with ten countries (Nigeria, Mainland China, Pakistan, Philippines, India, Indonesia, Bangladesh, Vietnam, Myanmar, and Kenya) accounting for over 94% of the total variance in global prevalence (appendix p 40). Sensitivity analysis of the total number of children aged 5 years or younger with HBV infection in 2022 showed that ten countries (Nigeria, Pakistan, Mali, Philippines, Indonesia, Mainland China, India, Vietnam, Bangladesh, and Myanmar) were responsible for 99% of the variance found at the global level (appendix p 40).

Discussion

Based on our model, which standardised all estimates to the year 2022 and considered the effects of prophylaxis programmes, we estimated the global prevalence of HBV infection to be 257·5 million—lower than the 357·7 million based on the literature review alone. Modelling, when validated, can account for the progress made and thereby provide real-time estimates of a rapidly changing disease burden. The difference in the global estimate presented here compared with previously published estimates is due to our exclusion of older studies and blood donor studies, and the inclusion of mortality and prophylaxis in our analysis.[4–7] Since our 2018 publication, we have added 50 models and validated another 20 countries.[10] The largest decrease in prevalence was observed in the African region, and was due to the inclusion of additional countries in the region, as there has been an increase in availability of data in recent years, and the continued impact of vaccination. The combination of these factors resulted in a lower overall prevalence in countries and regions in Africa, and thus a lower extrapolated prevalence for the remaining countries without estimates.

Although the number of people living with HBV infection is indicative of historical prevalence, the discrepancies between this modelled prevalence and that in children aged 5 years or younger provide insight into preventive strategies, particularly infant vaccination. HBV vaccination is a relatively inexpensive intervention, and protection at a young age is highly effective in preventing the development of chronic infection when exposed to the virus. When the estimates of overall prevalence and prevalence in children aged 5 years or younger are compared, they show the importance of robust prophylaxis schedules: China had the greatest overall number of people living with HBV infection, but ranked 16th in terms of HBV infections in this younger

age group. Among the 16 countries with the greatest number of young children with HBV infection, China was the only country with timely birth dose vaccination coverage of 90% or greater. Nine of these countries had not yet introduced timely birth dose vaccination. In many low-income and middle-income countries, the availability of timely birth dose vaccination and HBIG is restricted to the private sector, and families must pay out of pocket to secure crucial HBV prophylaxis for their infants.

Prevalence was highest among children aged 5 years or younger in the WHO African region—1·7% versus a global prevalence of 0·7%—and this region was also notably the region with the lowest coverage of timely birth dose vaccination globally, at 14%. The lowest prevalence among this younger population (<0·1%) was found in the region of the Americas. This region had a lower population-level prevalence before vaccination implementation than many other regions, but was also proactive in implementing vaccination early on. On a regional level, the Western Pacific and European regions have reached the recommended threshold of 90% or greater coverage of three-dose vaccination. China has a three-dose vaccination coverage of 99% in infants, and has a large impact on the regional average in the Western Pacific. The global average of 46% of infants receiving a timely birth dose vaccination is also impacted by the coverage rates in populous countries, as India represents 28% and China represents 17% of all timely birth dose vaccinations administered globally. Notably, India has twice the number of births that China has. When India and China are excluded from the global average, timely birth dose vaccination coverage drops to 34%. The global average is driven by timely birth dose vaccination in high-income and, in particular, upper-middle-income countries, as coverage in low-income countries is estimated to be only 8%.

There are several limitations to this study. Although country-specific prevalence data were available for 99·7% of the estimated total infections globally, 15 of the extrapolated models and eight of the unmodelled countries have populations over 1 million.

Because of an absence of recent data, we used studies from before 1990 for Djibouti, Federated States of Micronesia, Papua New Guinea, Samoa, and Tuvalu. However, 94% of all studies we used were done after 1990, 82% after 2000, and 55% after 2010. While these are the most accurate estimates that are currently available at the national population level, they might obscure regional variations and not account for certain populations at high risk (eg, migrants, Indigenous peoples and nations, people who inject drugs, sex workers, and other vulnerable populations) that might have an increased prevalence. Furthermore, the current analysis did not explicitly examine the differences between rural and urban areas, where access to prophylaxis measures might differ. These limitations emphasise the necessity of national strategies tailored to target the regions and populations most impacted by HBV infection.

The effect of immigration and emigration was not included, apart from in the USA and Switzerland, as it is beyond the scope of the current study. For these two countries separate in-depth analyses have been published previously.[18,19] Prevalence might have been underestimated in low-prevalence countries where many individuals are immigrating from high-prevalence countries. The effect of migration is an important area for future research and has been well documented in countries such as Belgium, Canada, Spain, and Sweden.[20–26]

Our model does not consider co-infections of HBV with HIV, HCV, or hepatitis D virus (HDV), which might accelerate disease progression. HBV–HDV co-infection substantially affects morbidity and mortality, but the effect of HDV co-infection on HBV prevalence is likely to be within the uncertainty interval of our modelled outputs. The model also does not consider occult infection. Although the disease progression rates we used are of the highest quality available, the base estimates might not be representative of all populations. The current model also does not consider the effect of HBsAg clearance among individuals with chronic HBV infection. HBsAg clearance has been shown to occur at a low rate and most often in older (≥59 years old) individuals with inactive infection (ie, immune control).[27–31] It would only impact the overall prevalence of HBV infection in long-term forecasts, as the incidence of HBV infection is dependent on high viral load, and it has been shown that individuals that clear HBsAg can still develop hepatocellular carcinoma, especially if they have cirrhosis and other liver comorbidities, such as non-alcoholic fatty liver disease.[32–35]

The extrapolation of HBV prevalence in children aged 5 years or younger might underestimate or overestimate the actual prevalence in the countries without data. Based on country interviews, treatment and diagnosis estimates are likely to be underestimates, as they are often higher than what is reflected in the available literature. In many countries, the majority of individuals with diagnosed HIV are treated with antivirals that are also active against HBV, and thus a large portion of those co-infected with HIV and HBV are receiving treatment.

Although hepatocellular carcinoma is reported at the national level, the fraction attributable to HBV, HCV, alcohol use, and non-alcoholic steatohepatitis is more difficult to discern.[36–39] We have relied on available data from national registries and tertiary centres treating patients with liver cancer to validate our model, and the same transition rates were applied to all other countries when data were not available. This is a limitation because HBV-related hepatocellular carcinoma rates in countries with high-quality empirical data might not be representative of all countries. Finally, all uncertain inputs were assumed to be Beta-PERT-distributed and

the model was thus susceptible to the misspecification bias, which is not accounted for by the reported UIs.

Since the last publication, the proportion of pregnant women with high viral load who received antiviral prophylaxis has increased from less than 1% to 4% but remains low globally. Once again, large increases have occurred in high-income countries, which tend to have lower prevalence of HBV infection. The greatest progress towards eliminating HBV infection continues to be achieved through the prevention of mother-to-child transmission and through infant vaccination. Of the modelled countries, 135 are estimated to have met the 2020 target of 1% prevalence among children aged 5 years or younger, and 71 have already met the 2030 target of 0·1% prevalence if they continue their prophylaxis programmes at their current levels.

Although these achievements should be lauded, many other countries have not met these targets and have yet to introduce any additional measures to prevent mother-to-child transmission (ie, timely birth dose vaccination and antiviral treatment of pregnant mothers with a high viral load). Expanding or creating programmes to screen pregnant individuals for HBV infection and implement additional interventions to prevent mother-to-child transmission (such as timely birth dose vaccination, HBIG, and antiviral treatment) could leverage progress in other disease areas, such as HIV, and could have benefits beyond HBV by increasing access to screening and treatment in rural areas and educating health-care workers. For many countries, antiviral treatment of mothers during pregnancy is a better option than HBIG administered to infants, as antiviral treatment is now affordable, readily available, and does not require cold chain (refrigeration distribution and storage). This option is also supported by a recent study of 280 HBeAg-positive pregnant women and 272 infants, which found that a HBIG-free regimen with initiation of maternal tenofovir disoproxil fumarate treatment at 16 weeks' gestation and timely birth dose vaccination did not significantly differ from the standard of care (ie, maternal tenofovir disoproxil fumarate treatment from 28 weeks' gestation and HBIG treatment and timely birth dose vaccination of infants), with both groups showing 0% mother-to-child transmission at 28 days postpartum.[40] However, continued reliance on complex eligibility requirements, including HBV viral load, is unrealistic in most middle-income and low-income settings. A recent study showed that treating all pregnant women who are living with HBV infection could be more cost-effective than only treating those with a very high viral load or those who are HBeAg positive when accounting for diagnostic costs.[41] Free access to antiviral treatment is limited to HIV-co-infected patients in most middle-income and low-income countries, including those in Sub-Saharan Africa.

The effect of COVID-19 on prevention programmes requires immediate attention as, from 2015 to 2019, incident cases of chronic HBV infection globally were decreasing at a rate of almost 66 000 per year, whereas we estimated an increase in incidence from 2019 to 2020 due to reduced vaccination rates. Our projections indicate that the rate of reduction in HBV incidence between 2020 and 2030 will decrease to 30 000 fewer cases per year. This situation is further complicated by the fact that, although Gavi, the Vaccine Alliance, had in 2018 committed to support countries to introduce HBV birth dose vaccination from 2021, the COVID-19 pandemic in 2020 led them to defer and reassess implementation, and it has since remained on hold. Upon announcement of Gavi's possible involvement, many countries put their plans for birth dose vaccination on hold to allocate resources elsewhere. Thus, many are calling for Gavi to fulfil its previous commitments and support timely birth dose vaccination programmes, which would undoubtedly have a major impact on the future incidence and disease burden of HBV infection.[42,43] If Gavi follows through with their recent announcement to provide programmatic support for timely birth dose, there will be a large effect on these outcomes. COVID-19 has also negatively affected the ability of low-income and middle-income countries to screen, monitor and treat individuals for viral hepatitis.[44] Because of individuals not seeking diagnosis or care out of fear of being infected with SARS-CoV-2, and valuable human resources being transferred towards the pandemic, there needs to be a conscious shift in this new phase, since WHO ended its declaration of COVID as an international public health emergency, to reprioritise viral hepatitis.

Globally, the relative targets of a 65% reduction in liver-related deaths and the absolute target of four deaths or fewer per 100 000 by 2030 are not only completely out of reach, but are trending in the wrong direction due to several factors. Treatment and diagnosis rates remain unacceptably low, and thus the effect of treatment on morbidity and mortality continues to be minimal. This situation is complicated by the fact that treatment regimens, under the current treatment guidelines, do not eliminate progression to hepatocellular carcinoma, but reduce it by approximately 75%.[45] The treatment target of 80% of those eligible, proposed in a previous study and by WHO, would thus only directly reduce hepatocellular carcinoma incidence by 60%.[9] These factors mean that every country needs to have very high levels of diagnosis and treatment of eligible individuals to markedly affect HBV-related mortality and morbidity Achieving 80% treatment targets is theoretically possible, but a monumental challenge; potentially meeting the mortality targets would require treating individuals earlier (ie, preventing progression to cirrhosis). As most individuals do not develop hepatocellular carcinoma and decompensated cirrhosis until middle age, (42 in Africa and 55 in the rest of the world), it is likely that the incidence of new cases of HBV will decrease while morbidity and mortality continue to increase.

Policy makers and associations often cite safety concerns as a reason not to expand treatment HBV

treatment eligibility, although tenofovir disoproxil fumarate is already widely used as part of pre-exposure prophylaxis for individuals at risk of HIV infection. Generic tenofovir alafenamide is already available in 99 countries and could substantially alleviate these safety concerns given that it is associated with a lower risk of adverse effects than tenofovir disoproxil fumarate.[46] However, tenofovir alafenamide is also limited to people with HBV–HIV co-infection in most middle-income and low-income countries, including those in sub-Saharan Africa. Furthermore, even making affordable, well tolerated medications available will have little effect in the absence of increased screening and awareness campaigns.

Of the 170 modelled countries, 34 are estimated to have reached the 2020 interim service target set by WHO of diagnosing 30% of the infected population. We also estimate that the 2020 interim service target of treating 5 million was exceeded, although this target was almost exclusively met by China. Most countries will need to quickly increase their screening and treatment of HBV to meet the targets of 90% diagnosed and 80% of those eligible treated by 2030.

Treatment eligibility guidelines are rapidly shifting, and the eligible population is expected to increase. Guidelines from Canada, Germany, Japan, New Zealand, and Norway have already approved the treatment of individuals with a viral load of at least 2000 IU/mL and alanine aminotransferase (ALT) concentration above the upper limit of normal.[47–49] It is anticipated that other countries and associations will adopt this approach. China has gone further and approved treatment for all individuals with detectable HBV DNA and an elevated ALT concentration, as well as individuals with normal ALT concentration who have other risks for developing hepatocellular carcinoma.[50,51] While HBV DNA detection currently requires a PCR test, China has stated that HBsAg could be used in settings where PCR is not readily available. At present, high-income countries, which account for just over 4% of global infections, use diagnostic and treatment standards that are not feasible for use in regions where most individuals infected with HBV live. In these settings, when the diagnostics and treatment are available, patients must pay for them out of pocket, which further limits access.

We have the tools available to eliminate HBV infection among children and considerably reduce HBV-related morbidity and mortality in individuals who are infected. Unfortunately, our estimates of the current levels of prophylaxis, diagnosis, and treatment at the national, regional, and global levels provide yet another warning about the insufficient rate of progress towards elimination of HBV. Although gains have been made since our previous publication in 2018, none have been large enough to alter the global trajectory of failing to meet the 2030 elimination targets. For the past 7 years, the implementation of frameworks and strategies towards this goal have, at the global level, been unsuccessful and have been exacerbated by the COVID-19 pandemic. We have 7 years left to make rapid progress towards eliminating viral hepatitis as a public health threat by 2030. As more than a million lives are lost every year, collaboration is needed to identify and trial new solutions to prevent the devastating cost associated with the status quo.

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DM Razavi-Shearer and H Razavi conceived the study. DM Razavi-Shearer designed the methodology and was responsible for project administration. DM Razavi-Shearer and H Razavi supervised the study. DM Razavi-Shearer, AS Voeller, C Estes, E Mooneyhan, H Razavi, I Gamkrelidze, K Razavi-Shearer, and S Blach did the formal analysis. H Razavi acquired funding. DM Razavi-Shearer, I Gamkrelidze, and S Blach were responsible for data visualization. DM Razavi-Shearer, AS Voeller, C Estes, E Mooneyhan, H Razavi, I Gamkrelidze, K Razavi-Shearer, and S Blach wrote the original draft. AS Voeller, C Estes, DM Razavi-Shearer, E Mooneyhan, H Razavi, IG, K Razavi-Shearer, and S Blach had access to the underlying data and models. DM Razavi-Shearer, AS Voeller, C Estes, E Mooneyhan, I Gamkrelidze, K Razavi-Shearer, and S Blach accessed and verified the data. All authors curated data. All authors validated data. All authors reviewed and edited the manuscript. All authors had full access to the data for their country and accept responsibility to submit for publication.

Declaration of interests

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Data sharing

The sources of all underlying data and modelling assumptions can be found in the appendix. These data can also be found at The Polaris Observatory, https://cdafound.org/dashboard/polaris/. For additional inquiries, please contact the authors within 1 year of publication.

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