Mass migration to Europe: an opportunity for elimination of hepatitis B virus?

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People from low-to-middle income countries have been migrating to western Europe on a large scale in recent years. Data indicate that the number of first-time asylum applications by non-EU members increased from 290 000 in 2011 to more than 1·3 million in 2015. During the peak period of migration, The Global Health Sector Strategy on Viral Hepatitis was adopted by WHO. Viral hepatitis, and particularly hepatitis B virus (HBV), is an important disease because of its high prevalence and associated mortality. In some cases, HBV can be carried by refugees arriving from regions of high and intermediate prevalence. Refugees with HBV might not show clinical symptoms and not be diagnosed in destination countries with a low prevalence, where screening is not regularly done. Although transmission to the host population is low, dedicated surveillance and tailored public health policies are required. It is important to note that some of the countries that receive many migrants do not have a universal HBV vaccination programme. In this Viewpoint, we argue that the current large-scale movement from regions with high or intermediate HBV prevalence should be taken as an opportunity to achieve viral hepatitis elimination targets, by establishing a well prepared infrastructure for HBV screening, vaccination, and treatment.

Introduction

Western Europe has recently received a high number of refugees and migrants from low-to-middle income countries like Syria, Iraq, Afghanistan, and various north African countries. In contrast to immigrants in previous decades—who were mainly men migrating because of economic or political reasons—recent immigrants include women and children, as well as men, who have left their home countries and seek asylum because of regional violence and persecution.^{1,2} Data released by Eurostat² reveal that the number of first-time asylum applications by non-EU members increased from 290 000 in 2011, to 600 000 in 2014, to more than 1·3 million cases in 2015³ (figure 1). The EU has received at least 4 million refugees between 2011 and 2017.³ These numbers do not include undocumented immigrants, and therefore are likely to underestimate migrant movement to Europe.³ In addition, recent global political changes, like the travel ban against six Muslim-majority nations imposed by the USA, might further increase migration to European countries.⁴

Many of these immigrants originate from areas where health-care infrastructures have collapsed because of war and violence, leaving little access to adequate health services like vaccination, screening, and therapy for infectious diseases. The immigrant population varies considerably in culture, ethnic origin, language, religion, lifestyle, and health. Although less of a risk than travel for tourism and livestock movement, human migration can be accompanied by communicable diseases that are difficult to eradicate in some areas (eg, poliomyelitis)⁵ or are more prevalent in the countries of origin (eg, tuberculosis).⁶ A recent UCL-*Lancet* Commission on migration and health dismissed the common myth of migration as a source of infectious disease transmission on the basis of factual data.⁷ Often, the rhetoric of migrants as carriers of disease is used in the contemporary political climate to fuel prejudices and to create an inaccurate stereotype of migrating individuals. However, restrictive laws and discrimination impede access to proper health care and put migrants at risk for developing health problems, including communicable diseases.^{7,8} The lack of universal regulations and current large-scale human migration represent a unique challenge for European public health-care systems.⁸ Movement of individuals from high-endemic areas to low-endemic regions might affect the disease burden of specific pathogens in destination countries.⁹ Although trans-mission to the host population is low, dedicated surveillance and tailored public health policies are required to control the infectious agents that are potentially being introduced. Among them, viral hepatitis—and particularly hepatitis B virus (HBV)—represents an important communicable disease, which can be carried by refugees arriving from regions of high and intermediate prevalence (mainly from Africa, the Middle East, and Asia) into northern and western European countries with a low prevalence of HBV. For instance, the estimated HBsAg prevalence is more than 8% for sub-Saharan African countries, 2·6% for Syria, and 1·6% for Afghanistan, while the prevalence in Germany—the European country that has received the highest number of refugees—is estimated to be between 0·3% and 0·6%.^{10,11}

Figure 1: Total number of first-time asylum seekers arriving in Europe between 2011 and 2017

The public health importance of HBV

Because of the broad availability of a vaccine globally, viral hepatitis caused by HBV is often not considered a major public health problem. However, even half a century after the development and implementation of an effective vaccine, HBV infection still represents a serious health problem worldwide.¹² In fact, the number of HBV-related deaths due to cirrhosis or hepatocellular carcinoma increased by 33% between 1990 and 2013 to more than 686 000 cases worldwide.¹³ Approximately a third of the human population shows serological markers of a past or current HBV infection.¹⁴ The most recent estimate from 2015 of global HBV prevalence emphasised a high degree of HBV endemicity in Asia and Africa, where more than 95 million inhabitants in Asia and 75 million inhabitants in Africa have HBV infection. This survey also highlighted a sharp trend of increasing HBV infection in parts of Africa.¹¹ In the past few decades, the acute pandemic and the rapid health-deteriorating effects of HIV urged the research community to invest their resources in studying HIV. However, viral hepatitis is currently responsible for more deaths than HIV and is deemed a silent epidemic in Africa.¹⁵ Despite available vaccines and effective antivirals, poor awareness and restricted resources are major obstacles to efficiently combat HBV in sub-Saharan Africa. Therefore, at present, only preventing vertical transmission of HBV seems an achievable goal.^{11,16,17}

It is estimated that up to 40% of carriers of chronic HBV will develop liver cirrhosis, hepatocellular carcinoma, or liver failure,^{18,19} and between 40% and 80% are not aware of their infection status.²⁰ The direct and indirect post-infection complication costs for carriers of HBV imposes a financial burden of up to US\$ 1 billion in the USA alone.^{21,22} The availability of generic tenofovir and entecavir has substantially decreased the expense of antiviral therapy (eg, tenofovir costs decreased by more than 85% from 2004 to 2016) in many countries. However, the global coverage of antiviral therapy is very low. Of note, only 4·8 million patients with HBV are currently undergoing treatment, which constitutes only a small proportion of the large HBV reservoir.^{23–25}

Carriers of chronic HBV living in different geographical regions harbour various HBV strains (genotypes, subgenotypes, and subtypes), which are used as markers in molecular epidemiological studies.^{26–28} A substantial number of people have now migrated from regions with high and intermediate HBV prevalence to those with low prevalence. Considering the different demographic characteristics and public health policies in origin and destination countries of recent immigrants, global public health authorities are now challenged to revise previous strategies and implement effective HBV prophylaxis and surveillance systems. For instance, according to the regional prevalence of HBV, vaccination in different age groups and target groups is advised.²⁹

HBV-related demographic variables in origin and destination countries

The most common route of acquiring HBV infection in resource-limited geographical regions is either perinatal transmission or transmission during childhood.³⁰ Mother-to-child transmission can occur despite immediate active and passive vaccination of the neonate. This risk can be efficiently reduced by treating pregnant women who are highly viraemic from the third trimester until 4 weeks after delivery.³¹ In addition to limited health-care access, poor living conditions, lack of general education and awareness about HBV, inadequate preventive measures, and insufficient HBV immunity in the general population contribute to the prevalence of HBV in these areas.^{17,32,33} Furthermore, war-related sexual assaults threaten the health of women and children as the most vulnerable subgroups. Often, victims of violence do not report such incidents, increasing the risk of transmitting sexually transmitted diseases, like HBV, and subsequent clinical complications.³⁴ Without targeted interventions, immigrants remain at higher risk of HBV infection. The stigma associated with HBV can hinder screening and treatment, thus increasing onward transmission in destination countries after settlement.³⁵ Demographic analyses from 2018 show that more than 82% of first-time non-EU asylum seekers in the EU are younger than 35 years old, and 51% are aged between 18 and 35 years. Also, 25% of immigrants between 18 and 35 years are women.² These numbers indicate that a substantial proportion of the immigrant population is of childbearing age, and pregnant women with HBV are at risk of vertical transmission to their offspring.

Western Europe is a region of low (<2%) HBV prevalence, where the main routes of HBV transmission are unprotected sex and unsafe injection practices. An epidemiological report in 2014 indicated that 13 million carriers of chronic HBV live in the European WHO Region.³⁶ More than 80% of these infections were categorised as imported cases, although less than a third of countries provided data on imported cases.³⁷ Data released by the European Centre for Disease Prevention and Control (ECDC) revealed that there are more than 22 000 new cases of HBV infection in the EU per year.³⁷ Although the current method of surveillance does not efficiently extract the data of HBV prevalence among immigrant communities, ECDC reports that this rate is much higher than in the local population. For instance, HBsAg prevalence among African refugees living in Italy was estimated to be between 3·3% and 26·7% up until 2009, while the HBV prevalence in the general population of Italy was 1·9% in 2012.³⁷

Merging existing data for immigration and HBV prevalence in origin and host countries could assist authorities in evaluating the situation. Therefore, we did an analysis of immigration numbers and the effect of immigration on HBV prevalence in Europe (panel). We used data for the number of first-time asylum seekers released by Eurostat (for 2011–17) and a report on global HBV prevalence issued by ECDC.^{3,37} The Eurostat dataset provides the annual number of first-time asylum applicants in European countries. First-time asylum applicants are individuals that apply for asylum for the first time in a given member state (a person can only be defined as a first-time asylum applicant if they have never applied for international protection in the respective country in the past, irrespective of applications in another country of the EU).² The analysis shows that the recent immigrants to Europe could include a considerable number of carriers of chronic HBV from regions with high and intermediate endemicity between 2011 and 2017 (figure 2, appendix). Using the Eurostat and ECDC datasets, we estimated the direct effect of recently immigrated carriers of HBV on the number of carriers of HBV in the baseline population living in European destination countries. In detail, we analysed the number of first-time asylum applicants that arrived in EU countries between 2011 and 2017, based on the available Eurostat data.³ Of 44 countries with the highest number of people migrating to Europe, we estimated the migrant population sizes that arrived in individual EU member states. Based on the data reported by ECDC, the HBV carrier population size was estimated for all separate immigrant communities regarding their different origins.³⁷ By adding the number of immigrants with HBV infection to the baseline population of carriers of chronic HBV, we were able to assess the effect of migration on the HBV prevalence in European countries. These estimations indicate that migration of individuals from intermediate-endemic and high-endemic regions could have a large effect on the number of carriers of chronic HBV in destination countries. For instance, in Sweden the relative burden of carriers of chronic HBV in the migrant population could exceed the estimated HBV burden in the host population (figure 3, appendix). This observation is not surprising because Sweden has a low indigenous prevalence of HBV and accepted a high number of migrants between 2011 and 2017 (figure 2, appendix). The same scenario was observed in other European countries (eg, Switzerland and the Netherlands), albeit with a less pronounced effect. Generally, the estimated numbers imply a large difference between the number of HBV infections in migrant populations and the numbers of carriers of HBV in host populations. Importantly, some of the countries experiencing the largest effect have not yet implemented the universal HBV vaccination programme for infants (figure 3). A report by ECDC⁹ showed an unexpected increase of newly

diagnosed HBV infections in countries with a low prevalence, which corroborates our estimates. This observation was mainly attributed to an increase in the number of chronic HBV cases in northern European countries, which does not correspond with HBV sero-prevalence surveys. This discrepancy could be related to the intake of migrants from intermediate-endemic and high-endemic regions that might be excluded from these surveys.³⁸ These findings highlight the difficulties of interpreting prevalence data, because differences in screening intensity and testing programmes can affect the HBV prevalence surveillance.³⁹ Also, the asymptomatic nature of chronic HBV infection further impedes the generation of robust epidemiological data.

Migrants arriving in Europe often have better levels of health than individuals in their country of origin. This observation is called the healthy migrant concept, which implies that primarily healthy people make the transit to other countries.⁴⁰ However, latent HBV infections might be present in this seemingly healthy population because most patients infected with HBV are unaware of their disease status and show no sign of infection.²³ Regardless of their country of origin, healthy and non-healthy immigrants are unavoidably gathered and live together in designated areas. Occasionally, these locations are overcrowded and provide inadequate living conditions, which could increase the risk of infectious disease transmission. Incidents of violence and sexual assault in immigration camps have been reported, and women and children are particularly vulnerable to sexual abuse, rape, and violence.⁴¹ Overall, the displacement of immigrants exposes healthy individuals to an increased risk of acquiring communicable diseases. Although the risk of disease outbreak is low in European settings, careful surveillance remains a key measure for preventing large-scale outbreaks.⁴²

The ECDC has estimated that the prevalence of carriers of chronic HBV is 6% among migrants born in endemic countries that arrived in Europe.³⁷ In line with our analysis, the ECDC stated that the relative burden of chronic HBV infection in migrants as a proportion to the overall burden in host countries could be exceptionally high (eg, in Sweden and the Netherlands). The prevalence of HBV in migrant populations arriving in Europe can be highly variable depending on the country of origin. HBV screening in migrant populations reported a prevalence as low as 3% and up to more than 6%, which often exceeds the indigenous HBV prevalence.^{10,43–46} The analysis in this report, which takes into account the heterogeneity of migrant origins, resulted in an average HBV prevalence of 6% in the first-time asylum seeker population. Although this number could be an overestimation of the actual prevalence, the data included only first-time asylum applicants and did not include undocumented and illegal immigration, which could have an additional effect on the total HBV prevalence in host countries.^{47,48}

Figure 2: World map illustrating the annual numbers of first-time asylum seekers from the country of origin (red colour scale) and the number of applications in European destination countries per 100 000 inhabitants (blue colour scale) between 2011 and 2017

Figure 3: Proportion of the baseline carriers of chronic HBV in the European destination country and the estimated number of carriers of chronic HBV of the immigrants that arrived between 2011 and 2017
HBV=hepatitis B virus.

Programmes and strategies

HBV vaccination strategies are generally still a controversial issue in the European public health system. Even though the cost-effectiveness of universal infant HBV vaccination has been shown, four member states of the WHO European Region (Sweden, Finland, Denmark, and Iceland) have not yet implemented this approach and restrict vaccination to high-risk groups.²⁹ Moreover, some countries like Norway and the UK began the infant HBV vaccination programme only recently. In addition to vaccination programmes, the medical screening of immigrants is a country-specific policy in the EU. In some of the countries with low HBV prevalence, only pregnant mothers born in high-prevalence regions are screened to provide immediate vaccination to their newborns.⁴⁹

Non-obligatory infant vaccination against HBV in western and northern Europe, the instability of the political climate in this continent, and an increasing number of immigrants from high and intermediate HBV prevalent regions are three crucial aspects that make Europe more susceptible to an HBV epidemic than in the past.⁵⁰ The demographic structure of the European population is changing and European health policies should accommodate these dynamics. More active surveillance programmes (including screening of immigrants), implementation of HBV mass vaccination, and efficient adherence to follow-up of identified chronic carriers (linkage to care), are highly recommended. Implementing such strategies in current programmes could enable the prevention of HBV horizontal transmission to non-immunised individuals and curb vertical transmission in Europe.

In September, 2014, WHO launched the European Vaccine Action Plan 2015–20, which is part of the Global Vaccine Action Plan. This programme aims “to guide member states in the European region towards their joint vision of a region free of vaccine-preventable diseases”.⁵¹ This platform provides six goals such as maintenance of a polio-free status, elimination of measles and rubella, and control of HBV infection. From the start, the authorities have emphasised that the success of this programme is dependent on sufficient human and financial resources. However, recent large-scale migration into Europe makes the European Vaccine Action Plan objectives more challenging. When it comes to tackling the goal of control of HBV infection, the demographic changes of the target population need to be taken into account. The increase in the number of carriers of chronic HBV emphasises the need for action that should be taken in line with the European Vaccine Action Plan.

A recent report by WHO considered the equitable delivery of immunisation services for migrants and refugees in the WHO European Region.⁵² The authors concluded that policies directed at immunisation, vaccine delivery, and access to immunisation services vary widely in the region. For instance, specific regulations that address immunisation of migrants and refugees are often missing, which translates into restrictive barriers for migrants and refugees to receive vaccination and appropriate health care. According to European guidelines, migrants should be vaccinated according to the vaccination schedule of the host country soon after arrival. Vaccination should be offered to individuals who intend to stay for more than 1 week, irrespective of their legal status. However, in practice these conditions are rarely met because of multiple challenges in management and service allocation. For instance, how should vaccination be organised and documented (eg, in the case of follow-up vaccinations), and what is the best approach to promote vaccination? These concerns were also shared in a survey among vaccination experts of 32 EU member states.⁵³ The respondents underpinned the need for EU-level guidelines on vaccination and indicated that vaccination should be offered primarily at the point of entry or at the holding level (eg, reception centres and migrant camps). Accordingly, future actions should focus on a systemic and tailored approach to address these challenges and provide adequate protection for migrants and refugees.

Efficient control of HBV infection requires a clear and precise knowledge of the target population.¹¹ In respect of human rights and personal dignity, the series of actions including demographic data collection, screening, vaccination, therapy, and monitoring should cover all migrants, whether they are documented or undocumented.⁸

The objectives of the European Vaccine Action Plan programme are mainly oriented around immunisation. Nevertheless, population screening is a prerequisite to meet the goal of control of HBV and should precede any immunisation actions. Screening migrants is an essential measure to prevent disease transmission and progression in affected patients. Newly arriving migrant populations in European countries require careful guidance and legitimate access to screening, post-screening immunisation, and treatment. An evaluation of several approaches has shown that viral hepatitis screening in immigrant populations is cost-effective.³⁸ Effectiveness in decreasing morbidity and mortality is much more pronounced for HBV than HCV infections.^{38,54,55} A 2018 systematic review⁵⁶ established that screening is highly effective, both in terms of costs and clinically, even in populations with a seroprevalence of HBsAg less than 2%. However, the Migration Integration Policy Index health system

survey concluded that the programmes and policies addressing these general necessities to secure immigrant health are still under-developed in many European countries. This report highlighted specific key challenges related to adequate access to health care and services, responsiveness to migrants' specific needs, interpretation of services, and local training of health professionals.⁵⁷ Currently, no standard guidelines for screening, vaccination, and treatment of migrants exist, and often these practices vary with the available resources in each country.

In a stepwise approach, robust screening of the target population will identify the individuals who are infected and need further monitoring and treatment. It will also allow an assessment of which individuals are likely to transmit HBV (an estimated 40% to 80% of this key population are not aware of their own infection).²⁰ Although the benefit of screening to decrease the risk of transmission and to facilitate a timely diagnosis is well described, mandatory screening is controversial and every European country has its own screening policies.⁵⁸ The disproportionality of HBV infection between immigrant and host-country populations, specifically in people arriving from intermediate-endemic and high-endemic regions, underlines the need for screening to better understand the HBV burden among recent European migrants.

All refugees and immigrants with HBV infection need to be granted access to immune or antiviral therapy (or both), with uninterrupted further monitoring, if they meet the treatment criteria.⁵⁹ A strong link between diagnosis and antiviral therapy will not only efficiently decrease the morbidity and mortality of end-stage liver diseases but also block HBV transmissions among immigrants and others.^{38,60} Consequently, vaccination of uninfected high-risk populations and neonates should be incorporated in this procedure. Although vaccination of child immigrants originating from high-prevalent regions has been shown to be very efficient,⁶¹ it is difficult to identify and vaccinate the high-risk individuals among immigrants in clinical practice. In addition, not all European countries support this idea.⁶¹

Together with a strong laboratory capacity for screening, appropriate resources need to be assigned to treatment facilities to follow the therapeutic policies for patients without discrimination based on origin, race, religion, age, gender, and legal status.⁶² It has been strongly emphasised that implementing a universal screening strategy only makes sense if linkage to care or vaccination can be secured in the destination country.⁵⁶ However, the effectiveness varies with the type of disease and target population.⁶³ The benefit of screening and linkage to care in viral hepatitis has already been indicated in controlling infections in European prisons.⁶⁴ However, the mobility of immigrants and the uncertainty of their final destination impose multiple challenges for screening follow-up. Additionally, different ethnicities and social barriers (eg, linguistic and cultural barriers) can impede efficient communication with health-care professionals and subsequent linkage to care. To address these challenges, policy makers have evaluated community-based screening approaches and showed a promising potential for establishing a cohesive care setting.^{65,66} Yet, a comprehensive analysis of different strategies should be done to provide an evidence-based approach to harmonise HBV screening across EU member states and linkage to post-diagnostic follow-up.

Because of human movement and past immigration, the epidemiological profile of HBV is changing globally, and non-native viral strains are imported in new regions.^{67–69} To facilitate epidemiological research, novel cases of HBV infection could be reported to a European HBV surveillance platform, in which the HBV strain could be investigated with molecular analyses. By applying phylogenetic and phylogeographical tools to the HBV genome sequences, researchers could trace the source of infection and provide information on the time scale of HBV spread.²⁶

In May, 2016, an ambitious programme entitled the Global Health Sector Strategy on Viral Hepatitis was adopted by WHO to globally eliminate viral hepatitis infections. This programme aims to decrease the incidence of chronic infections by 65% and mortality by 90% by 2030, through improvement of key interventions like diagnosis, universal vaccination, harm reduction, safety in blood transfusion, and injection.⁷⁰ Subsequently, ten proposed core programmatic and epidemiological indicators were set up to implement and monitor this strategy. The European Monitoring Centre for Drugs and Drug Addiction, together with the ECDC, started to technically underpin this WHO strategy in Europe.⁷¹ In a first evaluation, these two organisations concluded that epidemiological data gathering is far from sufficient in Europe and varies by country. For instance, data related to key high-risk groups, injection safety levels, and prevalence of viral hepatitis among immigrants, and data related to testing and treatment levels are not consistently collected. It seems that Europe is still suffering from a lack of standardised protocols.

In brief, the WHO and European Monitoring Centre for Drugs and Drug Addiction programmes put viral hepatitis in a high priority position on the public health agenda to reduce new HBV cases and avoid hepatitis-related mortality. Although this strategy addresses all five types of viral hepatitis (A, B, C, D, and E), the public health burden of hepatitis B and C and the associated risk for chronic infection puts a strong focus on these two diseases.

Like the European Vaccine Action Plan, global elimination of HBV by 2030 is only achievable when large cohorts of carriers of HBV are well defined and accessible. Migrants are now settling in Europe, where sufficient resources are allocated and systematic screening, vaccination, and effective treatment seems more feasible. In this setting, presenting appropriate information about HBV infection and its consequences could encourage individuals to participate in the process of control and hopefully elimination. A crucial factor in health-care strategies is education, because low-level education regarding HBV is associated with HBV transmission.⁴⁸ Finally, data collection on screening and vaccine coverage, and cancer registry data can efficiently assist the evaluation of interventions,⁷² although several intrinsic and extrinsic barriers restrict the data generated by current routine surveillance.⁸

Immigration: a challenge or an opportunity?

Immigration is a challenging matter from a political standpoint, and in terms of integration and public health, is receiving much attention in political debates. To strengthen their campaigns, politicians often cite a link between migration and infectious diseases as rhetoric. These messages strike fear and fuel prejudices regarding immigration among the general population, despite the evidence base being rather weak. A 2018 UCL–*Lancet* Commission report addresses the common myths that are spread through the media and refutes them using data-driven facts.⁷ As health authorities, we do not consider immigration an immediate threat for public health in host countries. However, we cannot ignore that the high number of migrants originating from regions with intermediate or high HBV endemicity could have an effect on the HBV burden in destination countries and increase the pool of carriers of chronic HBV in Europe.⁹ Instead, we should acknowledge this possibility and use the momentum to address the goals set by WHO to eliminate viral hepatitis as a historical challenge of human health. The facilities that are available in Europe could contribute to the success of this programme. However, a well organised strategy of screening to differentiate between immigrants who are healthy or infected would be required. Subsequent screening follow-up, including immunisation and treatment of individuals who are infected, should be implemented in an efficient way for the elimination of viral hepatitis to be achieved.

Conclusions

Migration is recognised as an independent social determinant of health. Large-scale immigration might contribute to a change in the demographic dynamics of host populations in terms of viral hepatitis in destination countries. The current mass movement from high-prevalence or intermediate-prevalence regions is a potential challenge to public health for health authorities of countries with low HBV prevalence. However, the resettlement of migrants in a well prepared health platform provides health authorities with a unique setting for screening, vaccination, and treatment of individuals infected with HBV. Instead of a potential threat for human health, this current period of migration represents an opportunity to contribute to the elimination of HBV. A successful battle against the HBV epidemic requires a revision of public health strategies in destination countries. Together with a changing European political context, recent political changes in the USA might negatively affect national and global public health policies.⁷³ However, decision making by European public health authorities could minimise the impact of such uncertainties.

Contributors

MRP and MT developed the concept of the Viewpoint. PL and MRP wrote the first draft. MT collected the data and did the analysis. SA-B-O, SD, SMA, FT, CV, and FN contributed to the development of the content by adding their personal and scientific ideas. All authors edited and agreed to the final draft of the manuscript.

Declaration of interests

We declare no competing interests.

Acknowledgments

MT is a strategic based PhD fellow at Fonds voor Wetenschappelijk Onderzoek Vlaanderen (Belgium). MRP is supported by a postdoctoral grant from the Fonds voor Wetenschappelijk Onderzoek Vlaanderen (Belgium). SD was supported by the Fonds Wetenschappelijk Onderzoek (Belgium) and is funded by the Fonds National de la Recherche Scientifique (Belgium).

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Supplementary table 1: Top 44 countries of origin grouped according to WHO region with HBV prevalence in the respective country

African Region	Region of the Americas	South-East Asia Region	European Region	Eastern Mediterranean Region	Western Pacific Region
Ivory Coast (13,2)	Haiti (4,8)	India (3,2)	Moldova (9,6)	Tunisia (4,9)	Vietnam (12,5)
Cameroon (11,4)	Venezuela (1,9)	Bangladesh (4,8)	Montenegro (3,3)	Libya (2,2)	China (10,2)
Ethiopia (5,5)		Sri Lanka (2,4)	Ukraine (2,2)	Lebanon (1,7)	
Ghana (13,4)			Serbia (3,3)	Syria (5,6)	
Nigeria (13,3)			Russia (2,9)	Afghanistan (10,5)	
Eritrea (15,5)			Albania (9,0)	Pakistan (4,2)	
Mali (13,2)			Kosovo (3,3)	Somalia (12,4)	
Congo (11,4)			Macedonia (3,3)	Iraq (1,3)	
Gambia (3,4)			Bosnia and Herzegovina (3,6)	Iran (3,1)	
Guinea (16,3)			Georgia (3,9)	Egypt (4,2)	
Algeria (2,6)			Turkey (4,3)	Morocco (1,8)	
Senegal (12,7)			Armenia (0,6)	Sudan (18,6)	

Supplementary table 2: Average prevalence data on HBV carriers in Europe in 2011-2017 and the estimated impact of immigration on the average baseline chronic HBV carrier population in destination countries

Country	Prevalence (%)	Baseline HBV Carriers Country	HBV Carriers Immigrants	Total HBV carriers	% HBV carrier increase
Austria	0,55	47127	11563	58690	24,5
Belgium	0,7	78535	8046	86581	10,2
Bulgaria	4,25	306916	3591	310508	1,2
Cyprus	0,9	7693	608	8301	7,9
Czech Republic	0,7	73738	181	73919	0,2
Denmark ^a	0,55	31099	3182	34281	10,2
Estonia	0,58	7648	35	7683	0,5
Finland ^a	0,2	10909	2081	12990	19,1
France	0,68	435239	17631	452869	4,1
Germany	0,6	487974	81504	569478	16,7
Greece	2,33	254157	5852	260009	2,3
Hungary	1,08	106601	15594	122195	14,6
Iceland ^a	0,55	1804	90	1894	5,0
Ireland	0,1	4654	499	5153	10,7
Italy	1,89	1139102	31881	1170983	2,8
Latvia	1,39	27775	89	27864	0,3
Liechtenstein	0,55	204	13	218	6,5
Lithuania	2,03	59528	123	59651	0,2
Luxembourg	0,55	3059	442	3500	14,4
Malta	0,55	2354	1000	3354	42,5
Netherlands	0,1	16881	7257	24138	43,0
Norway	0,55	28186	5854	34040	20,8
Poland	1,44	547422	1908	549330	0,3
Portugal	1,35	140639	242	140881	0,2
Romania	5,49	1092128	456	1092584	0,0
Slovakia	0,7	37928	132	38060	0,3
Slovenia	3,29	67804	173	67977	0,3
Spain	0,66	307442	2046	309488	0,7
Sweden ^a	0,2	19424	22665	42089	116,7
Switzerland	0,2	16360	11250	27610	68,8
UK	0,54	348866	9960	358826	2,9

^a Countries that do not have an HBV infant vaccination program