J Biochem Technol (2026) 17(2): 135-143
https://doi.org/10.51847/hMfqSyBSUQ
ISSN: 0974-2328

Vaccination Organization against Viral Hepatitis B in the Adult Population (Kyrgyz Republic)

Kalybekova Kanykei Dosbaevna*, Nurmatov Zuridin Sharipovich, Askarbekova Guldeste Askarbekovna, Keneshova Gulira Baktybekovna, Sandybaeva Zamira Khudaiberdievna, Bekiev Kubanychbek Muratovich, Kurmanalieva Aiturgan Talantbekovna

Received: 18 January 2026 / Received in revised form: 24 April 2026, Accepted: 28 April 2026, Published online: 25 May 2026

Abstract

Hepatitis B virus (HBV) infection remains a major global public health problem and is a leading cause of chronic liver disease, cirrhosis, and hepatocellular carcinoma. Although universal childhood vaccination has significantly reduced HBV prevalence worldwide, vaccination coverage among adults remains inadequate, particularly in low- and middle-income countries. This gap continues to sustain viral transmission and hinders global elimination efforts. The aim of this study was to assess the organization of hepatitis B vaccination programs among adults, identify barriers to immunization, and evaluate factors influencing vaccine coverage, with a focus on the Kyrgyz Republic. A structured literature review was conducted using international databases, including PubMed, Scopus, and Web of Science, along with relevant national sources. The review examined HBV epidemiology, vaccine effectiveness, and challenges related to adult immunization. The findings show that although initial vaccination uptake among adults is relatively high, completion of the full three-dose schedule is often low, with noticeable drop-off between doses. Significant regional differences in coverage were identified, mainly due to disparities in healthcare access, service organization, and population mobility. Key barriers include limited awareness, vaccine hesitancy, and financial and logistical constraints within healthcare systems. Healthcare providers were also found to strongly influence public attitudes toward vaccination. Overall, improving adult HBV vaccination coverage requires a comprehensive strategy involving health system strengthening, targeted education, and improved access to vaccination services to support global hepatitis B elimination goals.

Keywords: Hepatitis B, Vaccination, Adult immunization, Vaccine coverage, Kyrgyz Republic

Kalybekova Kanykei Dosbaevna*
Department of Public Health with a Course in Evidence-Based Medicine, International Medical Faculty, Osh State University, Osh, Kyrgyzstan.

Nurmatov Zuridin Sharipovich
Department of Infectious Diseases, International Higher School of Medicine, Bishkek, Kyrgyzstan.

Askarbekova Guldeste Askarbekovna
Department of Normal, Pathological Physiology and Pharmacology, Medical Faculty, Osh State University, Osh, Kyrgyzstan.

Keneshova Gulira Baktybekovna
Department of Therapeutic Disciplines, Center for Postgraduate and Continuing Medical Education, Medical Faculty, Osh State University, Osh, Kyrgyzstan.

Sandybaeva Zamira Khudaiberdievna
Department of Pharmaceutical Chemistry and Technology of Medicines, Medical Faculty, Osh State University, Osh, Kyrgyzstan.

Bekiev Kubanychbek Muratovich
Department of Military Medical Training and Life Safety, Medical Faculty, Osh State University, Osh, Kyrgyzstan.

Kurmanalieva Aiturgan Talantbekovna
Department of Pharmaceutical Disciplines Subject-Cycle Commission, Medical Faculty, Osh State University, Osh, Kyrgyzstan.

***E-mail:** kkalybekova@oshsu.kg

Introduction

Viral hepatitis B (HBV) remains a major global public health concern, characterized by a high burden of chronic infection and long-term complications. According to the World Health Organization, an estimated 296 million individuals were living with chronic HBV infection worldwide in 2019, with approximately 1.5 million new infections occurring annually (Sun & Guo, 2025). HBV is responsible for around 820,000 deaths each year, primarily due to progressive liver disease, including cirrhosis and hepatocellular carcinoma. The distribution of HBV infection is highly heterogeneous, with the highest prevalence observed in the Western Pacific and African regions, where population-level prevalence exceeds 5–8% (Al-Busafi & Alwassief, 2024; Pardo-Zamora & Castellano-Rioja, 2024). In contrast, lower prevalence rates are reported in high-income countries, reflecting differences in vaccination coverage, healthcare access, and public health infrastructure. Despite the availability of effective antiviral therapies and preventive measures, HBV continues to impose a

substantial burden on healthcare systems, particularly in low- and middle-income countries (Maslyakova *et al*., 2023; Al-Busafi & Alwassief, 2024).

Vaccination against hepatitis B is widely recognized as the cornerstone of primary prevention and one of the most cost-effective public health interventions (Hamad *et al*., 2018). Since its introduction in the 1980s and subsequent incorporation into national immunization schedules, especially through universal newborn vaccination programs, the incidence and prevalence of HBV infection have declined significantly in many regions (Mironova & Ghany, 2024). In countries with high vaccination coverage, the prevalence of chronic HBV infection among children has decreased to below 1%. The global health agenda, including the targets set by the United Nations Sustainable Development Goals and the WHO Global Health Sector Strategy on viral hepatitis, aims to eliminate hepatitis B as a public health threat by 2030, with specific targets of a 90% reduction in new infections and a 65% reduction in HBV-related mortality (Ahmed *et al*., 2020; Jannath *et al*., 2025; Khetsuriani *et al*., 2025). However, achieving these targets remains challenging due to persistent barriers to vaccination. Studies conducted across diverse settings have identified key obstacles, including insufficient knowledge and awareness among the population, vaccine hesitancy driven by misinformation, financial and geographic barriers, and limitations in healthcare delivery systems, particularly in resource-constrained environments (Babatunde *et al*., 2022; Lembo *et al*., 2023).

In Central Asia, including the Kyrgyz Republic, hepatitis B vaccination is implemented through national immunization programs, with routine vaccination of newborns and risk groups. These efforts have contributed to a reduction in HBV prevalence among younger populations. Nevertheless, the adult population remains vulnerable, largely due to historically lower vaccination coverage, incomplete immunization schedules, and ongoing exposure risks (Negreiros & Ory, 2024; Brandl *et al*., 2025). High levels of labor migration, both within and outside the region, further increase the potential for HBV transmission, while disparities in access to preventive and healthcare services persist between urban and rural areas. Additionally, systematic data on adult vaccination coverage and program effectiveness remain limited. Given these challenges, a comprehensive assessment of the organization and delivery of hepatitis B vaccination among adults is essential. Identifying structural, socio-economic, and behavioral barriers to immunization uptake will support the development of targeted interventions to improve coverage (Jesima & Goel, 2022; Li *et al*., 2024). Therefore, the aim of this study is to analyze the current state of HBV vaccination among adults, evaluate the effectiveness of existing immunization strategies, and propose evidence-based measures to enhance vaccine uptake and strengthen public health outcomes.

Materials and Methods

This study is based on a structured analytical narrative review of scientific literature focusing on the epidemiology of viral hepatitis B (HBV) and the organization and effectiveness of vaccination programs. The analysis incorporates peer-reviewed articles published in international and national scientific journals, as well as official reports from international organizations and national regulatory documents governing immunoprophylaxis. A systematic literature search was conducted using major international databases, including PubMed, Scopus, and Web of Science, in addition to national scientific electronic libraries, to ensure comprehensive coverage of relevant sources. The search strategy was developed using a combination of keywords such as “hepatitis B,” “HBV,” “epidemiology,” “vaccination,” “immunization programs,” “vaccine coverage,” “adult vaccination,” “barriers,” “vaccine hesitancy,” “Central Asia,” and “Kyrgyz Republic.” Boolean operators were applied to refine the search and improve precision, including combinations such as (“hepatitis B” OR “HBV”) AND (“vaccination” OR “immunization”), (“HBV epidemiology”) AND (“vaccine coverage” OR “adult vaccination”), and (“hepatitis B vaccination”) AND (“barriers” OR “hesitancy” OR “access”), as well as region-specific queries such as (“Central Asia” OR “Kyrgyz Republic”) AND (“hepatitis B” AND “vaccination”). The inclusion criteria comprised studies addressing HBV epidemiology, the effectiveness of vaccination programs, and factors influencing vaccination uptake among adult populations, with both quantitative and qualitative research considered. Preference was given to publications from the past two decades, while earlier foundational studies were included where relevant. Studies lacking methodological rigor, duplicates, or those not aligned with the study objectives were excluded. Data were analyzed using methods of systematization, comparative analysis, and synthesis of findings, with particular emphasis on literature examining the organization of hepatitis B vaccination in Central Asian countries, especially the Kyrgyz Republic, to identify region-specific challenges and determinants of immunization coverage.

Results and Discussion

Global Epidemiology and Burden of HBV

The hepatitis B virus (HBV) is a vaccine-preventable disease that puts additional economic pressure on families, communities, and the country. HBV infection is a serious problem worldwide, as it is one of the top ten leading causes of death and is 50-100 times more contagious than human immunodeficiency virus (HIV) (SA Al-Busafi *et al*., 2024). According to international studies, the hepatitis B virus is responsible for approximately 30-55 % of cases of hepatocellular carcinoma (HCC) and a significant proportion of cases of liver cirrhosis worldwide (Al-Busafi & Alwassief, 2024). Overall, about 15-40 % of chronically infected patients develop cirrhosis or hepatocellular carcinoma during their lifetime, making HBV one of the most significant risk factors for primary liver cancer. As a result, the annual mortality rate from complications of HBV infection, including cirrhosis and HCC, exceeds 880,000 cases, which underlines the need to strengthen preventive measures (Varghese *et al*., 2024; Bona *et al*., 2025). Despite the fact that significant progress has been made in the fight against viral hepatitis B (HBV) in recent decades, it remains one of the leading causes of morbidity and mortality worldwide, with an estimated global prevalence of 2.5% to 5.6% among all age groups. At the same time, more than 240 million people are carriers of HBsAg, which defines HBV infection as an urgent global health problem

regardless of the socio-economic level of countries (Ashokkumar *et al*., 2022; Zhang *et al*., 2022).

Impact and Effectiveness of HBV Vaccination Programs

In this regard, HBV vaccination is considered the most effective strategy for primary prevention of infection. Numerous studies have shown that mass immunization can significantly reduce the prevalence of chronic infection and prevent the development of its long-term complications, including cirrhosis of the liver and hepatocellular carcinoma (Rahmani *et al*., 2022; Belfiore *et al*., 2023). The global hepatitis B Vaccination program was initiated in the 1980s, and already in 1992, the World Health Organization recommended that HBV vaccination be included in the national preventive vaccination calendars of all countries of the world. Currently, the hepatitis B vaccine is integrated into immunization programs in more than 180-190 countries, which has significantly reduced the incidence and prevalence of chronic forms of infection (Romano' & Zanetti, 2022; Varoneckaitė *et al*., 2024).

Mass vaccination has significantly changed the epidemiology of HBV infection in many regions of the world. In the Western Pacific region of the World Health Organization, where the prevalence of the virus among children previously reached 8 %, by 2014 this figure had decreased to less than 1 %, which indicates the high effectiveness of immunization programs. International studies estimate that infant vaccination programs prevented about 210 million new infections by 2015, and about 200 million infections and 11.9 million deaths in low-and middle-income countries by 2020 (Nelson *et al*., 2016; Akhter & Yao, 2025). The organization of hepatitis B vaccination in most countries worldwide involves a multi-stage approach, including universal vaccination of newborns within the first 24 hours of life, subsequent doses within the standard immunization schedule, and vaccination of high-risk groups in the adult population. Vaccination is usually carried out according to the scheme of 0-1-6 months, which ensures the formation of stable immunity in most vaccinated individuals (Mironova & Ghany, 2024).

Organization of HBV Vaccination Programs Worldwide

The organization of hepatitis B vaccination in different countries of the world has certain features. In the United States, vaccination is implemented through universal immunization of newborns at birth, as well as the introduction of targeted programs for high-risk groups. In European countries, approaches to organizing HBV vaccination vary, but most states include universal vaccination of newborns and children in their national immunization programs. Of particular interest is the experience of China, where, prior to the introduction of mass vaccination, one of the highest prevalence rates of HBV infection was observed (Romano' & Zanetti, 2022). The implementation of the universal vaccination program for newborns has significantly reduced the prevalence of infection among children. In the Western Pacific region, vaccination coverage at birth increased from 63% to 85%, and third-dose coverage increased from 76% to 93%, which reduced chronic HBV infection in children to less than 1% (Solomon-Rakiep *et al*., 2023). In Central Asian countries, the situation with adult vaccination against HBV is characterized by a number of systemic and organizational difficulties. Among them, there is a lack of integration of adult vaccination into national immunization programs, a low level of public awareness about the ways of transmission of the virus, as well as limited attention to prevention among the working-age population. An additional risk factor is high labor migration, which contributes to the spread of infection and makes it difficult to monitor vaccination status in the population (Nurmanova, 2024). In Kazakhstan, despite the introduction of national immunization programs and high vaccination coverage among children, adult vaccination remains insufficient. The main barriers are insufficient public awareness, limited access to vaccines, and problems in organizing preventive programs. In Uzbekistan, the main obstacles to adult HBV vaccination remain financial constraints, a lack of vaccines, and difficulties in their transportation and storage, especially in remote regions of the country. Despite the high level of vaccination coverage among children, there is still a low level of awareness among the adult population about the ways of transmission of the virus and the need for vaccination (Wong *et al*., 2017).

Barriers to Adult HBV Vaccination

Vaccination coverage is affected by several barriers, such as insufficient knowledge of the hepatitis B virus and its symptoms, lack of time for testing or lack of health insurance, people's attitudes to and awareness of vaccines, their perception of diseases and health, social factors, habits, etc. (Mohanty *et al*., 2020). Among the barriers is the widespread misconception among the population and even among health professionals that vaccines are intended only for children. There are also logistical problems associated with the delivery of vaccines, the inability to determine the status of immunization, and the financing of adult vaccination, as well as visits to vaccination sites (Kaushik *et al*., 2025). In total, the following barriers were identified that affect the effective expansion of hepatitis B vaccination coverage: These barriers are not similar in nature and vary by country and target group. Most of the studies focused on the non-zero dose of the hepatitis B vaccine. According to the review, the results show that 36 studies related to barriers mainly indicate a lack of awareness about HBV among the general population and in high-risk groups, the level of education of caregivers, cultural beliefs, fear of side effects, parents' concern about HIV / AIDS, etc. health professionals' lack of awareness, lack of confidence in the vaccine, insufficient knowledge of dose administration methods, insufficient screening of high-risk groups, poor communication, insufficient training of health professionals, long delays in access to the vaccine, high cost of hepatitis B immunoglobulin, cold chain problems, etc. to achieve vaccination coverage Various strategies have been developed among the adult population, but little has been achieved and progress is slow. Thus, despite significant progress in reducing the prevalence of the hepatitis B virus through childhood immunization programs, adult vaccination remains one of the key outstanding issues in the global health system. Differences in the level of economic development of countries, access to health services, public awareness, and effective organization of immunization programs lead to significant regional differences in adult vaccination coverage.

In the Kyrgyz Republic, HBV vaccination is carried out according to the scheme, which includes the introduction of the first dose in the first 24 hours of life of the newborn, and then subsequent doses

in accordance with the standard immunization schedule. The implementation of this program has significantly reduced the incidence of acute forms of hepatitis B among children and adolescents (Sadeghimehr *et al*., 2025). According to national studies, the introduction of HBV vaccination in the preventive vaccination calendar of the Kyrgyz Republic has led to a significant reduction in the prevalence of infection among the child population and a decrease in the number of new cases of the disease. Nevertheless, chronic infection continues to persist among the adult population, especially among those born before the start of mass vaccination, which makes it necessary to expand preventive measures aimed at adult age groups. Vaccination is organized in the country through a network of primary health care organizations, including family medicine centers and paramedic-obstetric centers. Coordination of the immunoprophylaxis program is carried out by the Republican Center for Immunoprophylaxis of the Ministry of Health of the Kyrgyz Republic, which is responsible for planning vaccine purchases, monitoring vaccination coverage, and conducting awareness-raising activities (World Health Organization, 2023).

Adult Vaccination Coverage and Completion (2024–2025)

Analysis of data on vaccination against viral hepatitis B among the adult population of the Kyrgyz Republic indicates a gradual expansion of the immunization program in 2024-2025, but at the same time reveals the continuing problem of incomplete completion of the three-dose vaccination scheme, as shown in **Figure 1**.

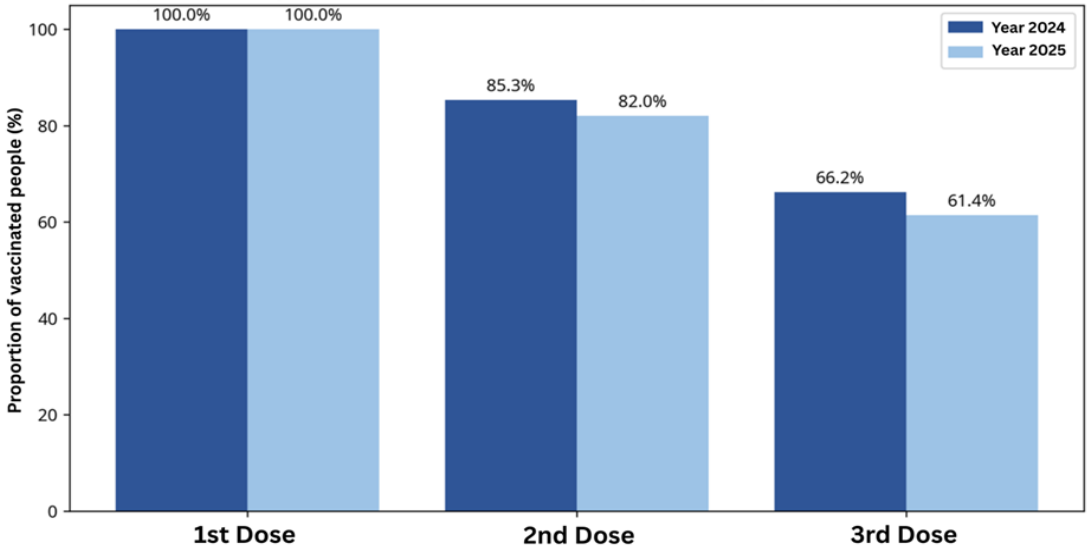

Figure 1. Comparison of receipt of the 1st, 2nd and 3rd doses of HBV vaccine among adults

A comparative analysis of vaccination rates against viral hepatitis B among adults in 2024 and 2025 shows differences in the level of completion of the three-dose immunization scheme **(Figure 1)**. In both years, the first dose of the vaccine was taken as a baseline (100%), which reflects the total number of people who started vaccination. The transition from the first to the second dose is characterized by a relatively high level of adherence to the continuation of vaccination. In 2024, 85.3% of people who started vaccination received the second dose, while in 2025 this figure was 82.0 %, which indicates a slight decrease in the level of completion of the second stage of immunization (Akzholtoevna *et al*., 2025). A more pronounced decrease is observed during the transition to the introduction of the third dose of the vaccine, which is the final stage of the full course of immunization. In 2024, 66.2% of people who started vaccination completed the full course of vaccination, while in 2025 this figure decreased to 61.4 % (Goldstein *et al*., 2005).

Thus, despite the increase in the total number of people vaccinated in 2025, the proportion of adults who completed the full course of vaccination was lower than in the previous year. This trend indicates the presence of losses at the stage of completion of vaccination and indicates the need to strengthen measures aimed at increasing the commitment of the adult population to complete the full course of immunization against viral hepatitis B **(Table 1)**.

Table 1. Monthly report on hepatitis B vaccination in Kyrgyzstan as of 05.01.2026

Region of Kyrgyzstan	Vaccines Received	Vaccines Administered			Revaccination	Remaining Vaccines	ET Conducted		Notes (Discarded)
		1st dose	2nd dose	3rd dose			Yes	No	x
Bishkek City	713,360	269,973	233,326	161,444	368	4,549	21,201	5,772	-

Chui	775,500	309,444	242,269	182,275	51	3,936	29,964	-	25
Issyk-Kul	605,518	229,999	194,063	136,687	68	4,011	22,999	-	-
Talas	350,000	115,569	101,165	82,515	29	4,279	12,225	-	-
Naryn	484,473	178,677	159,182	125,920	103	1,972	19,760	277	-
Osh Region	1,686,601	653,324	538,111	429,994	64	6,408	638,421	1,291	4
Osh City	352,249	136,676	111,123	88,858	20	1,572	10,800	847	76
Jalal-Abad	1,227,740	415,552	378,814	320,147	-	11,293	37,994	-	-
Batken	711,000	187,725	169,797	124,997	0	2,289	26,915	0	0
Republic Total	6,905,441	2,496,629	2,129,355	1,652,274	703	60,919	820,189	8,187	105

Analysis of regional differences in the completion rate of vaccination against viral hepatitis B among the adult population of the Kyrgyz Republic revealed significant variability in indicators between regions. The level of completion of the three-dose vaccination scheme varied from 59.1 % to 77.0 %, which indicates the heterogeneity of the implementation of the immunization program at the regional level. The highest level of vaccination completion was registered in Jalal-Abad region (77.0 %), as well as in Talas (71.0%) and Naryn regions (70.5%). These regions belong to the category of areas with high completion of vaccination, where the proportion of people who have completed a full course of immunization exceeds 70 %. Probably, the higher level of completion of vaccination in these regions may be associated with a better commitment of the population to preventive measures and a more efficient organization of the work of medical institutions. Batken (66.7 %) and Osh oblasts (65.8%) are regions with an average level of vaccination completion. Despite relatively satisfactory indicators, these regions show some losses between the start and end of the vaccination course, which may indicate the need to strengthen measures aimed at increasing the population's commitment to complete the full course of immunization (Zarylbekovna *et al*., 2025). The lowest rates of vaccination completion were registered in the Chui region (59.1 %), Bishkek city (59.9%), and the Issyk-Kul region (59.5%), where the proportion of people who completed the full course of vaccination does not exceed 60 %. These regions belong to the category of territories with low completion of vaccination, which indicates more pronounced losses at the stage of completion of the three-dose immunization scheme.

The results obtained indicate that there are significant regional differences in the level of completion of HBV vaccination, which may reflect the influence of demographic characteristics of regions, migration activity of the population, differences in the availability of medical services, and the organization of preventive programs. The revealed differences emphasize the need to develop regionally oriented measures aimed at increasing the commitment of the adult population to complete the full course of vaccination and improving the organizational mechanisms for implementing immunization programs.

Public Awareness and Attitudes

Social studies show that most people in the country have a basic knowledge of vaccination, but the level of in-depth awareness remains limited. Thus, about 89 % of respondents know that vaccination is intended for the prevention of infectious diseases, but only 73 % can name specific diseases that are prevented by vaccination. In general, the attitude of the population to vaccination in the country remains mostly positive. According to the study, 77.1 % of respondents support vaccination, but there is still a group of doubters (9.1 %) and opponents of vaccination (about 2 %). The main reasons for doubts and refusal of vaccination are fear of possible side effects, lack of information about the composition and safety of vaccines, the influence of misinformation in social networks, as well as religious and cultural factors (Dubé *et al*., 2013).

An additional problem is the uneven availability of vaccination in different regions of the country. In some cases, residents of remote and rural areas face geographical difficulties in obtaining health services, including preventive vaccinations. According to the results of the study, about 17.8 % of respondents indicated limited access to vaccination due to geographical factors, and 17.3 % noted financial barriers (Li *et al*., 2024). Sources of health information play an important role in shaping the population's attitude to vaccination. The study showed that health workers remain the main source of information about vaccination for the population (about 87.6 %), while Internet resources and social networks are used much less frequently, but can contribute to the dissemination of false information. At the same time, the level of trust in health workers remains relatively high: about 59.4% of respondents rate health workers' information about vaccination as very good (Huseth-Zosel *et al*., 2024).

Despite the success achieved in the implementation of hepatitis B virus immunoprophylaxis programs, a number of issues related to adult vaccination remain insufficiently studied. In particular, factors affecting adult vaccination coverage require further research, including insufficient public awareness of the transmission routes and benefits of vaccination, the presence of socio-cultural barriers, and organizational and logistical difficulties associated with the availability of preventive vaccinations in different regions (Mast *et al*., 2006). It should be noted that at present, generalized scientific data reflecting the effectiveness of measures to increase the coverage of adult vaccination against viral hepatitis B remain limited. The lack of systematic information on the impact of educational, organizational, and communication interventions on adult vaccination rates makes it difficult to develop effective immunoprophylaxis strategies (Wangensteen *et al*., 2025).

In this regard, it is necessary to continue research aimed at studying the factors that determine adult adherence to HBV vaccination, as well as at developing and implementing comprehensive measures that help improve the effectiveness of immunization programs and expand vaccination coverage among adult populations.

The paper points to the ongoing gaps in adult hepatitis B immunization in the face of the proven success of childhood immunization campaigns. Although global interventions have greatly lowered the prevalence rates of HBV among younger populations, the adult population still poses a great reservoir of infection, especially in those areas where vaccination has been initiated in the recent past. This has been in line with the trends of earlier global studies that indicate that people who were born before the introduction of routine vaccination are still at high risk of persistent HBV infection, as shown in a study by T Stroffolini *et al*. (2023) (Wangensteen *et al*., 2025). One of the significant outcomes is the decreased rate of three-dose vaccines in adults. Even though the percentage of vaccination initiation is quite high, compliance drops at the later stages, especially when the dose is the last one. This non-adherence is a blind spot to the success of vaccination programs, since partial immunization is not the best in the long term. Other settings have also reported similar challenges, with the multi-dose vaccine schedules linked to decreased compliance, particularly among adult groups that are more likely to be less engaged with preventive healthcare (Wangensteen *et al*., 2025). These results indicate that the follow-up mechanisms and patient retention need to be a priority in immunization strategies.

The identified regional differences in vaccination coverage also highlight the significance of situational factors. Regional disparities are probably the mirror of the disparities in the accessibility to healthcare services, organization of primary care, and mobility of the population. Specifically, there is a risk that the continuity of care can be disrupted by high rates of labor migration, and the completion of vaccination schemes can be hampered as people will change regions or countries. Other transitional and Central Asian studies have also found similar correlations between migration and decreased vaccination continuity (World Health Organization, n.d). The solutions to these disparities will be region-specific and will have to consider the health system capacity and population dynamics in each region. The results also indicate the influence of knowledge, perception, and trust on shaping vaccination behavior. Although there is a comparably high general awareness of vaccination, there are certain knowledge gaps concerning HBV and the prevention of this virus, which have led to uncertainty and reluctance. The fear of vaccine safety, misinformation exposure, and cultural beliefs still have an impact on the decision-making process (Almalki *et al*., 2025). These findings are consistent with previous data that confidence in vaccination is a defining factor of vaccination rates, especially in adults who do not regularly participate in preventive healthcare practices. The high status of healthcare workers as a reliable source of information opens up a prospect to enhance communication strategies in primary healthcare systems (Brumbaugh *et al*., 2025).

The barriers to access are a major limiting factor to vaccination coverage. The availability of vaccination services is limited by geographic differences, especially in rural and remote regions, and economic aspects might also inhibit vaccination. Other low- and middle-income contexts have shown that these structural barriers may significantly limit the use of adult immunization programs (Sahitia *et al*., 2025). Enhancing accessibility by decentralizing services, outreach activities, and financial aid mechanisms can thus be a vital step towards higher coverage. Combined, these results indicate that a multi-level, concerted effort is needed to enhance adult HBV vaccination. Effective immunization strategies need to ensure continuity of care, improve the infrastructure of the health system, enhance communication with the population, and overcome socio-economic barriers (de Koning *et al*., 2024). System-level interventions coupled with specific educational campaigns have been demonstrated to result in longer-lasting positive changes in vaccine uptake. Simultaneously, there is a significant gap in the evidence base due to the limited availability of adult vaccination information in Central Asia (Siddiqui *et al*., 2022). More studies should be conducted to gain a better insight into the factors that determine the behavior of vaccination in this situation, and also how specific interventions can be effectively used. Production of such evidence will be crucial in the development of context-specific approaches and the progress towards the eradication of hepatitis B as a social health menace (Liu *et al*., 2025).

Future Recommendation

The next steps towards better hepatitis B vaccination coverage in adults should be aimed at enhancing the capacity of the health system and the population engagement with the following recommendation:

Targeted vaccination measures in the adult population and high-risk and mobile populations in particular should be developed and implemented. The inclusion of adult immunization in current primary care systems and regular check-ups might enhance access and follow-up of care (World Health Organization, 2025).

To promote awareness in the population with the help of evidence-based health education campaigns that will dispel the myths about vaccination, increase the level of knowledge about the transmission of hepatitis B, its prevention, and the long-term effects. Since there is a high trust in healthcare professionals, communication training and support of healthcare workers on effective communication strategies should be viewed as an important intervention (Kheir *et al*., 2022).

To enhance monitoring and follow-up systems to help in fulfilling the entire vaccination schedule. The dropout rates between the doses of the vaccine can be decreased with the introduction of digital health tools, reminder systems, and patient tracking mechanisms. Moreover, a more precise evaluation of the vaccination coverage and program efficacy will be possible with the strengthening of data collection and surveillance systems (Dautov *et al*., 2025).

To deal with structural constraints like geographic and financial constraints. To a large extent, increasing the number of outreach services in rural and underserved communities and the idea of subsidized or free vaccination of adults may boost the uptake dramatically (Brandl *et al*., 2026).

To assess the efficacy of specific interventions, as well as to learn more about behavioral, social, and systemic factors of adult vaccination. Creation of context-specific evidence, especially in Central Asian contexts, will facilitate the creation of bespoke strategies to realize long-term gains in vaccination coverage and become part of global elimination objectives of hepatitis B (Siddiqui *et al*., 2025).

Conclusion

Notwithstanding the rise in immunized individuals, the issue of inadequate immunization against viral hepatitis B among the adult population persists. The findings reveal substantial regional disparities in the completion rates of HBV vaccination, potentially attributable to demographic characteristics, population migration patterns, variations in healthcare accessibility, and the structuring of preventive initiatives. Data analysis reveals that additional study is required on the determinants affecting adult adherence to vaccination, encompassing public awareness of preventive immunizations, socio-cultural attributes, and accessibility to health facilities. Further research will elucidate the primary obstacles to completing the full vaccination regimen and formulate effective strategies to enhance vaccination coverage and optimize the organizational frameworks for executing immunoprophylaxis programs, while considering regional characteristics.

Acknowledgments: The authors would like to thank the Ohio State University for their valuable contributions, technical support, and collaboration throughout this work. Their insights and assistance greatly enhanced the quality of the research.

Conflict of interest: None

Financial support: None

Ethics statement: This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

References

Ahmed, O. H., Kadheem, E. J., & Noman, S. K. (2020). The antihyperglycemic effect of N-butanol leaves extracts of Iraqi Fumaria parviflora on alloxan-induced diabetic rats. *Systematic Reviews in Pharmacy, 11*(11), 757–761. doi:10.31838/srp.2020.11.108

Akhter, R., & Yao, D. (2025). Comparative evaluation of orthodontic clear aligner attachments using scanning electron microscopy. *Asian Journal of Periodontics & Orthodontics, 5*, 129–140. doi:10.51847/GyJtq8HEWl

Akzholtoevna, A. A., Talgatovich, D. T., Tilenovna, T. U., Omurzhanovna, M. A., Kozmanbetovna, T. A., Kamalovna, A. A., & Mirza, A. M. (2025). Monitoring and evaluation of infection control in healthcare organizations: A retrospective study. *Journal of Advanced Pharmacy Education and Research, 15*(1), 114–123. doi:10.51847/lKPoGCPw5j

Al-Busafi, S. A., & Alwassief, A. (2024). Global perspectives on hepatitis B vaccination: Challenges, achievements, and the road to elimination by 2030. *Vaccines, 12*(3), 288. doi:10.3390/vaccines12030288

Almalki, F., Alraffah, Y. M., Alasiri, R. A., Dhafar, M. W., Albogami, F. M., Alhazmi, M. N., Alyazidi, A. M., Alharbi, L. A., & Alotaibi, M. E. (2025). Knowledge, attitude and practice towards hepatitis B infection and HBV vaccine among the healthy population in Makkah, Saudi Arabia. *Infection and Drug Resistance, 18*, 2153–2164. doi:10.2147/IDR.S517243

Ashokkumar, P., Giri, G. V. V., & Pandya, K. (2022). Parotid abscess-associated facial palsy in hemodialysis patients: Clinical and surgical considerations. *Asian Journal of Periodontics & Orthodontics, 2*, 47–50. doi:10.51847/naDu2XfBBQ

Babatunde, A. O., Togunwa, T. O., Awosiku, O., Siddiqui, M. F., Rabiu, A. T., Akintola, A. A., Dauda, B. J., & Aborode, A. T. (2022). Internet of Things, machine learning, and blockchain technology: Emerging technologies revolutionizing universal health coverage. *Frontiers in Public Health, 10*, 1024203. doi:10.3389/fpubh.2022.1024203

Belfiore, C. I., Manfredini, M., & Dipalma, G. (2023). Longitudinal analysis of bacterial colonization on clear orthodontic retainers using 16S rRNA sequencing. *Asian Journal of Periodontics & Orthodontics, 3*, 35–43. doi:10.51847/01LDpzGEFa

Bona, C., Camacho-Alonso, F., & Vaca, A. (2025). Oral biofilm control in patients using orthodontic aligners: Evidence from a systematic review. *Asian Journal of Periodontics & Orthodontics, 5*, 33–42. doi:10.51847/siIhUaqfip

Brandl, M., Nurmatov, Z., Sattarova, G., Abdrakhmanova, Z., Temirbekova, S., Nuridinova, Z., Dautov, T., Kanybekov, B., Kerimkulov, B., Akunova, I., et al. (2026). Liver cirrhosis and hepatocellular carcinoma attributable to hepatitis B and C in Kyrgyzstan, 2019–2024: A prospective and retrospective study. *The Lancet Regional Health – Europe, 65*, 101665. doi:10.1016/j.lanepe.2026.101665

Brandl, M., Zhumagulova, G., Ishenapysova, G., Nurmatov, Z., Kuchuk, T. E., Zamirbekova, N., Sattarova, G., Temirbekova, S., Bekenova, Z., Gassowski, M., et al. (2025). Nationwide representative serosurvey of third-grade school children to evaluate hepatitis B vaccination impact in Kyrgyzstan, 2022. *BMC Infectious Diseases, 25*(1), 100. doi:10.1186/s12879-025-10491-8

Brumbaugh, K. Q., Gellert, F., & Mokdad, A. H. (2025). Understanding vaccine hesitancy: Insights and improvement strategies drawn from a multi-study review. *Vaccines, 13*(10), 1003. doi:10.3390/vaccines13101003

Dautov, T., Abzhaparova, Z., Zairova, M., Zholdoshev, T., Myrzabekova, C., Nurmatov, S., & Siddiqui, M. F. (2025). Digital epidemiology of hepatitis A, B, C, D, E in Central Asia, Russia, and Belarus using Google Trends. *Journal of Biochemical Technology, 16*, 99–106. doi:10.51847/J2RfBDpWMO

de Koning, R., Gonzalez Utrilla, M., Spanaus, E., Moore, M., & Lomazzi, M. (2024). Strategies used to improve vaccine uptake among healthcare providers: A systematic review. *Vaccine: X, 19*, 100519. doi:10.1016/j.jvacx.2024.100519

DSpace. (n.d.). Retrieved April 28, 2026, from

https://iris.who.int/items/926478c1-8c1f-4cae-a6b5-3dd27b2d7065

Dubé, E., Laberge, C., Guay, M., Bramadat, P., Roy, R., & Bettinger, J. (2013). Vaccine hesitancy: An overview. *Human Vaccines & Immunotherapeutics, 9*(8), 1763–1773. doi:10.4161/hv.24657

Goldstein, S. T., Zhou, F., Hadler, S. C., Bell, B. P., Mast, E. E., & Margolis, H. S. (2005). A mathematical model to estimate global hepatitis B disease burden and vaccination impact. *International Journal of Epidemiology, 34*(6), 1329–1339. doi:10.1093/ije/dyi206

Hamad, M., Jaafar, N., Ahmed, O. H., & Abd, M. (2018). GC/MS analysis of terpenes of Boswellia serrata resin found in Iraq. *Journal of Global Pharma Technology, 10*, 290–294.

Mironova, M., & Ghany, M. G. (2024). Hepatitis B vaccine: Four decades on. *Vaccines, 12*(4), 439. doi:10.3390/vaccines12040439

Huseth-Zosel, A. L., Fuller, H., Hicks, A., & Carson, P. J. (2024). Reliance on sources of immunization information and vaccine uptake among older adults in a rural state: The mediating role of trust. *Vaccine, 42*(12), 3107–3114. doi:10.1016/j.vaccine.2024.04.030

Jannath, A., Elango, R., & Chidambaranathan, A. M. (2025). A scoping review on ethical issues in the mpox outbreak. *Asian Journal of Ethics, Health & Medicine, 5*, 36–51. doi:10.51847/EQ8at7Q7lA

Jesima, J., & Goel, B. (2022). Professional ethics in practice: General practitioners' perspectives on ethical demands in clinical work. *Asian Journal of Ethics, Health & Medicine, 2*, 10–22. doi:10.51847/8AqciDbIxe

Kaushik, A., Fomicheva, J., Boonstra, N., Faber, E., Gupta, S., & Kest, H. (2025). Pediatric vaccine hesitancy in the United States—the growing problem and strategies for management including motivational interviewing. *Vaccines, 13*(2), 115. doi:10.3390/vaccines13020115

Kheir, O. O., Freeland, C., Abdo, A. E., Yousif, M. E. M., Altayeb, E. O., & Mekonnen, H. D. (2022). Assessment of hepatitis B knowledge and awareness among the Sudanese population in Khartoum State. *Pan African Medical Journal, 41*, 217. doi:10.11604/pamj.2022.41.217.30390

Khetsuriani, N., Tursunova, D., Kasimova, R., Sharapov, S., Stewart, B., Matyakubov, M., Latipov, R., Mosina, L., Yusupaliyev, B., & Musabaev, E. (2025). Prevalence of chronic hepatitis B virus infection among children in Uzbekistan: Impact of vaccination. *Vaccine, 48*, 126743. doi:10.1016/j.vaccine.2025.126743

Kyrgyzstan confirms achievement of hepatitis B control targets. (2023). Retrieved April 28, 2026, from https://www.who.int/europe/news/item/21-12-2023-kyrgyzstan-confirms-achievement-of-hepatitis-b-control-targets

Lembo, L., Barra, M., & Iriti, A. (2023). Building trust in the application of machine learning algorithms for rare disease diagnosis. *Asian Journal of Ethics, Health & Medicine, 3*, 26–39. doi:10.51847/Mo7NXmiBnA

Li, C., Thapa, D., Mi, Q., Gao, Y., & Fu, X. (2024). Disparities in hepatitis B virus healthcare service access among marginalised poor populations: A mixed-method systematic review. *Infectious Diseases of Poverty, 13*(1), 58. doi:10.1186/s40249-024-01225-0

Liu, J., Zhang, Y., Zhang, H., & Tan, H. (2025). Estimating the effects of interventions on increasing vaccination: Systematic review and meta-analysis. *BMJ Global Health, 10*, e017142. doi:10.1136/bmjgh-2024-017142

Maslyakova, A. R., Magomedova, S. A., Romantsov, I. N., Nurbagandov, S. M., Bulovin, M. N., & Podobin, O. R. (2023). Evaluation of the anticancer potential of selenium nanoparticles. *Archives of International Journal of Cancer Allied Sciences, 3*(2), 41–47. doi:10.51847/POXX7HfEZo

Mast, E. E., Weinbaum, C. M., Fiore, A. E., Alter, M. J., Bell, B. P., Finelli, L., Rodewald, L. E., Douglas, J. M., Janssen, R. S., & Ward, J. W. (2006). A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: Recommendations of the Advisory Committee on Immunization Practices (ACIP). Part II: Immunization of adults. *MMWR Recommendations and Reports, 55*(RR-16), 1–25.

Mironova, M., & Ghany, M. G. (2024). Hepatitis B vaccine: Four decades on. *Vaccines, 12*(4), 439. doi:10.3390/vaccines12040439

Mohanty, P., Jena, P., & Patnaik, L. (2020). Vaccination against hepatitis B: A scoping review. *Asian Pacific Journal of Cancer Prevention, 21*(12), 3453–3459. doi:10.31557/APJCP.2020.21.12.3453

Negreiros, A. B., & Ory, M. G. (2024). Navigating uncertain outcomes: Returning genomic results in children with developmental delays. *Asian Journal of Ethics, Health & Medicine, 4*, 20–27. doi:10.51847/grOfZd8oyo

Nelson, N. P., Easterbrook, P. J., & McMahon, B. J. (2016). Epidemiology of hepatitis B virus infection and impact of vaccination on disease. *Clinics in Liver Disease, 20*(4), 607–628. doi:10.1016/j.cld.2016.06.006

Nurmanova, B. (2024). Reporting of progress toward eliminating viral hepatitis B and C in the Central Asian region. *Advanced Gut & Microbiome Research*. doi:10.1155/2024/4818435

Pardo-Zamora, F., & Castellano-Rioja, G. (2024). Liquid biopsy in oral cancer diagnosis: A narrative review of emerging diagnostic tools. *Archives of International Journal of Cancer Allied Sciences, 4*(1), 1–6. doi:10.51847/CcaLqtzvoN

Rahmani, A., Montecucco, A., Vitturi, B. K., Debarbieri, N., Dini, G., & Durando, P. (2022). Long-term effectiveness of hepatitis B vaccination in the protection of healthcare students in highly developed countries: A systematic review and meta-analysis. *Vaccines, 10*(11), 1841. doi:10.3390/vaccines10111841

Romano, L., & Zanetti, A. R. (2022). Hepatitis B vaccination: A historical overview with a focus on the Italian achievements. *Viruses, 14*(7), 1515. doi:10.3390/v14071515

Sadeghimehr, M., Mosina, L., Sim, S. Y., & Datta, S. S. (2025). Health and economic impact of hepatitis B vaccination in the national immunization program in Belarus, Georgia, Kyrgyzstan, Republic of Moldova, Turkmenistan and Uzbekistan—a modelling study. *Frontiers in Public Health, 13*, 1567033. doi:10.3389/fpubh.2025.1567033

Sahitia, S., Idris, I. B., Safian, N., Ali, R. F., Shamsuddin, K., & Hod, R. (2025). Barriers to childhood immunization in rural and remote areas: A qualitative exploration from the perspectives of community leaders in Sindh, Pakistan. *Qualitative Health Research, 35*(3). doi:10.1177/10497323241263279

Siddiqui, M. F., Azaroual, M., Villela, R., Kalmatov, R., Babu, P., Boueri, M., Bay, S., El Etry, H., Mitalipova, A., Baig, M., et al. (2025). Inequality in genetic healthcare: Bridging gaps with deep learning innovations in low-income and middle-income countries. In K. Raza (Ed.), *Deep learning in genetics and genomics* (pp. 397–410). Academic Press. doi:10.1016/B978-0-443-27574-6.00003-5

Siddiqui, M. F., Nohra, L., Saleh, M., Thakkar, K., Trivedi, R., Moujally, S. N., Deeb, H., Nicolas, G., & Emmanuel, N. (2022). Computational intelligence: A step forward in cancer biomarker discovery and therapeutic target prediction. In K. Raza (Ed.), *Computational intelligence in oncology* (pp. 233–250). Springer. doi:10.1007/978-981-16-9221-5_14

Solomon-Rakiep, T., Olivier, J., & Amponsah-Dacosta, E. (2023). Weak adoption and performance of hepatitis B birth-dose vaccination programs in Africa: Time to consider systems complexity? A scoping review. *Tropical Medicine and Infectious Disease, 8*(10), 474. doi:10.3390/tropicalmed8100474

Sun, J., & Guo, J. (2025). Global, regional, and national burden of chronic hepatitis B-related cirrhosis from 1990 to 2021 and projections to 2050: A finding from the Global Burden of Disease Study 2021. *Clinical and Translational Gastroenterology, 16*(10), e00890. doi:10.14309/ctg.0000000000000890

Vaccinating at every age is key to unlocking the full potential of immunization. (2025). Retrieved April 28, 2026, from https://www.who.int/news/item/05-06-2025-vaccinating-at-every-age-is-key-to-unlocking-the-full-potential-of-immunization

Varghese, N., Majeed, A., Nyalakonda, S., Boortalary, T., Halegoua-DeMarzio, D., & Hann, H. W. (2024). Review of related factors for persistent risk of hepatitis B virus-associated hepatocellular carcinoma. *Cancers, 16*(4), 777. doi:10.3390/cancers16040777

Varoneckaitė, M., Jasinskaitė, K., Varoneckas, A., Vasiliauskas, A., & Leketas, M. (2024). Comparing root resorption in fixed vs. clear aligner orthodontics: A radiographic study. *Asian Journal of Periodontics & Orthodontics, 4*, 34–41. doi:10.51847/fl7oRw6Djo

Wangensteen, L., Mohamed, F., Oberhelman-Eaton, S. S., Averkamp, N. M., Kiernan, J. A., Selladurai, R. I., Bohn, B. A., Lai, B., & O'Grady, J. (2025). A strategy to improve hepatitis B vaccine uptake in hesitant adults: The offer-offer-test-vaccinate approach. *Journal of Primary Care & Community Health, 16*, 21501319251408993. doi:10.1177/21501319251408993

Wong, R. J., Nguyen, M. T., Trinh, H. N., Chan, C., Huynh, A., Ly, M. T., Nguyen, H. A., Nguyen, K. K., Torres, S., Yang, J., et al. (2017). Hepatitis B surface antigen loss and sustained viral suppression in Asian chronic hepatitis B patients: A community-based real-world study. *Journal of Viral Hepatitis, 24*(12), 1089–1097. doi:10.1111/jvh.12736

Zarylbekovna, K. A., Toktobolotovna, A. B., Talgatovich, D. T., Alina, T., Tezekbayevich, Z. S., & Siddiqui, M. F. (2025). Prevalence and predictors of post-COVID syndrome in the Kyrgyz population: A clinical overview. *Journal of Advanced Pharmacy Education and Research, 15*(3), 101–108. doi:10.51847/mV57OLHozd

Zhang, C., Liu, Y., Zhao, H., & Wang, G. (2022). Global patterns and trends in total burden of hepatitis B from 1990 to 2019 and predictions to 2030. *Clinical Epidemiology, 14*, 1519–1533. doi:10.2147/CLEP.S389853