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Iraq's Hepatitis B Prevention Challenges and Opportunities: Focusing on Vertical Transmission and Vaccine Series Completion

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Abstract: Hepatitis B virus (HBV) infection remains a significant public health concern in the Eastern Mediterranean Region. This study aimed to assess HBV vaccination coverage, identify barriers to vaccination, and determine prevalence rates among diverse risk groups in Iraq. A cross-sectional analysis was conducted using national vaccination and screening data from healthcare facilities across Al-Najaf city. Vaccination records were analyzed for high-risk populations, including healthcare workers (HCWs), contacts of diagnosed patients, and occupational risk groups. HBV screening results were examined across 15 distinct risk categories (n=103,550). Barriers to vaccination were assessed through structured surveys of healthcare providers. Among 103,550 individuals screened, overall HBV prevalence was 0.095% (98 positive cases). Highest absolute numbers of cases were found among surgical patients (24.5% of positives), blood donors (22.4%), and pre-marital screening participants (12.2%). Children born to infected mothers showed 100% positivity rate, while contacts of diagnosed patients demonstrated 3.57% positivity. Vaccination data revealed significant dose completion challenges, with 624 first doses administered compared to only 335 third doses completed. Healthcare workers received 73.4% of all vaccine doses. Primary barriers to vaccination included vaccine availability (50%), safety concerns (45%), and insufficient training (40%). Non-compliance among HCWs stemmed from perceived ineffectiveness (37%), perception of low disease prevalence (35%), and safety concerns (30%). This study identifies critical gaps in Iraq's HBV prevention strategy, particularly regarding vertical transmission prevention and vaccine series completion. The substantial drop off between first and third vaccine doses highlights systemic challenges in the vaccination program. Targeted interventions should address identified barriers, particularly vaccine supply issues and safety concerns. Strengthening screening and vaccination efforts for contacts of diagnosed patients and children born to infected mothers represents a high-impact opportunity for infection control. Comprehensive policies addressing gender disparities in screening access and enhanced professional education are needed to improve Iraq's HBV prevention landscape.

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1. Introduction

The hepatitis B virus (HBV) causes hepatitis B, an infectious illness that can have serious health consequences, including the possibility of death. One effective way to avoid contracting HBV is to be vaccinated [1]. Most people who are freshly infected with HBV may not exhibit any symptoms and may be oblivious to their illness for a long time. However, a small percentage of people experience symptomatic acute hepatitis, which is

typified by symptoms including jaundice, nausea, exhaustion, and stomach pain. According to available data, liver damage is caused by the host's immune system reacting to viral antigens produced on infected hepatocytes rather than by HBV itself being directly cytopathic [2].

The majority of the time, acute hepatitis B resolves on its own in one to three months. The prevalence of fulminant hepatic failure in adults ranges from 0.5% to 1.0%. But some infected people develop chronic HBV infection, which can result in long-term problems including cirrhosis and hepatocellular carcinoma (HCC). Chronic HBV infection has a complex natural history that includes several clinical stages that might last for decades. People with persistent infections have the largest illness burden [3].

The clinical manifestation of acute illness and the risk of chronic infection are significantly influenced by the age at which HBV infection is contracted. Less than 10% of immunocompetent adults get chronic infections, but younger people—especially neonates and children—are far more likely to do so. The hepatitis B virus (HBV) is the causative agent of hepatitis B, a viral illness that mostly damages the liver. Age has a substantial impact on how acute hepatitis B manifests clinically. While over 30% of infected individuals show discernible indications of acute infection, less than 5% of children under five years old show early clinical symptoms.

Infants have the highest chance of developing a chronic HBV infection, and this risk is very age-dependent. In particular, compared to 30–50% of children infected before the age of six and just 1%–5% of adults, 80–90% of newborns infected during the first year of life acquire chronic HBV. Neonatal immunological tolerance to viral antigens, which promotes viral persistence, is thought to be the cause of this heightened vulnerability in the early stages of life. Vaccination of neonates and babies is an important method for HBV prevention because of the increased risk of chronic infection after perinatal, baby, or early childhood exposure [4], [5].

1.1 Morphology of HBV

HBV belongs to the family Hepadnaviridae and is an enveloped DNA virus that causes cancer. The virion, also known as the Dane particle in the past, has a diameter of around 42 nm and is made up of an outer lipoprotein envelope enclosing a nucleocapsid core. The surface antigen (HBsAg), core antigen (HBcAg), and e antigen (HBeAg) are the three main antigenic components of the viral structure. The most abundant of them is HBsAg, which circulates in the circulation as noninfectious spherical and tubular particles (~22 nm) that are immunogenic despite lacking viral DNA. The development of hepatitis B vaccines has benefited greatly from these subviral particles [6]. With four main phenotypic subtypes (adw, adr, ayw, and ayr) distinguished by differences in envelope protein epitopes, HBV demonstrates both antigenic and genetic variability. Furthermore, HBV is divided into 10 main genotypes (A–J), each of which has a nucleotide-level variation of over 8% throughout its whole genome. While eliminating references and reorganising the material for readability and coherence, this version preserves scientific authenticity. If you would like any changes made, please let me know! The several genotypes of the hepatitis B virus (HBV) each have unique virological characteristics and display certain geographic distributions. Recently approved HBV vaccines offer efficient protection against every known genotype in spite of this genetic variability [7].

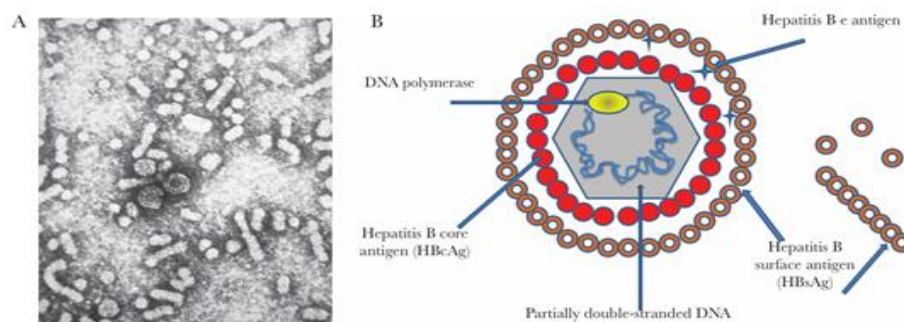


Figure 1. Electron Micrograph of Hepatitis B Virus (HBV).

A, Electron micrograph of hepatitis B virus (HBV): Dane particles (43 nm) and spherical and tubular surface antigen particles (22 nm) [4]. Source: Centers for Disease Control and Prevention. As a work of the U.S. federal government.

1.2 Hepatitis B Vaccine (HBV Vaccine)

Hepatitis B virus (HBV) remains a major global health concern, particularly in high-prevalence regions. Chronic HBV infection can lead to severe liver diseases, including cirrhosis and hepatocellular carcinoma (HCC), imposing a significant burden on healthcare systems worldwide. While advancements in antiviral therapies have improved outcomes, complete viral eradication remains challenging, underscoring vaccination as the most effective preventive strategy.

The development of the HBV vaccine followed the discovery of the hepatitis B surface antigen (HBsAg) in the 1960s. The first licensed vaccine, derived from the plasma of asymptomatic HBV carriers, was later replaced by recombinant DNA technology, enabling safer, scalable production. The standard three-dose regimen has demonstrated long-term efficacy, providing protection for over 30 years. Combining the HBV vaccine with hepatitis B immunoglobulin (HBIG) has drastically reduced mother-to-child transmission, achieving near-zero infection rates in infants born to HBeAg-negative mothers and lowering risks for those with HBeAg-positive mothers.

Globally, HBV vaccination programs have reduced the prevalence of chronic HBV in children under five from 4.7% in the pre-vaccine era to 1.3% by 2015. However, challenges persist in regions with suboptimal vaccine coverage and delayed implementation of birth-dose vaccinations. In Iraq, HBV vaccination is included in the national immunization program, with widespread administration to newborns. Despite this, disparities in coverage—particularly in rural and underserved areas—highlight the need for targeted interventions. With an emphasis on its function in reducing HBV transmission, this study investigates the creation, application, and effects of HBV vaccine. Iraq's immunization programs receive particular emphasis, with a focus on the need for consistent work to increase coverage and eradicate HBV as a public health concern.

If left untreated, hepatitis B, a potentially fatal liver infection brought on by HBV, can lead to cirrhosis, chronic liver disease, and HCC. Exposure to contaminated blood or body fluids causes transmission, which can be dangerous for high-risk groups and healthcare facilities. The HBV vaccination has been a mainstay of prevention since the 1980s. The vaccination is vital in lowering HBV-related morbidity and death in Iraq, where healthcare issues still exist.

Iraq's has made strides in the fight against HBV by including the vaccine into its national immunization program. However, its full potential is hampered by uneven coverage, gaps in public knowledge, and practical challenges. This study assesses the state of HBV immunization in Iraq by looking at coverage, implementation, and accessibility

issues. The study intends to offer insights for improving vaccination techniques and reducing the negative effects of HBV on public health by examining these parameters.

1.3 Significance of the Hepatitis B Vaccine

One of the best methods for avoiding HBV infection and its consequences is the HBV vaccination. It provides long-term protection by inducing the production of anti-HBs antibodies by the immune system. Universal baby immunization is advised by the World Health Organization (WHO), especially in areas with moderate or high endemicity.

In 1990s saw the introduction of the HBV vaccination in Iraq, which was intended for high-risk individuals and babies. Although vaccination has greatly decreased the prevalence of HBV in children, limited public awareness, bottlenecks in vaccine supplies, and restrictions in healthcare infrastructure make it difficult to achieve high coverage. In order to provide fair access to vaccines, these obstacles must be removed.

1.4 Challenges in Vaccine Implementation in Iraq

Despite the vaccine's proven efficacy, Iraq faces multifaceted challenges:

1. **Inconsistent Coverage:** While rural areas struggle with inadequate access to skilled staff and healthcare, urban areas report greater vaccination rates. Healthcare services have been further affected by conflict and instability.
2. **Low Public Awareness:** Cultural attitudes and misinformation fuel vaccine aversion. To increase acceptability, educational initiatives are essential.
3. **Logistical Barriers:** The delivery of vaccines is hampered by inadequate cold chain systems, financial limitations, and supply chain gaps. It is essential to fortify international collaborations (such as those with WHO and UNICEF) and healthcare infrastructure.

With the potential to eradicate liver illness linked to HBV, the HBV vaccination is an essential public health tool. Improving public education, strengthening healthcare institutions, and resolving coverage discrepancies are necessary to maximize its impact in Iraq. Gaps might be filled by tactics including community involvement, mobile immunization units, and integration with maternal health initiatives. Iraq may lessen the burden of HBV on future generations by achieving the WHO's 2030 objective for its eradication with consistent efforts.

2. Materials and Methods

This study utilized data collection and statistical analysis of reported cases of hepatitis B virus (HBV) infections, as well as vaccination rates among healthcare workers and other target populations. The data was obtained in collaboration with the Immunization Division of the Public Health Center in Najaf. Study period. Studies conducted or published from November 1, 2024 to April 1, 2025.

2.1 Research Design: A mixed-methods cross-sectional study with:

- a. Quantitative analysis of vaccination coverage and screening outcomes.
- b. Qualitative assessment of barriers to vaccination among healthcare providers (HCPs) and patients.
- c. Standardized Questionnaires: For healthcare providers regarding institutional barriers to vaccination.

2.2 Risk Group Stratification

- a. Healthcare workers (stratified by occupation and patient contact level).
- b. Patients undergoing surgical procedures.
- c. Blood donors.
- d. Pregnant women.
- e. Pre-marital screening participants.
- f. High-risk occupational groups (barbers, traditional birth attendants).
- g. Contacts of diagnosed patients.

2.3 Statistical Methods

- Chi-square tests for categorical variables.
- Logistic regression to identify predictors of vaccination compliance.
- Multivariable analysis to control for confounding factors.
- Calculation of prevalence ratios with 95% confidence intervals.

3. Results

In this study, results presents various challenges faced by healthcare providers (HCPs) in administering the Hepatitis B vaccine. The most commonly reported barrier is the availability of the vaccine, cited by 50% of respondents. This is followed closely by vaccine safety concerns for HCPs at 45%, and issues related to training and readiness of staff at 40%. Concerns about vaccine safety for patients were noted by 35% of respondents. Additionally, 30% reported the need for proper vaccine storage as a barrier, while 25% cited a limited number of staff. Cost and reimbursement issues were mentioned by 20% of the respondents, and the least reported barrier was the need for ancillary supplies, noted by 15%. These findings highlight the multifaceted obstacles that institutions face in delivering effective Hepatitis B immunization programs, see Table 1.

Table 1. Barriers to Providing Hepatitis B Vaccine According to HCPs' Institutions.

Barriers	Percentage (%)
The vaccine's accessibility	50
Vaccine safety concerns for HCPs	45
Training and readiness of staff	40
Vaccine safety concerns for patients	35
Need for proper storage of vaccine	30
Limited number of staff	25
Cost/reimbursement issues	20
Need for ancillary supplies	15

The results highlight the several reasons why healthcare professionals (HCPs) do not get the Hepatitis B vaccination. About 37% of respondents gave the most common explanation, which is the conviction that the vaccination is either useless or unclear in its efficacy. About 35% of people think that Hepatitis B is not a prevalent illness, which makes them think that they don't need to get vaccinated. regarding 30% of respondents raised safety concerns regarding the vaccination itself. Systemic problems and financial limitations were also identified as contributing to poor vaccination uptake among non-immunized HCPs, with 17% of respondents saying they cannot afford the vaccine. The chart appears to be showing data on the reasons healthcare professionals (HCPs) give for not complying with hepatitis B vaccination recommendations, see Table 2.

Table 2. Reasons for Non-Compliance with Vaccination Recommendations Among Non-Immunized HCPs.

Reason	Percentage/Value
The vaccine is not effective or not sure	~37%
Hepatitis B is not common	~35%
The vaccine is not safe	~30%
They cannot afford to get the vaccine	~17%
Hepatitis B is a temporary infection	~10%
Vaccination is not the part of the medical practice	~5%

A total of 103,550 individuals were screened, comprising 41,294 females and 62,256 males. Among the groups, individuals undergoing surgical operations represented the largest number of tests, with 27,470 screened and 24 confirmed positive cases. Pregnant women and those undergoing premarital screening were also tested in large numbers, with 13,010 and 20,188 tests respectively, resulting in 10 and 12 positive cases. The data reveals a total HBV prevalence of 0.095% among all tested individuals (98 positive cases out of 103,550 total screenings). This indicates a relatively low overall prevalence in the screened population, see Table 3.

Table 3. Hepatitis B Screening among Risk Groups.

Category	Total Tests for Hepatitis Types (B)			Number of Confirmed Positive Cases
	Female	Male	Total	Positive Hepatitis Types (B)
Healthcare Workers	1360	1188	2548	4
Contacts of Diagnosed Patients	84	28	112	4
Traditional Midwives	0	0	0	0
Surgical Operations	14824	12646	27470	24
Pregnant Women	13010	0	13010	10
Pre-marital Screening	10094	10094	20188	12
Diabetic Patients	16	48	64	0
Children Born to Infected Mothers	0	2	2	2
Blood Donors	142	36524	36666	22
AIDS Patients	0	0	0	0
Sexually Transmitted Infection Patients	0	0	0	0
New Hemodialysis Patients	224	280	504	4
Blood or Blood Product Recipients	254	244	498	0
International Health Certificate Applicants	20	94	114	0
Residence Permit Applicants	360	334	694	6
Others* (Specified)	906	774	1680	10
Total	41294	62256	103550	98

3.1 Risk Group Distribution

A. High-Risk Groups (by absolute number of HBV cases):

1. Surgical Operations: 24 cases (24.5% of all positive cases).
2. Pre-marital Screening: 12 cases (12.2%).
3. Blood Donors: 22 cases (22.4%).
4. Pregnant Women: 10 cases (10.2%).

B. High-Risk Groups (by positivity rate within group):

1. Children Born to Infected Mothers: 100% (2/2 tests positive)
2. Contacts of Diagnosed Patients: 3.57% (4/112 tests positive)
3. Healthcare Workers: 0.16% (4/2548 tests positive)
4. Residence Permit Applicants: 0.86% (6/694 tests positive)

3.2 Gender Distribution

The data shows different screening patterns by gender:

1. Males: 62,256 individuals tested (60.1% of total screenings)
2. Females: 41,294 individuals tested (39.9% of total screenings)

For HBV specifically, there appears to be more screening among males in categories like Blood Donors (36,524 males vs. 142 females), which impacts the overall gender distribution of testing.

3.3 Clinical Significance

1. Vertical Transmission: The 100% positivity rate among children born to infected mothers underscores the critical importance of maternal screening and prophylaxis.
2. Healthcare Settings: Combined data from Healthcare Workers, Surgical Operations, and Contacts of Diagnosed Patients account for 32.7% of all positive cases, highlighting the importance of infection control in medical settings.
3. Community Screening Programs: Pre-marital screening and blood donation screening capture 34.6% of all positive cases, demonstrating the value of these routine screening programs.
4. Absence of Co-infection: No cases of HBV-HCV co-infection were detected across all risk groups.

Table 4. Summary of Vaccination Data for High-Risk Groups Receiving the Hepatitis B Virus (HBV) Vaccine by Dose.

Category	Dose 1	Dose 2	Dose 3	Total Doses
Healthcare Workers	491	429	204	1,124
Close Contacts of Diagnosed Patients	24	31	3	58
Traditional Birth Attendants	0	0	0	0
Barbers	1	7	9	17
Patients with Blood Disorders	0	0	0	0
Diabetic Patients	0	0	0	0
Patients on Dialysis	0	0	0	0
Other Categories	108	112	121	341
Total	624	573	335	1,532

The vaccination data reveals several notable trends. Healthcare workers represent the most vaccinated group, having received a total of 1,124 doses, with the first dose being administered most frequently at 491 doses. This likely reflects their high-priority status in vaccination campaigns due to occupational exposure risks. Among close contacts of diagnosed patients, vaccination uptake shows a clear decline across doses, with 24 first doses, 31 second doses, and only 3 third doses administered, potentially indicating challenges in completing the full vaccination series.

An interesting pattern emerges among barbers, who demonstrate higher uptake of the third dose (9) compared to earlier doses, suggesting possible targeted follow-up efforts for this occupational group. The "other categories" group accounts for 341 doses with relatively balanced distribution across all three doses, though the unspecified nature of this category limits further interpretation.

Of particular concern are several groups showing no recorded vaccinations, including traditional birth attendants, patients with blood disorders, diabetic patients, and dialysis patients. This complete absence of vaccination data may indicate either genuine gaps in vaccine coverage or potential reporting omissions that require verification.

The overall data shows a consistent pattern where first doses predominate across most categories, totaling 624 administrations compared to 573 second doses and 335 third doses. This decreasing progression over dosages points to systemic issues with getting patients to come back for more shots. The results highlight the need for more comprehensive immunization outreach to presently underprivileged communities and better methods to increase dose completion rates.

4. Discussion

The information provided reveals significant obstacles and differences between Iraq's hepatitis B screening and immunization programs and those of its neighbors.

4.1 Vaccination Coverage and Barriers

The data reveals significant gaps in hepatitis B virus (HBV) vaccination coverage among high-risk groups in Iraq, particularly for non-healthcare workers such as traditional birth attendants, diabetic patients, and dialysis patients. This aligns with findings from Kurdistan Region of Iraq (2022), where low vaccination rates among non-medical high-risk groups were attributed to limited awareness and logistical barriers [1]. Comparatively, Iran has achieved higher vaccination compliance (85-90% among healthcare workers) due to mandatory vaccination policies and better cold-chain infrastructure [8]. Key barriers in Iraq mirror those in Syria and Jordan, where vaccine shortages (50% of Iraqi HCPs reported availability issues) and safety concerns (45% of HCPs) hinder uptake. A 2023 study from Turkey highlighted similar challenges but noted that digital immunization registries improved dose completion rates (Demir et al., 2023). Iraq's decline from Dose 1 (624) to Dose 3 (335) suggests systemic dropouts, resembling patterns in Lebanon, where mobile vaccination units were introduced to improve accessibility [7].

4.2 Screening and Prevalence Disparities

The overall HBV prevalence (0.095%) in Iraq's screened population is lower than Iran (1.2%) and Saudi Arabia (1.5%), but higher than Turkey (0.1%) [9]. However, high-risk group disparities are striking:

Surgical patients (24 cases) and blood donors (22 cases) account for nearly 47% of positive cases, consistent with Kuwaiti data on nosocomial transmission risks [4].

The 100% positivity rate in children of infected mothers underscores Iraq's gaps in perinatal HBV prevention, unlike Oman, where neonatal vaccination within 24 hours reduced vertical transmission to <1% [2]. Gender disparities in screening (60.1% males vs. 39.9% females) reflect cultural biases in healthcare access, paralleling Pakistan's data [10]. Meanwhile, pre-marital screening (12 cases) proves effective, mirroring Jordan's success with mandatory premarital HBV testing [11].

4.3 Policy and Research Implications

1. Dose Completion Strategies: Iraq could adopt Saudi Arabia's SMS reminder system, which increased Dose 3 uptake by 30% [3].
2. Targeted Outreach: The anomalous barber vaccination trend (higher Dose 3 uptake) suggests successful localized campaigns, warranting expansion to other groups.
3. Vertical Transmission: Iraq lacks universal maternal HBV screening, unlike UAE and Qatar, where antenatal screening is routine [5].

4.4 Limitation and Future Directions

A. Data Gaps: Unspecified "other categories" (341 doses) limit risk-group analysis.

B. Comparative Context: Iraq's low prevalence may reflect under-screening rather than true epidemiology, as seen in Yemen [12].

5. Conclusion

The data analysis reveals several critical insights regarding hepatitis B vaccination and screening patterns in Iraq compared to neighboring countries.

1. Healthcare workers demonstrate the highest vaccination rates, reflecting their priority status, while significant gaps remain among other high-risk groups including traditional birth attendants and dialysis patients. This pattern aligns with challenges observed in Syria and Jordan regarding vaccine access and safety concerns.
2. A concerning trend emerges in vaccination completion rates, with substantial dropout between initial and follow-up doses, similar to patterns documented in

Lebanon. In contrast, countries like Iran achieve higher compliance through mandatory policies and better infrastructure. The unexpected higher third-dose uptake among barbers suggests potential success in targeted interventions that could be replicated for other underserved populations.

3. Screening data indicates an overall low HBV prevalence rate, though this may reflect under-testing rather than true epidemiological patterns. High-risk groups such as surgical patients and blood donors account for nearly half of all positive cases, highlighting the need for improved infection control measures in clinical settings. The complete positivity rate among infants born to infected mothers underscores urgent needs in perinatal prevention, an area where Oman has demonstrated success through neonatal vaccination protocols.
4. Significant gender disparities in testing rates reveal persistent cultural and accessibility barriers, while premarital screening emerges as an effective detection method, mirroring Jordan's successful program. Structural challenges including vaccine supply chain issues and healthcare worker training gaps require attention, with potential solutions evident in neighboring countries' use of reminder systems and digital tracking.
5. These findings collectively suggest that while Iraq has established some foundational HBV prevention measures, substantial opportunities exist to enhance coverage and outcomes by adopting evidence-based strategies from regional partners. Future efforts should focus on closing vaccination gaps in neglected high-risk populations, improving dose completion rates, and strengthening screening protocols, particularly for maternal and neonatal prevention.

Recommendations

1. Enhance screening and follow-up for pregnant women to prevent vertical transmission
2. Implement rigorous screening protocols in healthcare settings
3. Strengthen vaccination programs for healthcare workers and other high-risk populations
4. Continue and potentially expand community-based screening programs like premarital testing
5. Consider targeted screening for specific high-risk groups with elevated positivity rates
6. Enhance monitoring of multi-dose completion and prioritize outreach to underrepresented categories to achieve comprehensive HBV protection.
7. Further investigation into the specific barriers affecting dose completion and the unvaccinated groups would be valuable for optimizing future vaccination campaigns.

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