International Scholars Journals

African Journal of Virology Research ISSN 2756-3413 Vol. 20 (6), pp. 001-014, June, 2026. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Mother-to-child transmission of hepatitis B virus in the Republic of the Congo: a systematic review of epidemiology and prevention challenges

Dimitry Moudiongui Mboungou Malanda[1,2,3], Archange Michel Emmanuel Mboungou Malonga[1], Shekina Jessica Dioukamba Darlla [1], Paola Candyse Tsimba Lemba[1,3], Bredin Roch Bissala Nkounkou [1,3], Laure Stella Ghoma Linguissi[1,4], Anicet Luc Magloire Boumba[1,3]

[1]Faculty of Health Sciences, Marien Ngouabi University, Brazzaville, Republic of the Congo. [2]Department of Anatomy and Cytopathology, Brazzaville University Hospital, Brazzaville, Republic of the Congo. [3]Research Unit in Virology and Molecular Biology at the FSSA, Brazzaville, Republic of the Congo. [4]National Institute for Health Sciences Research, Brazzaville, Republic of the Congo.

Abstract

Accepted 06 June, 2026

Introduction: Hepatitis B virus infection is a major public health problem, particularly in sub-Saharan Africa, where mother-to-child transmission (MTCT) is a key driver of endemicity. **Objective:** To review the epidemiology and modes of mother-to-child transmission of HBV in the Republic of the Congo to identify prevention challenges and strengthen perinatal surveillance. **Methodology:** A systematic literature review was conducted using international databases (PubMed, ScienceDirect, AJOL and SpringerLink). Studies published up to May 2026 addressing HBV prevalence, MTCT, and perinatal prevention were included. A total of 25 articles were selected based on methodological quality and contextual relevance. No standardized risk of bias tool (e.g., ROBIS or the Joanna Briggs Institute checklist) was applied, which constitutes a methodological limitation. Predefined criteria included study design, case definitions, use of validated diagnostic methods such as HBsAg serology and PCR, sample size, and transparency of methods and results. **Results:** No national study has directly measured the risk of HBV mother-to-child transmission in the Republic of the Congo. Available Congo-specific and regional African studies reported plausible MTCT risk estimates ranging from 2.5% to 3.5%. However, the risk of transmission is substantially increased among HBeAg-positive mothers with high viral loads who do not receive prophylaxis. Transmission may occur in utero, during delivery, or during the early postnatal period, although peripartum transmission appears to predominate. Infant vaccination has improved prevention outcomes, but birth-dose coverage remains insufficient, particularly in rural areas and in cases of home delivery. Limited access to prenatal screening, HBV immunoglobulin (HBIG), molecular diagnostics, and structured surveillance systems remains a major challenge. **Conclusion:** Mother-to-child transmission of HBV remains a major contributor to HBV endemicity in the Republic of the Congo. Strengthening prenatal screening, neonatal vaccination within 24 hours of birth, antiviral prophylaxis with tenofovir for high-risk pregnant women, and integrated perinatal surveillance systems is essential to sustainably reduce transmission and support WHO elimination targets by 2030.

Keywords: Prevalence; hepatitis B virus; mother-to-child transmission; Republic of the Congo.

Introduction

Viral hepatitis is caused by five types of viruses (A, B, C, D, and E) that differ in their modes of transmission and clinical courses [1]. HBV is one of the leading causes of chronic liver disease worldwide. It is responsible for nearly one million deaths each year [1,2,3]. It thus constitutes a major global public health problem because of its potential to progress to severe forms such as cirrhosis and hepatocellular carcinoma. HBV is transmitted through

exposure to infected blood and body fluids, during unsafe medical procedures and sexual intercourse, as well as through vertical transmission from mother to child [2,3,4]. Mother-to-child transmission (MTCT), defined as transmission occurring during pregnancy, childbirth, or the early postnatal period, is a major route of HBV infection in high-endemic settings [2,3,4]. Infection acquired during the perinatal period carries a very high risk of chronicity, contributing substantially to the persistence of HBV endemicity [3,4]. Thus, perinatal transmission represents a key determinant of maintenance of the reservoir of chronic carriers and of long-term epidemiological dynamics. HBV is a major global public health problem. According to the World Health Organization, approximately 296 million people were living with chronic HBV infection in 2019, with nearly 820,000 annual deaths linked to its complications, such as cirrhosis and hepatocellular carcinoma [5]. These figures reflect a considerable health burden, particularly concentrated in low- and middle-income countries. In the Republic of the Congo, HBV infection is endemic, with an estimated prevalence ranging from 4% to 8% among pregnant women, exposing a substantial number of newborns to the risk of early infection [6,7,8]. However, data specifically addressing mother-to-child transmission remain limited and fragmented. Only a few Congo-specific studies have evaluated HBV prevalence among pregnant women, and very limited information is available regarding MTCT risk, timing of transmission, virological profiles, and effectiveness of prevention strategies. This evidence gap limits the development of targeted public health interventions and robust perinatal surveillance systems. In Brazzaville, a 1995 study reported a prevalence of 6.5% among pregnant women, whereas a more recent review estimated MTCT risk at approximately 2.7% [6,7]. Available data suggest that mother-to-child transmission is a major mechanism sustaining infection and remains an important contributor to HBV persistence in the absence of adequate preventive measures [9,10]. Despite the existence of effective interventions, their implementation remains incomplete and unevenly distributed across the country. Availability and implementation of effective interventions such as prenatal screening, vaccination at birth, and administration of antivirals to mothers with high viral loads remain insufficient because of constraints related to the healthcare system, access to care, and absence of systematic surveillance programs [7,8]. Mother-to-child transmission of HBV remains a public health challenge [7,10]. Epidemiological data on MTCT are insufficient, fragmented, and outdated [6]. This lack of data limits policymakers' ability to implement targeted and effective interventions to prevent vertical transmission. These findings may inform prevention policies, strengthen perinatal surveillance, and contribute to the goals of HBV elimination. The objective of this study was to review the epidemiology and modes of mother-to-child transmission of HBV to identify prevention challenges and strengthen perinatal surveillance. It is part of an operational approach aimed at bridging the existing gaps between international recommendations and their implementation in the Congolese context.

Corresponding author E-mail: dimitrymboungou@yahoo.fr

I. Methodology

1. Type, sources, and search engines

A structured literature review was conducted in accordance with PRISMA guidelines, using PubMed, ScienceDirect, Google Scholar, AJOL, and SpringerLink databases. Additional grey literature was identified through ResearchGate and institutional reports This search strategy aimed to maximize the comprehensiveness of the available literature, particularly in African contexts where some publications are less frequently indexed in international databases.

The keywords used, combined with the Boolean operators "AND" and "OR," were:

- "Hepatitis B virus" OR "HBV infection";
- "Mother-to-child transmission" OR "MTCT";
- "HBV prevalence" OR "HBsAg prevalence";
- "Africa" OR "Republic of the Congo".

The search strategy was tailored to each database to optimize sensitivity and specificity of the results.

2. Inclusion criteria

The following were included:

- Studies published up to May 2026;
- Studies conducted in the Republic of the Congo or including country-specific data;
- Studies addressing:
- HBV prevalence;
- Mother-to-child transmission;
- Perinatal prevention;
- Original articles, systematic reviews, and institutional reports.

These criteria ensured contextual relevance and scientific quality of the data included in the analysis.

3. Exclusion criteria

The following were excluded:

- Studies outside the targeted geographic context;
- Insufficient or unusable data;
- Articles not available in full text;
- Studies focusing solely on other types of hepatitis.

This rigorous selection process aimed to limit biases related to data quality and ensure consistency of the synthesis.

4. Target population

Efforts to combat HBV target, among others, pregnant women and their newborns, because of the central role of mother-to-child transmission in endemicity of the disease [7,10]. Consequently, the findings are primarily relevant to the perinatal context. This focus helps identify priority areas for intervention to reduce early transmission and chronicity. They highlight the importance of prenatal screening, vaccination at birth, and enhanced surveillance during pregnancy and at delivery.

5. Selection and analysis steps

A total of 45 records were identified during the literature review. After title and abstract screening, 20 records were excluded. The remaining 25 articles and institutional reports underwent full-text assessment, and all met the predefined eligibility criteria for inclusion in the review and were retained for the final synthesis. The absence of full-text exclusions likely reflects the limited availability of Congo-specific literature on hepatitis B virus mother-to-child transmission.

Figure 1 illustrates the flowchart describing the various stages of identification, screening, eligibility, and inclusion of studies in the systematic review on mother-to-child transmission of HBV in the Republic of the Congo.

This approach was based on PRISMA guidelines. However, the review protocol was not prospectively registered in PROSPERO or the Open Science Framework, which constitutes a methodological limitation. No post-hoc modifications to the inclusion criteria were made during the review process.

No standardized quantitative tool was used to assess risk of bias. However, a non-standardized qualitative assessment was performed during study selection. Predefined criteria included study design, case definitions, use of validated diagnostic methods such as HBsAg serology and PCR, sample size, and transparency of methods and results.

Studies with unclear methodologies, insufficient data, or non-standardized diagnostic criteria were excluded. This approach ensured inclusion of studies with acceptable scientific rigor and contextual relevance to Central Africa and the Republic of the Congo. Nevertheless, the absence of a formal standardized appraisal tool such as ROBIS or Joanna Briggs Institute checklists remains a limitation that may introduce variability in interpretation of the findings.

II. Epidemiology

1. Overview of Congo-specific studies

Data on hepatitis B virus (HBV) infection and mother-to-child transmission in the Republic of the Congo remain limited. The available studies are few in number, are generally conducted in the main urban centers, and focus primarily on the prevalence of infection among pregnant women, associated risk factors, healthcare professionals' knowledge and practices, and the genetic diversity of the virus. Of the six studies identified, four focused directly on pregnant or postpartum women, one assessed healthcare providers involved in maternal care, and one investigated HBV molecular epidemiology. Together, these studies constitute the principal national evidence base for understanding HBV infection and mother-to-child transmission in the Republic of the Congo. Table I provides a synthesis of these Congolese studies included in this review and highlights their contribution to HBV epidemiology and the prevention of mother-to-child transmission.

2. Prevalence and genetic diversity

The overall risk of mother-to-child transmission of HBV in the Republic of the Congo has not been directly documented by a national study [6,7]. Available Congo-specific and regional African studies reported plausible MTCT risk estimates ranging from 2.5% to 3.5%, based on maternal HBsAg prevalence and known transmission risks associated with maternal virological status [6,7,11]. Because no quantitative meta-analysis was performed, these values should be interpreted as descriptive ranges rather than pooled national estimates. A major limitation of the available evidence is the scarcity of recent Congo-specific epidemiological data. Only a limited number of studies have specifically investigated HBV infection among pregnant women or MTCT in the Republic of the Congo [12,13]. Most available estimates are extrapolated from regional African studies or older investigations conducted in Brazzaville. Consequently, several prevention and surveillance recommendations discussed in this review are based partly on broader sub-Saharan African evidence. Prospective cohort studies and sentinel surveillance systems are therefore urgently needed to generate robust national estimates of HBV mother-to-child transmission in the Republic of the Congo [12,13,14]. This estimate may vary according to maternal virological status (HBeAg, viral load) and access to prevention strategies such as neonatal vaccination and immunoprophylaxis. Mother-to-child transmission of HBV is a critical driver of persistence of infection in the Congolese population, exposing children infected early in life to a high risk of chronicity and long-term liver complications [6,14]. HBV prevalence among pregnant women in selected studies in Brazzaville is approximately 7.2%, indicating a high risk of vertical transmission [15]. Furthermore, a proportion of HBsAg-positive women present markers of active viral replication, indicating a high potential for perinatal transmission in the absence of adequate prophylactic interventions [15]. In the absence of routine prophylaxis at birth, the risk of transmission varies according to maternal virological status and is considerably higher among HBeAg-positive mothers, underscoring the importance of

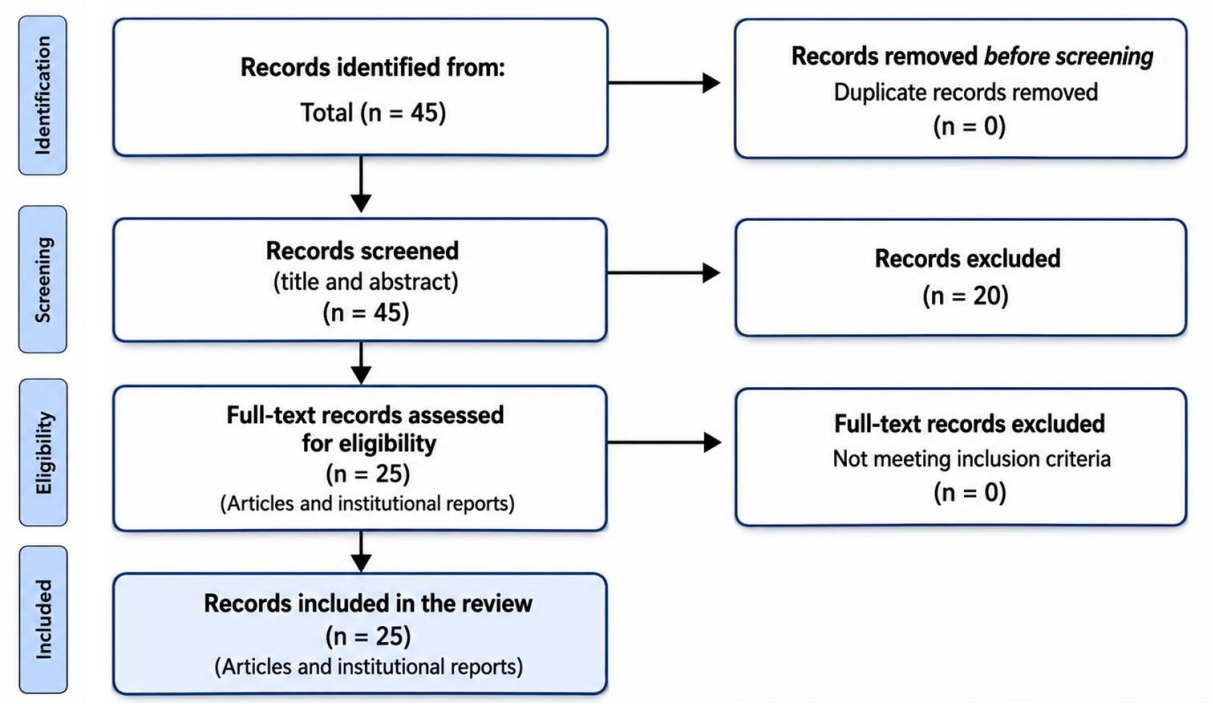

Figure 1. PRISMA flow diagram for the selection of studies.

enhanced preventive strategies [7,10]. In specific populations, hospitalized patients and certain at-risk groups, prevalence of HBV reaches comparable or even higher levels, indicating increased cumulative exposure and structural vulnerabilities [7].

The genetic diversity of HBV in the Republic of the Congo reflects regional transmission dynamics specific to Central Africa [16,17]. Molecular studies have shown predominance of genotype E, characteristic of areas of high endemicity in West and Central Africa [7,16,17]. Meanwhile, the less common genotype A indicates viral flow and histories of cross-transmission [7,16,17]. This genetic variability may influence clinical prognosis, response to antiviral treatments, and diagnostic performance. This geographic specificity reflects historical transmission dynamics and may influence response to interventions. Vaccination is generally effective against all known genotypes [18]. From a programmatic standpoint, the Republic of the Congo has incorporated HBV vaccination into its expanded childhood immunization schedule, notably through the pentavalent vaccine, contributing to a gradual reduction in early-onset infections. However, coverage of the birth-dose vaccine remains insufficient in rural areas despite good coverage of subsequent doses administered at 6, 10, and 14 weeks [7,19]. This shortfall constitutes a critical point in the prevention chain, limiting impact of control strategies. This overview highlights limitations in effective prevention of mother-to-child transmission. Lack of routine prenatal screening combined with neonatal prophylaxis, including immunoglobulins and early vaccination, is a major weakness in the prevention system despite strong evidence supporting effectiveness in high-endemic settings [7,19,20]. Consequently, the burden of persistent infections remains high, linked to uneven vaccination coverage and shortcomings in epidemiological surveillance. Strengthening data collection, systematic administration of the vaccine dose at birth, and follow-up of vaccinated cohorts appear to be priorities for optimizing prevention strategies [19,20].

3. Transmission routes

HBV transmission in the Republic of the Congo occurs within a context of high endemicity, where multiple routes of transmission coexist and contribute to maintenance of viral circulation [7,10,11]. These modes of transmission are dominated by vertical mother-to-child transmission and early horizontal transmission, in addition to sexual and blood-borne transmission [7,10,11]. This diversity of routes reflects complex transmission dynamics involving biological, behavioral, and structural factors related to the healthcare system. Figure 2 illustrates the interaction between vertical, horizontal, sexual, and blood-borne transmission routes in a high endemic setting.

Table I. HBV studies in the Republic of the Congo and MTCT relevance.

Author(s) and study	Year	Location	Study Population	Study Design	Main Findings	Relevance to MTCT
Itoua-Ngaporo A, et al. *Prevalence of hepatitis B viral markers in a population of pregnant women in Brazzaville (Congo)*	1995	Brazzaville	Pregnant women	Cross-sectional serological study	First estimate of HBV marker prevalence among pregnant women in the Republic of the Congo	Provided baseline data on HBV prevalence among pregnant women, a key population for MTCT
Ghoma Linguissi LS, Nkenfou CN. *Epidemiology of viral hepatitis in the Republic of the Congo: review*	2017	Republic of the Congo	National data	Narrative review	Summarized available evidence on viral hepatitis epidemiology in the country	Offered national epidemiological context for HBV and MTCT prevention strategies
Angounda BM, Bokilo Dzia A, Boumba LMA, et al. *Prevalence of serologic markers and risk factors for hepatitis B virus among pregnant women in Brazzaville, Congo*	2016	Brazzaville	Pregnant women	Cross-sectional study	Assessed HBV prevalence and associated risk factors during pregnancy	Identified maternal HBV burden and risk factors potentially associated with vertical transmission
Angounda BM, Ngouloubi GH, Dzia AB, et al. *Molecular characterization of hepatitis B virus among chronic hepatitis B patients from Pointe-Noire, Republic of the Congo*	2016	Pointe-Noire	Patients with chronic HBV infection	Molecular study	Described circulating HBV genotypes and molecular characteristics	Contributed information on viral strains potentially involved in transmission dynamics, including MTCT

3.1. Mother-to-child transmission

Vertical transmission is one of the main mechanisms driving persistence of HBV in sub-Saharan Africa. Transmission may occur during pregnancy (intrauterine transmission), during delivery (peripartum transmission), or during the early postnatal period through close maternal contact [7,21]. Peripartum transmission appears to be the predominant mechanism, mainly because of exposure to maternal blood and secretions during childbirth. Intrauterine transmission is less frequent but may occur in cases of placental microtransfusions, placental infection, or high maternal viral load. Early postnatal transmission may also contribute, particularly in settings characterized by delayed vaccination and limited neonatal prophylaxis. These transmission mechanisms are consistent with findings reported in international studies. [7,20,21,22]. In the Republic of the Congo, prevalence of HBV among

Table I Cont.

Ngami RS, Ahoui Apendi Mikolélé PCA, et al. *Midwives' knowledge and practice in preventing mother-to-child transmission of hepatitis B virus in Brazzaville (Congo)*	2023	Brazzaville	Midwives	Knowledge, attitudes and practices (KAP) study	Evaluated knowledge and practices regarding HBV prevention among maternity care providers	Assessed healthcare workers' preparedness to implement MTCT prevention measures
Massengo BRN, Ontsira Ngoyi EN, Mieret T, et al. *Risk factors for hepatitis B virus infection among postpartum women in Brazzaville, Republic of the Congo*	2023	Brazzaville	Postpartum women	Analytical cross-sectional study	Identified risk factors associated with HBV infection among postpartum women	Provided insights into maternal HBV exposure and factors influencing perinatal transmission risk

pregnant women is estimated at approximately 7.2%, and a proportion of infected women present markers of active viral replication, indicating a high potential for perinatal transmission [15]. The risk of transmission depends strongly on maternal virological status and is significantly higher among HBeAg-positive mothers than among HBeAg-negative mothers. In the absence of prophylaxis, particularly vaccination at birth with or without immunoglobulins, mother-to-child transmission often leads to chronic HBV infection in children infected at birth [21,22]. Thus, mother-to-child transmission plays a decisive role in establishing the reservoir of chronic HBV carriers. It represents the primary important factor of endemicity, continuously replenishing the pool of chronic carriers from the earliest years of life. Furthermore, this route of transmission directly reflects shortcomings in the healthcare system, particularly regarding prenatal screening, access to prophylaxis, and birth-dose vaccination coverage.

3.2. Horizontal transmission

Horizontal transmission within families and communities is common in Africa [7,12]. It occurs during childhood through close contact with infected bodily fluids [1,2,7]. It may result from minor skin injuries, sharing of sharp objects, or scarification and cultural practices [7,15]. The high seroprevalence of anti-HBc antibodies indicates early and widespread exposure to HBV within the population [12,13]. This horizontal transmission plays a complementary role to vertical transmission in maintenance of endemicity [1,2,21]. In settings characterized by high levels of promiscuity and limited access to hygiene and prevention measures, this transmission constitutes a major epidemiological pathway ensuring viral spread within communities.

3.3. Sexual transmission

Sexual transmission is a major route of HBV transmission among adolescents and adults. It is associated with exposure to infected bodily fluids [1,2,3]. Factors contributing to this transmission include multiple sexual partners, low condom use, and co-infections with other sexually transmitted infections [1,2,3,7]. In areas of high endemicity, this route contributes to viral spread, although it remains secondary to early transmission routes, including vertical and horizontal transmission [1,2,7,12].

3.4. Blood-borne and nosocomial transmission

Blood-borne transmission is a classic mode of HBV infection [2,7,12,13]. It may occur in settings involving unsafe blood transfusions, reuse of unsterilized medical

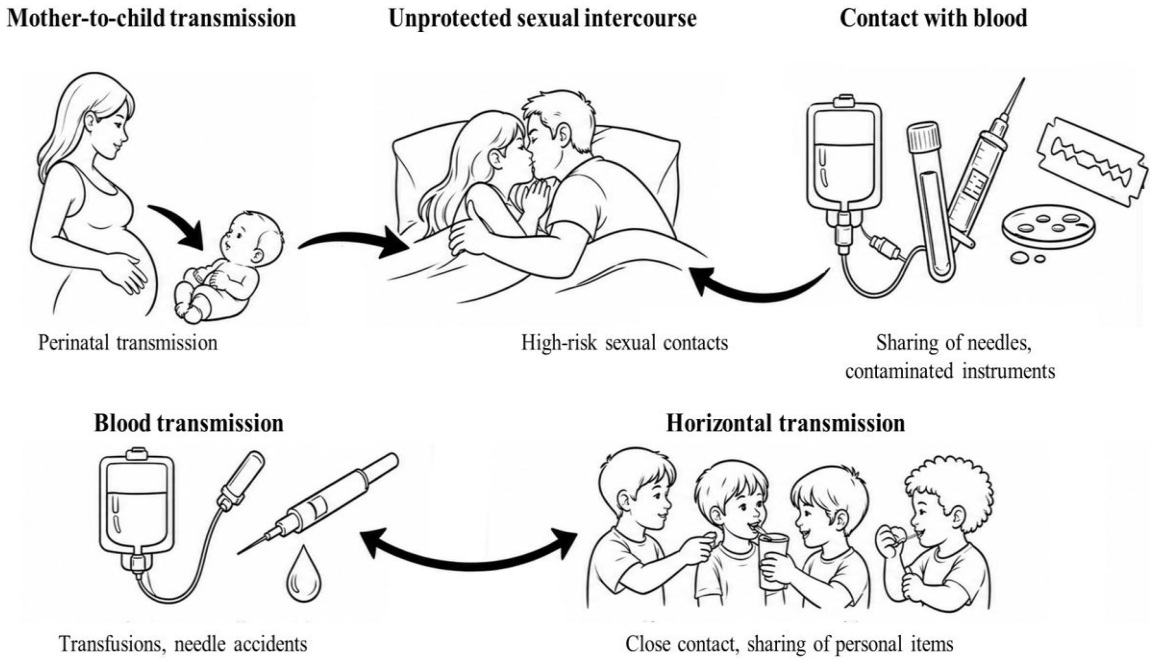

Figure 2. Conceptual model of HBV transmission routes and their interactions in a context of high endemicity (adapted from [7,21]).

equipment, occupational exposure among healthcare workers, and unsafe injections [2,7,20]. Although blood safety policies have improved, this mode of transmission persists in certain resource-limited settings [2,7,12]. Nosocomial infections also pose a significant risk, particularly in the absence of strict infection prevention and control measures [2,5,20].

3.5. Other modes of transmission

Overall, HBV transmission is dominated by mother-to-child transmission [1,21,22]. This represents the primary source of chronic infection, along with early horizontal transmission during childhood [1,7,12]. Sexual and blood-borne transmission also play significant, although secondary, roles in overall transmission dynamics [1,7,12,20]. Other less common routes include transmission linked to injection drug use, unsafe tattooing or piercing practices, and accidental exposures such as needle-stick injuries [1,2,5,20]. Although marginal at the population level, these emerging routes may become significant in at-risk subpopulations, underscoring the need for targeted and tailored surveillance. Overall, HBV transmission dynamics in the Republic of the Congo should be understood as an interconnected system in which various transmission routes reinforce one another, making an integrated prevention approach essential.

4. Demographic and geographic risk factors

4.1. Demographic risk factors

Hepatitis B virus infection is influenced by several interr-elated individual and sociodemographic factors [1,2,3,12]. These factors interact in complex ways and help shape transmission dynamics within populations, particularly in settings of high endemicity. Age and the timing of exposure are major determinants. The majority of infections occur during early childhood, either through mother-to-child transmission or through early horizontal transmission [1,2,4,7,9,21]. The risk of chronicity is markedly higher in newborns than in adults, in whom it remains relatively low, which explains the high prevalence of chronic carriers [1,2,5,20]. Thus, the age at which the infection is acquired is a critical factor that determines the natural course of the disease and the long-term epidemiological burden. Gender plays a role, with a higher prevalence among men, linked to certain risk behaviors and biological factors. This population also faces an increased risk of complications such as cirrhosis and hepatocellular carcinoma [2,3,12]. This disparity suggests an interaction between behavioral and hormonal factors and unequal access to care. Socioeconomic status appears to be a key factor, due to limited access to vaccination, crowded living conditions that facilitate transmission, and restricted access to care. Poverty is generally associated with an increased risk of infection [1,2,12,13]. It acts as a major structural determinant, influencing both exposure to the virus and the ability to benefit from prevention and treatment interventions. Certain professions and specific groups are at higher risk. These include healthcare workers, sex workers, blood transfusion recipients, and people living with HIV [1,2,5,20]. These groups often face multiple vulnerability factors, justifying targeted screening and

prevention strategies. Finally, individual behaviors have contributed to an increased risk of exposure within the population. These include having multiple sexual partners, low condom use, and certain cultural practices such as scarification and/or the sharing of sharp objects [1,2,7,15]. These behaviors, often rooted in specific sociocultural contexts, require tailored interventions that incorporate health education and community mobilization. Overall, demographic factors reflect an interaction between biological vulnerability, socioeconomic conditions, and individual behaviors, forming a cumulative risk system that sustains HBV transmission.

4.2. Geographic risk factors

Key risk factors associated with hepatitis B virus infection are summarized in Table II. These factors are part of a context of high endemicity [1,2,3,7,12]. This homogeneous distribution reflects long-standing and stable circulation of the virus within the population. The spatial distribution of the hepatitis B virus appears widespread across the entire country, affecting both rural and urban areas, with no exclusive concentration [1,2,7,12]. This homogeneous distribution reflects long-standing and stable circulation of the virus within the population. Certain trends emerge, with more pronounced horizontal transmission in rural areas and increased exposure in urban settings linked to healthcare and risk behaviors [7,12,15]. These differences reflect distinct exposure contexts related to lifestyles, cultural practices, and the organization of health services. Disparities in access to health services play a decisive role, with low vaccination coverage at birth, limited access to screening and treatment, and inadequate health infrastructure [1,2,5,19]. These regional inequalities constitute a major obstacle to the effective implementation of prevention and control strategies. In Africa, fewer than 10% of infected individuals are aware of their status, which contributes to silent transmission [2,3,12]. This low testing rate helps maintain a hidden reservoir of chronic carriers, making it difficult to control the epidemic. Certain environmental and biological factors play an indirect role. These include exposure to aflatoxin through contaminated food, which increases the risk of complications [23]. Co-endemicity with HIV and hepatitis D is a significant factor [3,12,17]. These interactions between environmental, infectious, and socioeconomic factors illustrate the complexity of HBV epidemiology, requiring a multidimensional approach to its control. Thus, geographical factors are not limited to mere spatial distribution, but reflect structural inequalities in access to care, health infrastructure, and living conditions, which profoundly influence the dynamics of virus transmission.

III. Methods for diagnosing HBV

The diagnosis of HBV is based on the detection of serological and molecular markers that allow the identification of acute or chronic infection [1,2,5,20]. It also enables the assessment of viral replication and plays a key role in guiding clinical management [2,5,20]. Beyond individual patient care, HBV diagnosis represents a strategic component of public health interventions, particularly in screening programs, prevention of mother-to-child transmission, and epidemiological surveillance. Over recent decades, diagnostic approaches have progressively evolved with the introduction of molecular techniques and point-of-care testing, reflecting major technological advances and strengthened efforts in HBV control [1,2,12,20]. However, access to these diagnostic tools remains unevenly distributed, highlighting a persistent gap between international recommendations and their implementation in resource-limited settings. The table III below summarizes the main diagnostic methods used in clinical practice and their respective clinical applications.

1. Conventional serological methods

1.1. Detection of HBsAg

Detection of HBsAg is the first-line test for screening for hepatitis B virus infection [1,2,5,20]. Initially performed using enzyme-linked immunosorbent assays (ELISA), this test enables the identification of chronic carriers and acute infections [5,20]. Rapid immunochromatographic tests have been introduced more recently to facilitate screening in resource-limited settings [1,2,5]. These rapid tests offer the advantages of increased accessibility and lower cost, and decentralized use, particularly in primary healthcare facilities and community-based campaigns. However, their variable sensitivity is a limitation that requires appropriate confirmation strategies, especially for low viral loads.

1.2. Other serological markers

Other serological markers of HBV infection play a key role in assessing infectious status and transmission risk [5,20]. HBeAg and anti-HBe antibodies help evaluate the level of viral activity and infectivity [5,20]. IgM anti-HBc antibodies are markers of recent infection, generally defined as less than six months. Anti-HBs antibodies indicate acquired immunity, whether natural or vaccine-induced [5,18,20]. Combined interpretation of these markers enables differentiation between acute infection, chronic infection, and immunity [5,20]. This distinction is crucial in the management of pregnant women and in prevention of mother-to-child transmission [9,21]. In practice, lack of routine access to all these markers in some settings limits diagnostic accuracy and may lead to underestimation of transmission risk, particularly in the absence of HBeAg and viral load data.

2. Molecular diagnosis

Quantification of HBV DNA by PCR has revolutionized diagnosis by providing a direct measure of viral replication [5,20]. It is an essential tool for assessing the risk of perinatal transmission, guiding initiation of antiviral

Table II. Some risk factors associated with hepatitis B virus infection.

Categories	Risk factors	Impact on the risk	References
Demographic	Early age (childhood, newborn)	High risk of chronicity in infected newborns	[1,2,3,5,9,12,21]
	Male	Higher prevalence and increased liver complications	
	Low socio-economic status	Limited access to vaccination, screening and care; promotes transmission	
Geographic	Rural areas	Early horizontal transmission more frequent	[1,2,3,7,12,13]
	Urban areas	Increased care-related exposure and risk behaviours	
	High regional endemicity (Central Africa)	Maintenance of a chronic large reservoir	
Behavioral / Cultural	Promiscuousness	Increased risk of sexual transmission	[2,3,4,7,15]
	Low condom use	Increased sexual transmission	
	Cultural practices (scarification, sharing of sharp objects)	Increased horizontal transmission	
Professionals / Specific Groups	Health worker	Occupational exposure to blood and body fluids	[2,3,5,20]
	People with HIV	Increased susceptibility and frequent co-infections	
	Transfused patients, sex workers	Increased risk from repeated exposure	
Biological / Environmental	HIV, hepatitis D co-endemicity	Influence on progression and complications	[3,5,7,16,17,21,23]
	Genotype E predominant	Stable endemic transmission, influences chronicity	
	aflatoxin exposure	Increases the risk of liver complications	

treatment, and monitoring therapeutic response [5,9,20]. Quantitative PCR has gradually been integrated, allowing better stratification of patients at high risk of mother-to-child transmission [5,9]. It currently represents the gold standard for viral load assessment, although accessibility remains limited in many African settings. Viral sequencing has contributed to the study of genetic diversity, with predominance of genotypes E and A in Central Africa [7,16,17]. It has enabled identification of mutations associated with antiviral resistance and vaccine escape

Table III. Diagnostic methods for HBV and their clinical applications.

Method	Marker/Test	Clinical utility
Classical serology	HBsAg (ELISA, RDT)	Screening for active/chronic infection
	HBeAg / Anti-HBe	Assessment of viral replication and infectivity
	Anti-HBc IgM	Marker of recent infection (< 6 months)
	Anti-HBs	Vaccine-induced or natural immunity
Molecular diagnosis	HBV DNA (quantitative PCR)	Viral load, MTCT risk, therapeutic monitoring
	Viral sequencing	Genetic diversity, resistance, vaccine escape
Emerging tests	POC (point-of-care)	Rapid detection in low-resource settings
	Biosensors/microfluidics	Promising tools for rural settings

phenomena [7,18,20]. However, the use of sequencing remains largely limited to research because of its cost and technical complexity, limiting integration into routine clinical practice.

3. Emerging technologies

Next-generation rapid tests, such as point-of-care molecular tests, enable detection of HBsAg and viral DNA in less than one hour. They are well adapted to rural areas and resource-limited settings [1,2,24]. These technologies represent a major advance in decentralization of diagnosis, reducing delays in clinical decision-making and improving linkage between screening and care. Combined HIV-HBV testing represents an important approach, facilitating simultaneous screening within integrated health programs, which is crucial in sub-Saharan Africa [2,12,24]. This integration optimizes existing resources and improves diagnostic coverage among at-risk populations. Biosensors and microfluidic technologies are currently undergoing validation [24,25]. They offer promising prospects for portable, rapid, and sensitive diagnostics. These approaches are well suited to settings with limited health infrastructure. In the medium term, these innovations could transform the diagnostic landscape by enabling widespread, rapid, and accessible screening, particularly in rural and remote areas.

4. Clinical applications

Methods for diagnosing HBV are used in multiple contexts. They are employed for general and preventive screening, including among blood donors, pregnant women, children, and at-risk populations [2,5]. They enable stratification of the risk of mother-to-child transmission by identifying women with high viral loads in order to adapt neonatal

prophylaxis [5,9,21]. They also play a central role in therapeutic monitoring by facilitating adjustment of antiviral treatments and early detection of resistance [3,20]. Finally, they contribute to epidemiological surveillance by enabling estimation of prevalence, study of viral genetic diversity, and monitoring of vaccination program effectiveness [3,12,16,18]. Thus, HBV diagnosis extends beyond the individual level and becomes a strategic tool for guiding public health policies and evaluating interventions.

5. Current constraints and challenges

Despite progress, several challenges remain regarding HBV diagnosis. Access to molecular diagnostics is limited outside major cities such as Brazzaville and Pointe-Noire. The cost of PCR tests and sequencing remains high. In addition, there is a substantial need for staff training and laboratory quality improvement to ensure reliability of results [3,5]. These constraints explain the predominance of conventional serological screening in most peripheral centers, whereas PCR remains limited to reference laboratories and specialized centers [5,7]. These inequalities in access to diagnosis reflect a major health divide, limiting the effectiveness of prevention and management strategies. Development of innovative solutions such as decentralization of diagnosis, use of point-of-care tests, and integration of services into primary healthcare appears essential for improving accessibility and equity. Furthermore, strengthening quality assurance systems, continuous staff training, and establishment of interconnected laboratory networks represent strategic levers for ensuring reliability and sustainability of diagnostic services.

IV. Management of HBV

Management of HBV is based on three complementary pillars: early clinical and laboratory diagnosis, appropriate antiviral treatment, and long-term monitoring for complications. It is part of an integrated continuum of care ranging from screening to long-term monitoring for liver complications, particularly in resource-limited settings. The initial evaluation of patients with chronic HBV infection includes several complementary investigations. Measurement of viral load by PCR enables assessment of viral replication and helps guide treatment decisions [5,7,25]. Measurement of transaminases (ALT/AST) helps assess hepatic inflammatory activity [5]. Analysis of serological markers (HBeAg/anti-HBe, anti-HBc IgM/IgG) helps characterize the stage of infection [5]. Assessment of liver fibrosis using FibroScan or biomarkers helps detect progression toward cirrhosis [5,7,24,25]. In resource-limited settings, simple non-invasive scores such as APRI and FIB-4 may serve as relevant alternatives for fibrosis assessment, improving accessibility at diagnosis. This stratification helps identify patients at high risk of complications such as cirrhosis or hepatocellular carcinoma and prioritize their care [3]. It also serves as a strategic tool for optimizing resource allocation in constrained healthcare systems. Antiviral treatment relies primarily on drugs with a high genetic barrier to resistance. Tenofovir disoproxil fumarate (TDF) is recommended as first-line therapy because of its potency and low resistance rate [5]. It is particularly indicated for patients with high viral loads and for pregnant women to reduce the risk of mother-to-child transmission [5,9]. Entecavir represents an effective alternative in cases of intolerance or non-response [5]. Other nucleoside analogues such as lamivudine or telbivudine are used less frequently because of lower efficacy and higher resistance rates [5]. The gradual introduction of long-acting formulations and simplified treatment strategies could improve adherence and long-term effectiveness in African settings.

Management requires regular monitoring, including viral load and liver enzyme assessment every three to six months, as well as screening for liver complications using imaging and biomarkers [5]. Evaluation of treatment adherence and adverse effects is also essential [5]. Integration of digital tools such as telemedicine, SMS follow-up, and electronic health records represents an innovative opportunity to improve patient follow-up and reduce loss to follow-up. These measures may be supported by national registries and regional cohorts enabling longitudinal epidemiological monitoring [3]. Prevention of complications relies on vaccinating unvaccinated contacts, managing co-infections, particularly HIV, and monitoring precancerous lesions in patients with advanced disease [5,7]. An integrated HBV-HIV approach appears particularly relevant in sub-Saharan Africa, enabling optimization of resources and improvement of intervention coverage. Several specific challenges limit optimal care in the Republic of the Congo. Access to first-line antivirals remains restricted in some areas. The cost of virological and fibrosis follow-up examinations remains high. Lack of specialized expertise also represents a major constraint. In addition, geographical inequalities in access to care and insufficient decentralization of services persist. The absence of structured national long-term monitoring programs highlights the need to strengthen health infrastructure, reduce diagnostic costs, and integrate HBV management into primary healthcare [3,8]. Reorganization of the system around a decentralized, community-based, and integrated care model could represent an innovative and sustainable strategy.

V. Challenges and need for enhanced perinatal Surveillance of HBV

Mother-to-child transmission of HBV remains a major public health issue contributing to continued endemicity [2,3]. It also represents a key determinant of the future burden of chronic liver disease within the population. The high prevalence among pregnant women, often associated

with elevated viral loads, exposes newborns to a substantial risk of perinatal infection. In the absence of intervention, infection acquired during the perinatal period frequently progresses to chronic infection [1,2,9]. Prenatal screening remains insufficiently systematic, limiting early identification of high-risk women and implementation of appropriate care [3,5]. This failure reflects a break in the continuum of maternal and child healthcare. Restricted access to PCR for HBV DNA quantification represents a barrier to risk stratification and antiviral prophylaxis among pregnant women [5,7,9]. Vaccination against HBV is included in the Expanded Programme on Immunization [5,7,19]. However, coverage of the birth-dose remains insufficient because of home deliveries and logistical constraints, while access to HBV immunoglobulin (HBIG) remains limited [5,7,19]. This situation highlights a mismatch between international recommendations and their operational implementation. Epidemiological surveillance systems remain insufficient because of the absence of national registries and incomplete longitudinal follow-up of mother-infant pairs, limiting evaluation of public health policies [3,9]. The lack of robust data constitutes a major obstacle to strategic planning and evaluation of interventions. In this context, these recommendations are based on international guidelines and regional evidence rather than national prospective data. In the Republic of the Congo, implementation of TDF prophylaxis from 28 weeks of gestation for HBsAg-positive pregnant women with high viral loads may represent a more feasible and sustainable strategy than widespread reliance on HBIG alone, given the high cost and limited availability of immunoglobulins. WHO currently recommends antiviral prophylaxis with tenofovir in pregnant women with high hepatitis B virus deoxyribonucleic acid levels to reduce mother-to-child transmission. Integrating HBV screening and antiviral prophylaxis into existing HIV and maternal health programs could substantially improve implementation and reduce operational costs. Experiences from several African countries have shown that integration of the HBV birth-dose into routine maternal and neonatal services can significantly improve vaccination timeliness, particularly when combined with community-based delivery strategies and strengthened cold-chain systems. It is therefore essential to strengthen universal screening among pregnant women, improve access to molecular diagnostics, extend vaccination at birth within 24 hours, and introduce antivirals such as tenofovir systematically in women with high viral loads [5,7,9,19]. Implementation of an integrated perinatal surveillance model, including systematic follow-up of mother-infant pairs for at least the first 12 months of life, represents a major organizational innovation. The establishment of integrated surveillance systems is essential to improve monitoring and progress toward WHO HBV elimination targets through a comprehensive approach combining prevention, screening, treatment, and follow-up [1,2,3]. A multisectoral approach involving communities, healthcare facilities, and policymakers is essential to ensure effectiveness and sustainability of interventions.

VI. Prevention of mother-to-child transmission of HBV through neonatal serovaccination

Prevention of vertical transmission of HBV is based on a combined serovaccination strategy associating early neonatal vaccination with administration of specific anti-HBV immunoglobulins [5,9]. Administration of the vaccine within 24 hours of birth is a WHO-recommended measure [1,2,5]. It prevents a substantial proportion of perinatal transmissions. Its effectiveness becomes very high when completed by the full vaccination schedule [1,2,5]. In newborns of HBsAg-positive mothers, the combination of vaccine and immunoglobulins administered at birth provides high protection against mother-to-child transmission [5,9]. Immunoglobulins provide immediate passive protection, whereas the vaccine induces long-term active immunity [5,9,18,19]. However, effectiveness of this strategy depends heavily on implementation during the first hours of life, which represents a major challenge in settings where home deliveries remain frequent. A residual risk of transmission may persist in cases of high maternal viral load, justifying introduction of antiviral treatment at the end of pregnancy in high-risk women [5,9,21]. Early identification of these women therefore represents a key element of prevention. Application of these protocols remains limited by unequal birth-dose vaccination coverage associated with deliveries outside healthcare facilities and logistical constraints [7,19]. Access to HBIG may also remain limited because of cost and availability [5]. The frequent absence of routine HBV screening during pregnancy limits identification of high-risk newborns and targeted implementation of preventive interventions [3,5,7]. Innovative strategies such as the use of community health workers for early vaccination or integration of HBV screening into existing HIV and maternal health programs could substantially improve vaccination coverage and prevention effectiveness. The impact of serovaccination strategies depends on effective implementation [3,5,19]. Antenatal screening, neonatal vaccination, and access to immunoglobulins must therefore be strengthened to reduce mother-to-child transmission.

Conclusion

HBV remains highly endemic in the Republic of the Congo, with a substantial burden among pregnant women and a persistent risk of mother-to-child transmission. Genotype E appears to predominate in available studies, consistent with regional Central African patterns. Although screening and vaccination programs have improved prevention efforts, timely birth-dose vaccination coverage remains insufficient, particularly in rural settings and in cases of home delivery. Antiviral treatment and long-term

monitoring are effective but remain unevenly accessible. Persistent MTCT reflects structural shortcomings in prenatal screening, neonatal vaccination, access to molecular diagnostics, and follow-up of mother-infant pairs. Achieving WHO HBV elimination targets by 2030 will require an integrated and decentralized strategy combining universal antenatal screening, timely neonatal vaccination, targeted TDF prophylaxis for high-risk pregnant women, strengthened epidemiological surveillance, and integration of HBV services into maternal and HIV health programs. Prospective national studies and sentinel surveillance systems are urgently needed to generate robust Congo-specific data and guide evidence-based public health interventions.

Conflicts of interest: The authors declare that they have no conflicts of interest.

Funding: This research did not receive any specific external funding.

Authors' contributions: DMMM: design, literature review, main drafting; DMMM and AMEMM: analysis and validation; SJDD: data collection and critical review.

References

1. World Health Organization. Hepatitis B [Internet]. Geneva: World Health Organization; 2025 [cited 2026 Apr 24]. Available from: https://www.who.int/fr/news-room/fact-sheets/detail/hepatitis-b
2. GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Gastroenterol Hepatol. 2022;7(9):796-829. doi: 10.1016/S2468-1253(22)00124-8.
3. Hsu YC, Huang DQ, Nguyen MH. Global burden of hepatitis B virus: current status, missed opportunities and a call for action. Nature Reviews Gastroenterology & Hepatology. 2023;20(8):524-537. doi:10.1038/s41575-023-00760-9.
4. Zhao X, Bai X, Xi Y. Intrauterine infection and mother-to-child transmission of hepatitis B virus: route and molecular mechanism. Infection and Drug Resistance. 2022;15:1743-1751. doi:10.2147/IDR.S359113.
5. Yao N, Fu S, Wu Y, Tian Z, Feng Y, Li J, Luo X, Yang Y, Ji F, Chen Y, Liu J, Zhao Y, Chen T. Incidence of mother-to-child transmission of hepatitis B in relation to maternal peripartum antiviral prophylaxis: a systematic review and meta-analysis. Acta Obstet Gynecol Scand. 2022;101(11):1197-1206. doi:10.1111/aogs.14448. PMID:36082797; PMCID:PMC9812094.
6. Itoua-Ngaporo A, Sapoulou MV, Ibara JR, Iloki LH, Denis F. Prevalence of hepatitis B viral markers in a population of pregnant women in Brazzaville (Congo). Journal de Gynécologie Obstétrique et Biologie de la Reproduction. 1995;24(5):534-536. PMID: 7499742.
7. Ghoma Linguissi LS, Nkenfou CN. Epidemiology of viral hepatitis in the Republic of the Congo: review. BMC Research Notes. 2017;10:665. doi:10.1186/s13104-017-2951-8.
8. Mudji J, Madinga B, Horsmans Y. Seroprevalence of viral hepatitis B and C and knowledge of hepatitis B virus among pregnant women attending prenatal care in the Democratic Republic of the Congo. American Journal of Tropical Medicine and Hygiene. 2021;104(3):1096-1100. doi:10.4269/ajtmh.20-0804.
9. Funk AL, Lu Y, Yoshida K, Zhao T, Boucheron P, van Holten J, et al. Efficacy and safety of antiviral prophylaxis during pregnancy to prevent mother-to-child transmission of hepatitis B virus: a systematic review and meta-analysis. Lancet Infect Dis. 2021;21(1):70-84. doi:10.1016/S1473-3099(20)30586-7.
10. Keane E, Funk AL, Shimakawa Y. Systematic review with meta-analysis: the risk of mother-to-child transmission of hepatitis B virus infection in sub-Saharan Africa. Alimentary Pharmacology & Therapeutics. 2016;44(10):1005-1017. doi:10.1111/apt.13795.
11. Angounda BM, Bokilo Dzia A, Boumba LMA, et al. Prevalence of serologic markers and risk factors for hepatitis B virus among pregnant women in Brazzaville, Congo. International Journal of Science and Research. 2016;5(1):1907-1912.
12. McNaughton AL, Lourenço J, Bester PA, et al. Hepatitis B virus seroepidemiology data for Africa: modelling intervention strategies based on a systematic review and meta-analysis. PLoS Medicine. 2020;17(4):e1003068. doi:10.1371/journal.pmed.1003068.
13. Quintas AE, Cuboia N, Cordeiro L, et al. Seroprevalence of hepatitis B virus surface antigen among African blood donors: a systematic review and meta-analysis. Frontiers in Public Health. 2024;12:1434816. doi:10.3389/fpubh.2024.1434816.
14. Ngami RS, Ahoui Apendi Mikolélé PCA, et al. Midwives' knowledge and practice in preventing mother-to-child transmission of hepatitis B virus in Brazzaville (Congo). Open Journal of Gastroenterology. 2023;13:439-446. doi:10.4236/ojgas.2023.1312042.
15. Massengo BRN, Ontsira Ngoyi EN, Mieret T, et al. Risk factors for hepatitis B virus infection among postpartum women in Brazzaville, Republic of the Congo. Health Sciences and Disease. 2023;24(2):26-30. doi:10.5281/hsd.v24i2.4220.
16. Angounda BM, Ngouloubi GH, Dzia AB, et al. Molecular characterization of hepatitis B virus among chronic hepatitis B patients from Pointe-Noire, Republic of the Congo. Infectious Agents and Cancer. 2016;11:51. doi:10.1186/s13027-016-0088-3.
17. Makuwa M, Caron M, Souquière S, et al. Prevalence and genetic diversity of hepatitis B and delta viruses in pregnant women in Gabon: molecular evidence that hepatitis delta virus clade 8 originates from and is endemic in Central Africa. Journal of Clinical Microbiology. 2008;46(2):754-756. doi:10.1128/JCM.02142-07.
18. Cassidy A, Mossman S, Olivieri A, et al. Hepatitis B vaccine effectiveness in the face of global HBV genotype

diversity. Expert Review of Vaccines. 2011;10(12):1709-1715. doi:10.1586/erv.11.151.
19. Bassoum O, Kimura M, Tal Dia A, et al. Coverage and timeliness of birth dose vaccination in sub-Saharan Africa: a systematic review and meta-analysis. Vaccines. 2020;8(2):301. doi:10.3390/vaccines8020301.
20. Terrault NA, Lok ASF, McMahon BJ, et al. Update on prevention, diagnosis, and treatment of chronic hepatitis B: AASLD 2018 hepatitis B guidance. Hepatology. 2018;67(4):1560-1599. doi:10.1002/hep.29800.
21. di Filippo Villa D, Navas MC. Vertical transmission of hepatitis B virus: an update. Microorganisms. 2023;11(5):1140. doi:10.3390/microorganisms11051140.
22. Gentile I, Borgia G. Vertical transmission of hepatitis B virus: challenges and solutions. International Journal of Women's Health. 2014;6:605-611. doi:10.2147/IJWH.S51138.
23. Liu Y, Wu F. Global burden of aflatoxin-induced hepatocellular carcinoma: a risk assessment. Environmental Health Perspectives. 2010;118(6):818-824. doi:10.1289/ehp.0901388.
24. Tyas AA, Raeni SF, Sakti SP, Sabarudin A. Recent advances of hepatitis B detection towards paper-based analytical devices. Sci World J. 2021;2021:6643573. doi:10.1155/2021/6643573.
25. Abu N, Mohd Bakhori N, Shueb RH. Lateral flow assay for hepatitis B detection: review of current and emerging assays. Micromachines. 2023;14(6):1239. doi:10.3390/mi14061239.