

Factors Associated with Uptake of Hepatitis B Birth Dose Vaccine among Newborns at Mubende Regional Referral Hospital, Mubende District

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Abstract

Background

Hepatitis B virus (HBV) infection remains a global public health challenge, with mother-to-child transmission (MTCT) accounting for the majority of chronic infections in high-endemic settings. The hepatitis B birth dose (HepB-BD) vaccine, administered within 24 hours of birth, is the most effective intervention against MTCT, offering over 95% protection. Despite Uganda's introduction of the HepB-BD into its national immunisation schedule in November 2022, national coverage remains low at 38%, with Mubende District recording only 22%, well below the WHO-recommended target of 90%. This study assessed HepB-BD vaccine uptake among newborns at Mubende Regional Referral Hospital (MRRH), associated factors, and the barriers and facilitators influencing vaccine delivery at the facility.

Methods

A mixed-methods study was conducted at MRRH between March 2024 and February 2025. A structured questionnaire was administered to 294 caretakers of newborns, selected through proportional stratified and systematic random sampling. Four key informant interviews were conducted with healthcare workers, and two focus group discussions were held with 16 caretakers. Quantitative data were analysed using modified Poisson regression in STATA 15 to estimate adjusted prevalence ratios (aPRs). Qualitative data were analysed thematically using ATLAS.ti version 9 and triangulated with quantitative findings.

Results

Of 294 caretakers surveyed, 252 (85.7%) reported that their newborns received general immunisation services at MRRH, of whom 175 (69.4%) had documented HepB-BD vaccination, exceeding national and district averages but below the WHO target. The only independent predictor of uptake in multivariable analysis was caretakers' awareness of vaccine availability: those unaware had an 84% lower probability of vaccination (aPR 0.16, 95% CI: 0.10–0.25, $p < 0.001$). Qualitative findings identified vaccine stockouts, healthcare worker communication gaps, and sociocultural misconceptions as key barriers, while health education and supportive healthcare worker attitudes were facilitators.

Conclusions

HepB-BD vaccine uptake at MRRH, while exceeding district and national averages, remains below the WHO target. Caretaker awareness of vaccine availability is the critical modifiable determinant. Improving health worker communication and ensuring consistent vaccine supply are essential to achieving the 90% coverage target and advancing Uganda's HBV elimination goals.

Background

Hepatitis B virus (HBV) infection remains a leading cause of chronic liver disease, cirrhosis, and hepatocellular carcinoma (HCC) globally, affecting an estimated 296 million people and causing approximately 820,000 deaths annually (1, 2). Despite the availability of a safe and effective vaccine since 1982, 1.5 million new infections occur each year, with the burden concentrated in low- and middle-income countries (LMICs) (1, 3). Mother-to-child transmission (MTCT) is the predominant route of HBV acquisition in high-endemic settings: infants born to hepatitis B e-antigen (HBeAg)-positive mothers face a 70–90% risk of perinatal infection, and 80–90% of those infected at birth will develop chronic HBV disease in adulthood. (4, 5). The hepatitis B birth dose (HepB-BD) vaccine, administered within 24 hours of birth, is the single most effective intervention against MTCT, offering over 95% protection when followed by completion of the routine immunisation series (5). The World Health Organization (WHO) accordingly recommends universal HepB-BD administration for all newborns within 24 hours of birth, with a global coverage target of 90% (5).

Sub-Saharan Africa (SSA) bears a disproportionate share of the global HBV burden, with over 81 million people chronically infected (6) and MTCT accounting for an estimated 350,000 infant infections annually (7). Despite this, only 13 of 48 SSA countries had introduced the HepB-BD into their routine immunisation schedules as of 2021, and regional coverage stood at only 18% in 2022, far below the WHO target (8). Studies across SSA consistently identify a core set of supply-side and demand-side barriers to HepB-BD uptake. On the supply side, cold chain limitations, vaccine stockouts, weak logistics systems, and inadequate health worker training have been documented as critical implementation bottlenecks (8, 9). On the demand side, low maternal awareness of HBV and the birth dose vaccine, poor health worker communication, and sociocultural beliefs opposing vaccination have been identified as key drivers of missed vaccination opportunities (10). Multi-country analyses further demonstrate that HepB-BD uptake is strongly associated with institutional delivery and skilled birth attendance, suggesting that facility-level factors dominate over individual sociodemographic characteristics in determining whether a newborn receives the vaccine (11).

Uganda bears a national chronic HBV prevalence of approximately 4.3% (12), with HBV seroprevalence among pregnant women reaching 11.8% in some districts, underscoring the significant risk of MTCT (13). An estimated 90% of infant HBV infections in Uganda occur through perinatal transmission (14). Uganda introduced the HepB-BD into its Expanded Programme on Immunisation (EPI) in November 2022, supported by national guidelines for hepatitis B prevention, testing, care, and treatment (15, 16). However, national HepB-BD coverage remains critically low at 38% as of 2024 (17). The limited evidence available from Uganda is consistent with broader SSA findings: qualitative studies report that mothers' trust in healthcare providers and paternal involvement are key enablers of uptake, while sociocultural misconceptions, staff attitudes, and persistent stockouts are the most commonly cited barriers (18, 19). Critically, most existing studies from Uganda have focused on community-level coverage or perceptions (18, 19), with very limited facility-level evidence and no published mixed-methods study

examining both the quantitative determinants and qualitative barriers to HepB-BD uptake at a referral hospital level.

Mubende District in central Uganda illustrates this gap clearly. Despite being served by Mubende Regional Referral Hospital (MRRH), one of only 13 regional referral hospitals in Uganda, serving a catchment population of over 521,966 across Mubende, Mityana, Kiboga, and Kyankwanzi districts (20), HepB-BD coverage in the district stands at only 22%, significantly below both the national average of 38% and the WHO target of 90% (17). This is especially concerning given that MRRH has comparatively greater infrastructure, staffing, and cold chain capacity than lower-level facilities in its catchment area. Evidence from comparable facility-level studies in other SSA settings demonstrates that even well-resourced hospitals can record persistently low birth dose coverage when health worker knowledge gaps, communication failures, and operational inefficiencies go unaddressed (9, 11). No published study has examined the specific factors associated with HepB-BD uptake at MRRH or at any facility in Mubende District, leaving health planners and UNEPI without the evidence needed to design targeted, context-specific interventions.

This study therefore aimed to assess the level of HepB-BD vaccine uptake among newborns at MRRH, determine the predisposing, enabling, healthcare system, and external environmental factors associated with uptake using the Andersen Behavioural Model of Health Services Use as a guiding framework (21), and explore the barriers and facilitators influencing vaccine delivery and acceptance at the facility.

Methods

Study design, setting and population

This mixed-methods study combined a quantitative cross-sectional survey with a qualitative inquiry, conducted at Mubende Regional Referral Hospital (MRRH) between March 2024 and February 2025. MRRH is a 175-bed public referral hospital serving four districts, Mubende, Mityana, Kiboga, and Kyankwanzi, in central Uganda, with a catchment population of approximately 521,966 (20). The study population comprised caretakers of infants born at MRRH during the study period, and healthcare workers actively involved in immunization services at the facility. Caretakers of infants with birth defects, contraindications to vaccination, or preterm birth, and healthcare workers who had left MRRH by the time of data collection, were excluded.

Sample size and sampling: The quantitative sample size was estimated using the Kish-Leslie formula, with a prevalence of 22% (district HepB-BD coverage) (22), 95% confidence interval, and 5% margin of error, yielding 264 participants. Adjusting for a 10% non-response rate gave a final sample of 294. A sampling frame was generated from the MRRH delivery register. Proportional stratified sampling was applied using the calendar month as the stratum, with systematic random sampling used within each stratum to select participants. For the qualitative component, sample size was determined by data saturation (23). Four Key Informant Interviews (KIIs) were conducted with purposively selected healthcare workers: a midwife, the immunization unit in-charge, a cold chain technician, and the

Assistant District Health Officer (ADHO) for Maternal and Child Health. Two Focus Group Discussions (FGDs) were conducted with caretakers: one comprising eight (8) female caretakers aged 20–38 years, and a second comprising eight caretakers, male and female, aged 25 years and above. Male caretakers were included in the second group to capture their underrepresented perspectives.

Outcome and study variables: The outcome variable was HepB-BD vaccine uptake, defined as a documented date of vaccine administration on the child's vaccination card, coded as a binary variable (yes/no). Independent variables were categorised into four domains: predisposing characteristics (age, sex, religion, marital status, education level, tribe, and awareness of the HepB-BD vaccine); enabling factors (employment status, household income, primary decision-maker, antenatal care attendance, and transport cost); healthcare system factors (health provider attitude, vaccine availability, facility accessibility, and health worker advice); and external environmental factors (place of residence and social norms).

Data collection

A structured questionnaire was administered face-to-face to caretakers and entered directly into KoboCollect (Version 2022.2.3), with inbuilt validation controls ensuring data completeness. Uptake was cross verified against vaccination cards. KIIs were conducted in English with healthcare workers; FGDs were conducted in Luganda, the dominant local language spoken in Mubende district. All sessions were audio-recorded with participant consent and transcribed verbatim immediately thereafter. Both the data collection tools were developed by the research and pre-tested among 30 caretakers at Kawempe Regional Referral Hospital, Kampala, approximately 10% of the planned sample, and refined for clarity and cultural appropriateness before the main study (24). The final tools have been uploaded as supplementary Material 1 and 2. Two research assistants with health-related degrees were trained for two days on study objectives, sampling, ethical principles, and neutral interviewing techniques. Daily field debriefings were held to monitor data quality.

Data analysis

Quantitative data were cleaned and coded in Microsoft Excel and analysed in STATA version 15. Descriptive statistics were computed for all variables. Since the prevalence of HepB-BD uptake exceeded 10%, modified Poisson regression with robust standard errors was used rather than logistic regression to avoid overestimation of the association measure (25, 26). Bivariable analysis was performed using chi-square tests and unadjusted modified Poisson regression to estimate crude prevalence ratios (PRs) with 95% confidence intervals (CIs). Variables with $p < 0.25$ at bivariable level, or those significant in prior literature, were included in multivariable analysis. Adjusted prevalence ratios (aPRs) with 95% CIs were reported, with statistical significance set at $p < 0.05$. Multicollinearity was assessed using the correlation coefficient; variables with a coefficient > 0.4 were excluded. Model fit was evaluated using the Pearson chi-square goodness-of-fit test.

Qualitative data were analysed using inductive thematic analysis in ATLAS.ti version 9, following Colaizzi's framework (27). Transcripts were coded, compared, and organized into subcategories and overarching themes. Qualitative findings were triangulated with quantitative results to provide a comprehensive understanding of the factors influencing HepB-BD vaccine uptake at MRRH.

Results

Sociodemographic characteristics of participants

A total of 294 caretakers were enrolled, achieving a 100% response rate. The majority were female (93.5%), aged 25–34 years (48.9%), married (86.7%), and of Catholic faith (45.2%). Nearly half had attained primary education as their highest level of schooling (44.6%), and most were self-employed in agriculture (51.4%). Three-quarters of participants (75.2%) reported a monthly household income of less than UGX 150,000. The dominant ethnic groups were Baganda (27.2%) and Batoro (25.9%). Full sociodemographic details are presented in Table 1.

Table 1
Sociodemographic characteristics of caretakers of newborns at Mubende
Regional Referral Hospital (n = 294)

Characteristic	Number of participants (n = 294)	Percentage
Age		
15–19	22	7.5
20–24	76	25.9
25–34	144	48.9
35–44	47	15.9
45–64	5	1.7
Sex		
Male	19	6.5
Female	275	93.5
Religion		
Catholic	133	45.2
Anglican	53	18.0
Pentecostal	65	22.1
Muslim	26	8.8
Others	17	5.8
Marital Status		
Single	14	4.8
Married	255	86.7
Divorced/Separated	23	7.8
Widowed	2	0.7
Education		
No education	25	8.5
Primary	131	44.6
Secondary	115	39.1
Tertiary & above	23	7.8
Tribe		

Characteristic	Number of participants (n = 294)	Percentage
Age		
Baganda	80	27.2
Banyankole	66	22.5
Banyoro	46	15.7
Batoro	76	25.9
Others	26	8.8
Employment		
None	45	15.3
Employed	31	10.5
Self-employed (Agriculture)	151	51.4
Self-employed (Business)	67	22.8
Income level		
Less than 150,000	221	75.2
150,000-499,000	58	19.7
Above 500,000	15	5.1

HepB-BD vaccine uptake

Of the 294 caretakers surveyed, 252 (85.7%) reported that their newborns received general immunisation services at MRRH. Among these, 175 (69.4%) newborns had documented HepB-BD vaccination on their vaccination cards (Table 2).

Table 2
Uptake of general immunization and HepB-BD vaccine among newborns at MRRH (n = 294)

Variable	Frequency	Percentage
General immunization (n = 294)		
No	42	14.3
Yes	252	85.7
Hep-B birth dose uptake (n = 252)		
No	77	30.6
Yes	175	69.4

Reasons for non-receipt of the HepB-BD vaccine

Among the 77 newborns (30.6%) who did not receive the HepB-BD vaccine, the most frequently cited reasons were low birth weight, vaccine unavailability at the time of delivery, and infant health issues. The distribution of reasons for non-vaccination is presented in Fig. 2. More than half of caretakers (62.2%, n = 183) reported that healthcare providers did not clearly explain the importance of the HepB-BD vaccine in an easy-to-understand manner.

Factors associated with HepB-BD vaccine uptake

Bivariable analysis

Bivariable analysis identified several variables significantly associated with HepB-BD vaccine uptake (Table 3). Self-employment in agriculture was associated with significantly lower uptake compared to unemployment (PR 0.78, 95% CI: 0.63–0.96, $p = 0.019$). When healthcare providers were the primary vaccination decision-makers, uptake was significantly lower compared to joint parental decision-making (PR 0.59, 95% CI: 0.37–0.93, $p = 0.022$). Transport costs were inversely associated with uptake across all cost categories compared to no transport cost: less than UGX 5,000 (PR 0.73, 95% CI: 0.65–0.81, $p < 0.001$), UGX 5,000–20,000 (PR 0.66, 95% CI: 0.58–0.75, $p < 0.001$), and above UGX 20,000 (PR 0.62, 95% CI: 0.40–0.95, $p = 0.027$). Caretakers who correctly identified vaccination timing as "at birth within 24 hours" had significantly higher uptake (PR 1.56, 95% CI: 1.32–1.84, $p < 0.001$). Caretakers unaware of vaccine availability at the facility had markedly lower uptake compared to those who knew it was available (PR 0.17, 95% CI: 0.11–0.28, $p < 0.001$). Demographic and socioeconomic variables, including age, sex, religion, marital status, education, tribe, and income, showed no statistically significant association with uptake (all $p > 0.05$).

Table 3

Bivariable analysis of factors associated with HepB-BD vaccine uptake among newborns at MRRH, Mubende District

Characteristic	Hep-B vaccine Uptake		Unadjusted PR (95% CI)	P value
	No n (%)	Yes n (%)		
Age				
15–19	6 (33.3)	12 (66.7)	1	
20–24	22 (31.9)	47 (68.1)	1.02 (0.71–1.47)	0.908
25–34	34 (27.2)	91 (72.8)	1.09 (0.77–1.54)	0.617
35–44	14 (37.8)	23 (62.2)	0.93 (0.62–1.41)	0.740
45–64	1 (33.3)	2 (66.7)	1.0 (0.42–2.38)	1.000
Sex				
Male	3 (25.0)	9 (75.0)	1	
Female	74 (30.8)	166 (69.2)	0.92 (0.66–1.29)	0.639
Religion				
Catholic	37 (31.4)	81 (68.6)	1	
Anglican	9 (20.9)	34 (79.1)	1.15 (0.95–1.40)	0.159
Pentecostal	18 (33.3)	36 (66.7)	0.97 (0.78–1.22)	0.799
Muslim	5 (22.7)	17 (77.3)	1.12 (0.87–1.46)	0.368
Others	8 (53.3)	7 (46.7)	0.68 (0.39–1.19)	0.173
Marital Status				
Single	3 (30.0)	7 (70.0)	1	
Married	70 (31.5)	152 (68.5)	0.98 (0.65–1.48)	0.917
Divorced/Separated	4 (20.0)	16 (80.0)	1.14 (0.72–1.81)	0.571
Education				
No education	5 (23.8)	16 (76.2)	1	
Primary	28 (26.9)	76 (73.1)	0.96 (0.73–1.25)	0.759
Secondary	39 (37.1)	66 (62.9)	0.83 (0.62–1.09)	0.180
Tertiary & above	5 (22.7)	17 (77.3)	1.01 (0.73–1.41)	0.933
Tribe				

Characteristic	Hep-B vaccine Uptake		Unadjusted PR (95% CI)	P value
	No n (%)	Yes n (%)		
Age				
Baganda	24 (34.8)	45 (65.2)	1	
Banyankole	20 (33.3)	40 (66.7)	1.02 (0.79–1.31)	0.863
Banyoro	11 (28.9)	27 (71.1)	1.09 (0.83–1.42)	0.529
Batoro	15 (23.4)	49 (76.6)	1.17 (0.94–1.46)	0.152
Others	7 (33.3)	14 (66.7)	1.02 (0.72–1.45)	0.902
Employment				
None	7 (19.4)	29 (80.6)	1	
Employed	8 (26.7)	22 (73.3)	0.91 (0.69–1.19)	0.494
Self-employed (Agriculture)	46 (37.4)	77 (62.6)	0.78 (0.63–0.96)	0.019
Self-employed (Business)	16 (25.4)	47 (74.6)	0.93 (0.75–1.15)	0.486
Income level				
Less than 150,000	58 (31.7)	125 (68.3)	1	
150,000-499,000	16 (29.6)	38 (70.4)	1.03 (0.84–1.26)	0.770
Above 500,000	3 (20.0)	12 (80.0)	1.17 (0.89–1.54)	0.255
Decision maker				
Both parents	35 (25.2)	104 (74.8)	1	
Father	8 (50.0)	8 (50.0)	0.67 (0.41–1.10)	0.114
Mother	18 (29.5)	43 (70.5)	0.94 (0.78–1.13)	0.537
Healthcare provider	14 (56.0)	11 (44.0)	0.59 (0.37–0.93)	0.022
Other relatives	2 (18.2)	9 (81.8)	1.09 (0.81–1.47)	0.553
Transport Cost to facility				
No cost	0 (0.0)	1 (100.0)	1	
Less than 5000	34 (27.4)	90 (72.6)	0.73 (0.65–0.81)	0.000
5000 to 20000	38 (33.9)	74 (66.1)	0.66 (0.58–0.75)	0.000
Above 20000	5 (38.5)	8 (61.5)	0.62 (0.40–0.95)	0.027
Knowledge of Hep-B timing				

Characteristic	Hep-B vaccine Uptake		Unadjusted PR (95% CI)	P value
	No n (%)	Yes n (%)		
Age				
I don't know	55 (42.6)	74 (57.4)	1	
At 6 months	4 (50.0)	4 (50.0)	0.87 (0.43–1.77)	0.705
Within the first week (7 days)	9 (32.1)	19 (67.9)	1.18 (0.88–1.59)	0.266
At birth (within 24 hours)	9 (10.6)	76 (89.4)	1.56 (1.32–1.84)	0.000
Knowledge of Vaccine availability				
Yes	3 (1.9)	156 (98.1)	1	
No	1 (25.0)	3 (75.0)	0.76 (0.43–1.35)	0.353
I don't know	73 (82.9)	15 (17.1)	0.17 (0.11–0.28)	0.000

Multivariable analysis

After adjusting for potential confounders, only caretakers' awareness of vaccine availability at the facility remained independently and significantly associated with HepB-BD vaccine uptake (Table 4). Caretakers who did not know whether the vaccine was available had significantly lower uptake compared to those who knew it was available (aPR 0.16, 95% CI: 0.10–0.25, $p < 0.001$). Caretakers who stated the vaccine was unavailable did not differ significantly from those aware of its availability (aPR 0.75, 95% CI: 0.44–1.29, $p = 0.299$). All other variables, including marital status, education, employment, income, transport costs, and knowledge of vaccination timing, lost statistical significance after adjustment (all $p > 0.05$). The model demonstrated adequate fit (Pearson chi-square goodness-of-fit $p > 0.05$); AIC = 431.8, BIC = 488.

Table 4

Multivariable analysis of factors associated with HepB-BD vaccine uptake among newborns at MRRH, Mubende District (**AIC-431.8, BIC-488.**)

Characteristic	Hep-B vaccine Uptake		Adjusted PR (95% CI)	P-value
	No n (%)	Yes n (%)		
Marital Status				
Single	3 (30.0)	7 (70.0)	1	
Married	70 (31.5)	152 (68.5)	1.02 (0.91–1.15)	0.673
Divorced/Separated	4 (20.0)	16 (80.0)	0.96 (0.83–1.11)	0.622
Education				
No education	5 (23.8)	16 (76.2)	1	
Primary	28 (26.9)	76 (73.1)	0.85 (0.68–1.06)	0.142
Secondary	39 (37.1)	66 (62.9)	0.82 (0.63–1.06)	0.134
Tertiary & above	5 (22.7)	17 (77.3)	0.82 (0.63–1.07)	0.142
Employment				
None	7 (19.4)	29 (80.6)	1	
Employed	8 (26.7)	22 (73.3)	0.90 (0.75–1.08)	0.260
Self-employed (Agriculture)	46 (37.4)	77 (62.6)	0.95 (0.79–1.12)	0.533
Self-employed (Business)	16 (25.4)	47 (74.6)	0.99 (0.86–1.15)	0.919
Income level				
Less than 150,000	58 (31.7)	125 (68.3)	1	
150,000-499,000	16 (29.6)	38 (70.4)	1.11 (0.93–1.32)	0.235
Above 500,000	3 (20.0)	12 (80.0)	1.12 (0.93–1.36)	0.244
Transport Cost to facility				
No cost	0 (0.0)	1 (100.0)	1	
Less than 5000	34 (27.4)	90 (72.6)	0.91 (0.81–1.03)	0.127
5000 to 20000	38 (33.9)	74 (66.1)	0.93 (0.79–1.09)	0.346
Above 20000	5 (38.5)	8 (61.5)	0.84 (0.70–1.01)	0.064
Knowledge of Hep-B timing				
I don't know	55 (42.6)	74 (57.4)	1	

Characteristic	Hep-B vaccine Uptake		Adjusted PR (95% CI)	P-value
	No n (%)	Yes n (%)		
Marital Status				
At 6 months	4 (50.0)	4 (50.0)	1.00 (0.62–1.60)	0.997
Within the first week (7 days)	9 (32.1)	19 (67.9)	0.88 (0.76–1.02)	0.095
At birth (within 24 hours)	9 (10.6)	76 (89.4)	0.94 (0.86–1.02)	0.156
Knowledge of vaccine availability				
Yes	3 (1.9)	156 (98.1)	1	
No	1 (25.0)	3 (75.0)	0.75 (0.44–1.29)	0.299
I don't know	73 (82.9)	15 (17.1)	0.16 (0.10–0.25)	0.000

Barriers and facilitators to HepB-BD vaccine uptake

The qualitative component comprised four KIIs with healthcare workers and two FGDs with 16 caretakers. Three overarching facilitator themes and three barrier themes were identified through thematic analysis, as summarised in Table 5.

Table 5

Summary of codes, sub-themes and themes from qualitative analysis of barriers and facilitators to HepB-BD vaccine uptake at MRRH

Codes	Sub-themes	Themes
- Health education sessions - Mothers' understanding and trust in health care workers - Community sensitization and IEC materials availability	Health education and vaccine awareness campaigns	Facilitators towards the uptake of HepB birth dose vaccine
- Vaccine supply chain and stock management - Proper Cold chain maintenance and vaccine storage - Continuous medical education	Proper planning for storage and logistics of vaccines	
- Community acceptance of vaccination - Maternal Leadership and Responsibility - Supportive paternal roles	Community and social acceptancy of vaccines	
- Irregular Health education sessions - Communication challenges and health workers attitudes - Inconsistent understanding of IEC materials	Low vaccine awareness and inadequate health education	Barriers towards the uptake of HepB birth dose vaccine
- Vaccine supply chain and stock management - Vaccine stock out - Staffing shortages and workload	Operational and logistical challenges	
- Religious beliefs opposing vaccination - Fear of vaccine side effects and injection pain - Child sickness - Mothers misconceptions and community rumors about vaccines.	Sociocultural and Individual barriers	

Facilitators

Health education and vaccine awareness. Healthcare workers reported conducting daily health education sessions at multiple points of care, including antenatal clinics, labour wards, immunisation units, and outreach activities, covering the importance and timing of HepB-BD vaccination. Mothers confirmed receiving this information and described trusting healthcare providers as a key motivator for vaccination: *"I listen to what they tell us and trust those nurses... the nurse is the one who understands all that in a better way"* (Respondent 1, Female, FGD 1).

Vaccine supply chain management. Healthcare workers described established ordering and stock monitoring procedures through a vaccine control book and requisition schedule, with monthly orders placed to the National Medical Stores (NMS) and proactive follow-up when deliveries were delayed: *"We normally place our orders to the district before they are finished to make sure we don't run out of stock"* (KII 1, Male).

Community and social acceptance of vaccination. Participants reported high levels of community acceptance of childhood immunisation as routine health intervention. Mothers frequently described themselves as the primary agents responsible for ensuring their children were vaccinated, even in the absence of spousal support. Paternal involvement, where present, was described as a facilitator through financial support, transport provision, and accompanying mothers to immunisation services: *"He gave me money for transport and even escorted me to the hospital to make sure the baby is vaccinated"* (Respondent 8, Female, FGD 2).

Barriers

Low vaccine awareness and inadequate health education. Participants reported that health education sessions were inconsistent, depending on staff availability and timing of patient arrival. Some mothers reported receiving no information about the HepB-BD vaccine: *"Some days health workers educate and on other days they don't, so some mothers don't get the information"* (Respondent 4, Female, FGD 2). Poor communication about vaccine availability and inconsistent messaging between staff were reported as sources of confusion among caretakers.

Operational and logistical challenges. Vaccine stockouts, particularly during weekends, public holidays, and night shifts, were identified as a critical barrier. Delayed deliveries from NMS resulted in service interruptions: *"Sometimes they delay to supply us with vaccines from NMS... we end up getting stockouts"* (KII 4, Female). Understaffing in the immunisation unit, with only three staff serving an average of 57 babies per day, was reported to cause long waiting times, early discharges before vaccination could be administered, and missed vaccination opportunities.

Sociocultural and individual barriers. Religious beliefs opposing vaccination were reported in specific community groups, including the Bishaka and New Reformers sects. Fear of vaccine side effects, particularly fever and prolonged crying, led some families to delay or refuse subsequent doses.

Community-level misinformation about vaccine safety was reported as a barrier, particularly when new vaccines were introduced without adequate community sensitisation: *"People lie to others that they want to kill them and reduce the population... so people fear and fail to bring their babies"* (Respondent 1, Female, FGD 1).

Discussion

This study assessed HepB-BD vaccine uptake and its associated factors among newborns at Mubende Regional Referral Hospital, providing the first facility-level evidence on this topic from Mubende District in central Uganda. The 69.4% uptake recorded at MRRH substantially exceeds both the national average of 38% and the Mubende District average of 22% (17), yet remains well below the WHO-recommended target of 90% (5). The single independent predictor of uptake in multivariable analysis was caretakers' awareness of vaccine availability at the facility, while qualitative findings revealed a complex interplay of health system, logistical, and sociocultural determinants (9).

The higher uptake at MRRH compared to district and national averages is consistent with evidence that institutional delivery at higher-level facilities is one of the strongest predictors of timely HepB-BD administration (11). Referral hospitals generally have more reliable cold chain infrastructure, trained immunisation staff, and structured postnatal care protocols than lower-level health centres, creating more favourable conditions for birth dose delivery (9, 28). HepB-BD coverage has been shown to correlate globally with rates of institutional delivery and skilled birth attendance (11), and facility-level capacity has been identified as a critical enabler of birth dose programmes across SSA (9). Male partner involvement further emerged as an important facilitator in this study, with fathers who accompanied mothers to MRRH and provided financial and logistical support contributing to higher vaccination uptake, consistent with evidence that engaging men in maternal and newborn health significantly improves care-seeking behaviour and immunisation outcomes in LMICs (29). Nevertheless, the gap between MRRH's 69.4% and the 90% target underscores that facility-level advantages and social support alone are insufficient without simultaneously addressing the specific operational and knowledge barriers identified in this study (9, 11, 30).

The most significant quantitative finding was that caretakers unaware of vaccine availability had an 84% lower probability of their newborn receiving the HepB-BD vaccine compared to those who were aware (aPR 0.16, 95% CI: 0.10–0.25). This is consistent with evidence from Nigeria, where low maternal awareness of vaccine availability and poor integration of immunisation into newborn care were identified as primary barriers to HepB-BD uptake (10). Multi-country assessments of HepB-BD implementation across five African countries further demonstrate that deficiency in knowledge about vaccine availability among both caretakers and health workers is directly linked to missed vaccination opportunities and persistently low coverage rates (28). Similarly, studies from Senegal confirm that caretaker awareness of HepB-BD is independently associated with timely vaccine receipt, with uninformed mothers significantly less likely to present their newborns for vaccination (31). The qualitative findings help explain the mechanism: irregular health education sessions, inconsistent communication about vaccine availability

between staff and caretakers, and confusion arising from stockouts, where mothers were redirected between units only to find vaccination unavailable, collectively eroded caretakers' awareness and trust (18, 32). Notably, caretakers who reported that the vaccine was unavailable did not differ significantly from those who knew it was available, suggesting that awareness itself, rather than the accuracy of information, may be the more critical determinant of uptake, a pattern observed in other immunisation contexts where the mere perception of unavailability reduces care-seeking behaviour (32).

Contrary to the extensive literature associating maternal education, household income, and socioeconomic status with vaccine uptake in community-based settings (33, 34), this study found no significant associations between these factors and HepB-BD uptake after adjustment. This finding likely reflects the unique context of birth dose vaccination, which occurs in a compressed window, ideally within 24 hours of delivery (5), when mothers are still recovering from childbirth and vaccination is primarily provider-initiated rather than dependent on autonomous health-seeking behaviour (28). In this immediate postpartum hospital setting, maternal and infant care decisions are guided by standardised protocols and provider recommendations rather than individual health literacy levels, thereby overriding the sociodemographic differences that typically drive immunisation disparities in community-based programmes (30). This interpretation is consistent with evidence that health system determinants dominate over individual-level factors in the delivery of maternal and neonatal vaccines in LMICs (30). Similarly, the loss of significance for transport costs after adjustment is consistent with the facility-based context of this study: once families have accessed delivery services at MRRH, transport costs no longer differentially influence the birth dose decision since vaccination occurs at the same facility visit and requires no additional health-seeking effort (11, 33). This contrasts with community-based immunisation settings where transport costs have been shown to significantly impact healthcare utilisation across African settings (35).

The qualitative findings add important depth to these quantitative results. Vaccine stockouts, particularly during weekends, night shifts, and public holidays, emerged as a critical system-level barrier, consistent with evidence that intermittent vaccine availability is a persistent and well-documented driver of missed immunisation opportunities across SSA (32) and in Uganda specifically (18). The intermittent nature of stockouts is especially concerning given that the HepB-BD vaccine must be administered within 24 hours of birth (5), leaving no buffer for supply chain failures. Understaffing in the immunisation unit, with only three staff serving an average of 57 infants per day, created workload pressures that contributed to long waiting times, early maternal discharges before vaccination could be administered and missed opportunities, consistent with evidence from facility-level assessments in African countries where human resource constraints are identified as a key bottleneck in birth dose programme performance (28). Healthcare worker attitudes, while generally supportive, were a barrier in specific instances, with some mothers describing discouraging interactions that undermined their willingness to vaccinate (18, 32). Evidence consistently demonstrates that provider training, communication skills, and motivation are important targets for intervention to improve immunisation coverage in LMICs (36).

Sociocultural barriers, including religious beliefs opposing vaccination among the Bishaka and New Reformers sects, fear of vaccine side effects, and community misinformation about vaccine safety, were present but not dominant drivers of non-vaccination in this study (18, 19). Most caretakers reported high community acceptance of childhood immunisation, and outright refusal was rare. Missed vaccinations were more commonly attributed to infant illness or logistical barriers than to deliberate hesitancy. These findings differ from studies in northern Uganda and other SSA countries where cultural and religious resistance to vaccination has been reported as a more prominent barrier to uptake (37), and are consistent with evidence suggesting that urbanised, facility-served populations are less susceptible to vaccine misinformation than rural communities with weaker health system contact (33).

The finding that low birth weight was among the top reasons cited for non-vaccination merits specific attention. Current WHO guidelines explicitly recommend that the HepB-BD vaccine is safe and effective for low-birth-weight infants weighing less than 2,000 grams and should not be withheld (5). Studies have demonstrated that immune responses to HepB-BD in low-birth-weight infants are comparable to those in full-term infants (38, 39). Healthcare worker hesitancy to vaccinate low birth weight newborns therefore represents a modifiable knowledge gap, and evidence from similar settings demonstrates that targeted in-service training of immunisation staff on contraindication criteria can meaningfully improve uptake of vaccines in neonatal populations (28).

Limitations

This study has several limitations. First, its single-facility design limits generalizability to other facilities in Mubende District or Uganda more broadly; uptake at lower-level health centres, which lack the infrastructure and staffing of MRRH, is likely considerably lower. Second, reliance on caretaker self-report for some variables, including awareness of vaccine availability and health education received, may have introduced information bias, a recognised limitation of cross-sectional survey designs; this was partially mitigated by cross-referencing vaccination status reports with child vaccination cards. Third, as a cross-sectional study, causal relationships between the identified factors and HepB-BD uptake cannot be established; the observed associations reflect correlations measured at a single point in time, and longitudinal or cohort studies would be better suited to confirm causality. Fourth, the retrospective identification of caretakers from delivery registers introduced potential recall bias, though the one-year study window was specifically chosen to minimise this.

Conclusions

This study provides the first facility-level evidence on HepB-BD vaccine uptake and its associated factors from Mubende District, central Uganda. The 69.4% uptake recorded at MRRH, while exceeding both the national average of 38% and the district average of 22%, remains below the WHO-recommended target of 90%, confirming that even well-resourced referral hospitals face significant gaps in birth dose vaccination coverage. Caretaker awareness of vaccine availability at the facility was the single independent predictor of uptake in multivariable analysis, underscoring that information gaps at the

point of care, rather than sociodemographic or socioeconomic factors, are the critical modifiable barrier in this setting. Qualitative findings further revealed that vaccine stockouts, understaffing, inconsistent health education, and sociocultural misconceptions interact to undermine uptake, while structured health education, supportive healthcare worker attitudes, and effective supply chain management serve as important facilitators.

These findings have direct programmatic relevance. Strengthening health worker communication about vaccine availability, ensuring uninterrupted vaccine supply including during weekends, night shifts, and public holidays, and addressing the misperception that low birth weight is a contraindication to HepB-BD vaccination are actionable, facility-level interventions that could meaningfully improve coverage at MRRH. Broader community sensitisation strategies targeting religious groups and addressing vaccine misinformation are warranted at the district level. The findings contribute to Uganda's national evidence base for scaling up HepB-BD coverage toward the 90% WHO target and support the case for prioritising facility-level operational research as a complement to national immunisation surveys in low- and middle-income countries.

Abbreviations

Abbreviation	Full term
aPR	Adjusted prevalence ratio
BIC	Bayesian Information Criterion
CI	Confidence interval
EPI	Expanded Programme on Immunisation
FGD	Focus Group Discussion
HBV	Hepatitis B virus
HepB-BD	Hepatitis B birth dose vaccine
KII	Key Informant Interview
LMICs	Low- and middle-income countries
MRRH	Mubende Regional Referral Hospital
MTCT	Mother-to-child transmission
PR	Prevalence ratio
SSA	Sub-Saharan Africa
UNEPI	Uganda National Expanded Programme on Immunisation
WHO	World Health Organization

Declarations

Human Ethics and Consent to Participate: Ethical approval for this study was obtained from the Makerere University School of Public Health Research and Ethics Committee (MakSPH-REC) - approval number 573. Administrative clearance (reference number: MRRH/ADM/201/1) was granted by the District Health Officer of Mubende District and the officer-in-charge at Mubende Regional Referral Hospital. The study was conducted in accordance with the principles of the Declaration of Helsinki and all relevant national and institutional guidelines for research involving human participants. Informed consent was obtained from all participants prior to any data collection activity. A Luganda version (Luganda is the most dominant spoken language in the study area) of the consent form was used for participants who didn't understand English. Although some caretaker participants were below 18 years old, all had delivered a newborn at MRRH and were therefore considered emancipated minors under the Uganda National Council for Science and Technology (UNCST) guidelines for research involving human participants, which recognise individuals who have given birth as competent to provide independent informed consent regardless of age. For participants who were unable to read, the consent form was read aloud in their preferred language by a research assistant in the presence of an impartial witness, who confirmed the participant's comprehension and willingness to participate before obtaining a thumbprint in place of a signature for the participant and a signature for the witness. No personal identifiers were recorded in any data collection instrument.

Consent for publication:

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

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This study received no external funding.

Author Contribution

RA conceptualized the study, conducted data collection and analysis, generated the tables and figures, interpreted the findings, and led the writing of the manuscript. VN and AS supervised the study, provided methodological guidance, reviewed the data analysis, and critically reviewed the manuscript. SK contributed to the interpretation of the findings and drafting of the manuscript. All authors read and approved the final manuscript.

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Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

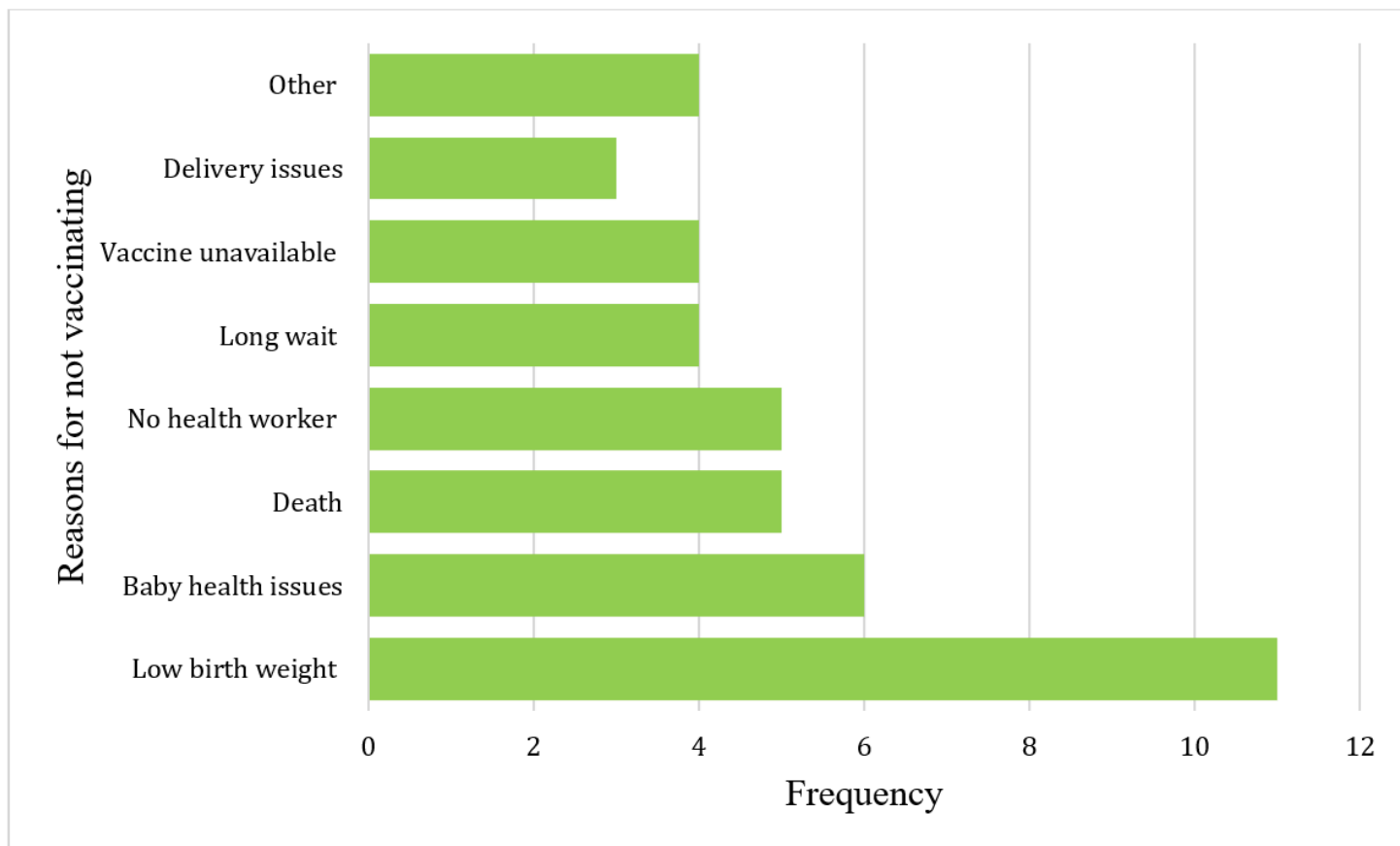


Figure 1

2. Reasons for non-receipt of the HepB-BD vaccine among newborns at MRRH.

Supplementary Files

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- [QuantitativeStudyQuestionnaire.docx](#)