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Maternal Knowledge of the Preventive Measures for Haemolytic Disease of the Newborn in St. Mary's Hospital, Umuowa, Orlu, Imo State, Nigeria

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Abstract-
Background: Haemolytic Disease of the Newborn (HDN) is a preventable immune-mediated condition causing significant neonatal morbidity and mortality, particularly in low-resource settings where awareness and access to preventive measures remain limited.

Objective: This study assessed maternal knowledge of HDN and its preventive measures, and identified barriers to effective prevention among mothers attending St. Mary's Hospital, Umuowa, Orlu, Imo State, Nigeria.

Methods: A descriptive cross-sectional study employing a census approach was conducted among 83 mothers attending the child welfare clinic. Data were collected using a structured, validated questionnaire with four sections: socio-demographics, knowledge of HDN (15 items), knowledge of preventive measures (16 items), and barriers to prevention (16 items). Reliability was established with Cronbach's alpha of 0.777. Data were analyzed using descriptive statistics (frequencies, percentages, means) and presented in tables.

Results: The majority of respondents (79.5%) demonstrated poor knowledge of both HDN (mean=1.92±0.93) and its preventive measures (mean=1.98±0.94). Only 45.8% knew their blood group and Rhesus factor, while 28.9% knew neither. Critical knowledge gaps existed regarding post-miscarriage sensitization risk (mean=1.76) and Anti-D prophylaxis indications (means ranging 1.69-1.77). Barriers assessment revealed moderate-to-high obstacles (mean=2.86±0.98), with 49.4% reporting high barriers. Top barriers included: never receiving information from health workers (mean=3.29), unawareness that Rh-negative mothers need special care (mean=3.25), unavailability of Anti-D (mean=3.19), poor provider explanation (mean=3.18), stock-outs of Rh typing kits (mean=3.13), and inadequate provider training (mean=3.08). Cultural barriers ranked lowest.

Conclusion: Profound knowledge deficits and systemic barriers perpetuate HDN prevention failure in this rural Nigerian community. Despite high antenatal attendance, essential screening and education are not routinely delivered. Urgent health system strengthening including provider training, commodity security, and structured patient education is required to prevent this avoidable disease.

Index Terms- Haemolytic Disease of the Newborn, Rh incompatibility, maternal knowledge, preventive measures, Anti-D immunoglobulin, Nigeria, barriers to care

I. INTRODUCTION

Background of the Study

Haemolytic Disease of the Newborn (HDN), also known as erythroblastosis fetalis, is a serious immune-mediated condition that occurs when maternal antibodies attack fetal red blood cells, leading to haemolysis, anaemia, jaundice, and in severe cases, fetal death (Okonkwo et al., 2021). HDN is most commonly caused by Rh(D) incompatibility, though other blood group antigens such as ABO and Kell can also be implicated. In Nigeria, where maternal and neonatal healthcare challenges persist, HDN remains a significant yet often under-prioritised cause of neonatal morbidity and mortality (Ezeaka et al., 2020).

Globally, the introduction of anti-D immunoglobulin (RhIg) prophylaxis has dramatically reduced the incidence of Rh-related HDN in high-income countries. However, in low-resource settings like Nigeria, awareness, accessibility, and utilization of preventive measures remain low (Adebami and Owa,

2021). Studies indicate that many Nigerian women of reproductive age lack adequate knowledge about blood group compatibility, sensitization risks, and available preventive interventions such as routine antenatal Rh screening and postpartum anti-D administration (Alabi et al., 2022).

Pegoraro et al. (2020) documented that following regulatory approval in 1968 of IgG anti-Rh(D) immunoprophylaxis to prevent maternal sensitization, the prospect of eradicating Rh disease was at hand. The combination of antenatal and post-partum immunoprophylaxis is approximately 99% effective at preventing maternal sensitization to Rh(D). However, their epidemiological investigation estimated that approximately 50% of women around the world who require this type of immunoprophylaxis do not receive it, presumably due to a lack of awareness, availability, and/or affordability, thereby putting hundreds of thousands of fetuses and neonates at risk for Rh disease each year.

Imo State, like many regions in Nigeria, faces gaps in maternal health education and preventive service coverage. Umuowa, a community in Orlu Local Government Area, is predominantly rural with limited access to specialised maternal health services. Preliminary observations suggest that many mothers are unaware of their blood group, the implications of Rh negativity, and the preventive strategies for HDN (Nwosu et al., 2023).

Statement of the Problem

Haemolytic Disease of the Newborn is a preventable condition that continues to contribute to neonatal illness and death in Nigeria, particularly in communities with limited health literacy and access to preventive care. Despite the availability of cost-effective interventions such as Rh typing and anti-D immunoglobulin prophylaxis, many Nigerian women remain unaware of these measures, leading to underutilization and avoidable neonatal complications (Ezeaka et al., 2020).

In Umuowa Orlu, Imo State, antenatal care attendance is often fragmented, and health education on blood group compatibility and HDN prevention is not routinely emphasized. Many mothers report not knowing their blood group or understanding the significance of Rh status in pregnancy. This knowledge gap is compounded by cultural beliefs, low educational attainment, and limited access to quality maternity services.

Without adequate knowledge, mothers are unable to advocate for necessary screenings or interventions during pregnancy and after delivery. This results in missed opportunities for prevention, leading to cases of severe neonatal jaundice, exchange transfusions, and long-term neurological sequelae. There is a poor empirical data on the level of knowledge and awareness of HDN prevention among mothers in rural communities like Umuowa.

Objectives of the Study

The main objective of this study was to assess the knowledge of mothers in St. Mary's Hospital, Umuowa, Orlu, Imo State, on the preventive measures for Haemolytic Disease of the Newborn.

The specific objectives were:

1. To assess the knowledge of mothers about HDN at St. Mary's Hospital, Umuowa, Orlu.
2. To assess the knowledge of the preventive measures of mothers at St. Mary's Hospital, Umuowa, Orlu.
3. To identify the barriers that hinder the effective prevention of HDN in St. Mary's Hospital, Umuowa, Orlu.

Research Questions

The study was guided by the following research questions:

1. What is the level of knowledge among mothers about HDN at St. Mary's Hospital, Umuowa Orlu?
2. What is the knowledge of the preventive measures on HDN among mothers at St. Mary Hospital, Umuowa, Orlu?
3. What are the barriers that hinder the effective prevention of Haemolytic Disease of the Newborn at St. Mary Hospital, Umuowa, Orlu?

II. LITERATURE REVIEW

Conceptual Review

Haemolytic Disease of the Newborn (HDN), also known as Haemolytic Disease of the Fetus and Newborn (HDFN) or erythroblastosis fetalis, is a serious alloimmune disorder that occurs when maternal IgG antibodies cross the placenta and attack specific antigens on fetal red blood cells, leading to their destruction (Nassar and Wehbe, 2022). This immune-mediated hemolysis can result in fetal anemia, reticulocytosis, and in severe cases, life-threatening complications such as hydrops fetalis a condition characterized by heart failure and fetal edema or even intrauterine death (Malik et al., 2025).

HDN is classified based on the target antigen. While several blood group systems can be involved including ABO, Kell, and other Rh antigens (c, E, C) anti-RhD (Rh disease) remains the most common and clinically significant cause, followed by anti-RhE and anti-Rhc (Koelewijn et al., 2025; De Oliveira Rodrigues et al., 2024). Globally, Rh(D) sensitization affects approximately 1 in 1,000 pregnancies, whereas non-D antibodies capable of causing HDN are found in about 1 in 500 pregnancies, though these generally pose a lower risk of severe disease (Koelewijn et al., 2025).

Maternal sensitization to fetal red cell antigens, which initiates HDFN, can occur due to a previous incompatible blood transfusion or from fetomaternal hemorrhage (FMH) during a current or past pregnancy (De Winter et al., 2023). Crucially, only maternal IgG antibodies can cross the placenta and bind to corresponding antigens on fetal red blood cells, marking them for destruction primarily in the fetal spleen and leading to progressive anemia (De Oliveira Rodrigues et al., 2024).

The clinical presentation can be subtle prenatally, with reduced fetal movements or sudden intrauterine death being possible indicators. Postnatally, early and severe jaundice is a key sign (Júnior et al., 2024). This underscores the vital importance of antenatal screening programs. Timely detection of maternal antibodies allows for close monitoring, enabling interventions such as intrauterine transfusions (IUT) to treat severe fetal anemia and prevent hydrops, and prompt postnatal treatment with phototherapy or exchange transfusion to prevent kernicterus.

The cornerstone of HDFN prevention is antenatal screening. Universal first-trimester blood group (ABO/RhD) typing and antibody screening, with repeat testing later in pregnancy, are essential to identify at-risk pregnancies (Júnior et al., 2024; De Oliveira Rodrigues et al., 2024). The combined use of antenatal and postnatal anti-D immunoglobulin (RhIg) is approximately 99% effective in preventing Rh(D) sensitization (Pegoraro et al., 2020).

Despite being largely preventable, HDFN continues to cause significant global morbidity and mortality, with an estimated 160,000 preventable perinatal deaths and 100,000 disability cases annually, primarily in low- and middle-income countries (Van 't Oever et al., 2022; Zipursky et al., 2018).

Theoretical Framework

This study was guided by the integration of several behavioral and systems-level models. At the individual level, the Health Belief Model (HBM) explains how a mother's perception of threat comprising her perceived susceptibility to Rh incompatibility and perceived severity of HDN outcomes interacts with her perceived benefits of and barriers to preventive actions to shape her health-seeking intentions (Jones et al., 2021).

Furthermore, the Knowledge-Attitude-Practice (KAP) Model provides a direct sequential framework, positing that accurate knowledge about HDN is a prerequisite for forming positive attitudes, which in turn are necessary for adopting preventive practices (Launiala, 2022). Assessing maternal knowledge, therefore, represents the critical first step in a chain that should lead to behavioral change.

The Socio-Ecological Model recognizes that health behaviors are influenced by multiple levels of factors including individual, interpersonal, organizational, community, and policy levels. This framework is essential for understanding the multi-level barriers to HDN prevention in resource-constrained settings.

Empirical Review

Agim et al. (2024) conducted a study to evaluate baseline knowledge of HDN and its prevention among mothers in rural health facilities in Imo State, Nigeria. Using a cross-sectional survey design with 300 postpartum mothers from three primary healthcare centers in Orlu LGA, they found that only 26.7% of mothers had heard of HDN. Knowledge of preventive measures was poor: 18% knew about anti-D immunoglobulin, and 12% understood the importance of Rh typing in pregnancy. Higher knowledge scores were significantly associated with higher education ($p=0.003$) and prior antenatal counseling ($p=0.01$).

Eze and Onyishi (2026) investigated the impact of a short educational intervention on maternal knowledge of HDN prevention in a rural Nigerian community using a pre-test/post-test quasi-experimental design with 200 mothers. Mean knowledge scores increased significantly from 3.2 ± 1.8 (pre-test) to 7.9 ± 2.1 (post-test) ($p<0.001$). Retention after two weeks remained high at a mean score of 6.8 ± 2.0. The greatest improvement was in knowledge of postnatal anti-D administration.

Akpan and Udo (2023) explored barriers to effective HDN prevention from the dual perspectives of mothers and healthcare providers in Cross River State using a qualitative phenomenological design. They identified health system barriers (inconsistent supply of anti-D, lack of Rh testing kits, inadequate staffing), financial barriers (high out-of-pocket costs), and knowledge and attitudinal barriers (low risk perception, provider complacency).

Mohammed et al. (2025) systematically identified and prioritized barriers to Rh prophylaxis in Kano State using a sequential explanatory mixed-methods design. The top three ranked barriers were drug stock-outs (78%), lack of patient education materials (65%), and insufficient training on updated guidelines (60%). Qualitative findings revealed that weak monitoring and evaluation systems and fragmented procurement processes underpinned the supply chain issues.

Giwa and Oni (2026) applied a barrier analysis framework to understand determinants of anti-D prophylaxis adherence among healthcare providers in Southwestern Nigeria. The most significant barriers reported were ambiguity in clinical guidelines (72%), fear of adverse drug reactions (58%), and high workload limiting patient counseling time (55%). Clinical audits showed that only 40% of eligible cases had correct prophylaxis documented.

III. METHODOLOGY

Study Design

A descriptive cross-sectional survey design was adopted for this study. This design was utilized to ensure the collection of accurate data at a single point in time without manipulation of variables, enabling a comprehensive analysis of maternal knowledge and barriers concerning HDN prevention.

Study Setting

The study was conducted at St. Mary's Hospital, Umuowa, located within Orlu Local Government Area (LGA) of Imo State, Nigeria. Orlu LGA is situated in the southeastern part of Nigeria, a region characterized by predominantly rural communities, subsistence farming, and significant constraints in healthcare infrastructure. St. Mary's Hospital serves as a critical faith-based, secondary-level health facility for Umuowa and its neighboring villages, providing services including antenatal care, delivery services, postnatal care, immunization, and child welfare clinics.

Target Population

The target population comprised mothers receiving maternal and child health services at St. Mary's Hospital, Umuowa. Specifically, the study focused on mothers attending the child welfare clinic who had delivered at least one child. According to the hospital's immunization records (2026), 83 mothers were expected to attend this clinic during January 2026, forming the accessible population frame.

Inclusion criteria: Mothers who had delivered at least one child (live or stillbirth), aged between 20 and 49 years, attending the child welfare clinic during the data collection period, and providing informed consent.

Sample Size and Sampling Technique

Given the well-defined and finite nature of the target population ($N=83$), a census sampling approach was employed. When a population is small, accessible,

and clearly bounded, surveying all members (a census) is methodologically preferred as it eliminates sampling error and provides a complete dataset for the group under investigation (Taherdoost, 2016). All eligible mothers who met the inclusion criteria and provided consent during the data collection window were invited to participate.

Instrument for Data Collection

The primary instrument was a structured, self-administered questionnaire developed by the researcher based on a comprehensive review of literature and aligned with the study's specific objectives. The questionnaire utilized a closed-ended format with four sections:

Section A: Demographic characteristics (11 items) including age, marital status, educational level, occupation, religion, parity, history of miscarriage/stillbirth, antenatal care visits, and knowledge of blood group/Rh status.

Section B: Knowledge of Haemolytic Disease of the Newborn (15 items) assessing awareness, causes, risk factors, and clinical manifestations using a 4-point Likert scale (Strongly Agree=4, Agree=3, Disagree=2, Strongly Disagree=1).

Section C: Knowledge of preventive measures for HDN (16 items) covering Rh typing, Anti-D immunoglobulin indications and timing, and screening protocols using the same 4-point Likert scale.

Section D: Barriers to effective HDN prevention (16 items) exploring knowledge, financial, health system, cultural, and social obstacles using a 4-point Likert scale where higher scores indicated greater barriers.

Validity and Reliability of the Instrument

Face validity was established by reviewing the questionnaire with a small group of individuals representative of the target population to confirm item relevance and clarity. Content validity was determined through formal review by a panel of three experts in maternal and child health, midwifery, and research methodology who evaluated the instrument for clarity, relevance, comprehensiveness, and alignment with study objectives.

Reliability was established through a pilot test administered to 8 respondents (approximately 10% of the intended sample) at Christiana Specialist Hospital in Owerri, a location serving a similar demographic but ensuring pilot participants were not part of the final study sample. Data from the pilot test were analyzed using Cronbach's Alpha coefficient, which yielded 0.777, indicating acceptable internal consistency reliability.

Method of Data Collection

Data collection commenced after obtaining ethical clearance from the Institutional Review Board of Merit College of Nursing Sciences and administrative permission from the management of St. Mary's Hospital. A trained research assistant, a qualified RN/RM, was engaged and briefed on the study's objectives, questionnaire structure, informed consent procedure, and the importance of maintaining neutrality and confidentiality.

Data were collected on the hospital's designated child welfare clinic days. The researcher and assistant approached all mothers attending the clinic, screened them against inclusion criteria, and provided a detailed explanation of the study. Informed consent was obtained from each eligible and willing participant. For participants with limited literacy, the consent form and questionnaire items were read aloud in the local language (Igbo), and verbal consent was documented. Completed questionnaires were checked on-site for completeness before secure storage.

Method of Data Analysis

Data were entered, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize demographic characteristics and key study variables. Tables were generated to illustrate the distribution of responses related to knowledge levels and perceived barriers.

For knowledge assessment (Sections B and C), scores were interpreted as: Good Knowledge (70% and above), Fair Knowledge (50%-69%), and Poor Knowledge (below 50%). For barriers assessment (Section D), scores were interpreted as: High Barriers

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(70% and above), Moderate Barriers (50%-69%), and Low Barriers (below 50%).

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Merit College of Nursing Sciences. Written administrative permission was obtained from the management of St. Mary's Hospital. Informed consent was obtained from every participant after explaining the purpose, procedures, potential benefits, and risks of the study in a language understandable to the participant. Participants were assured of voluntary participation, the right to withdraw at any time without penalty, and that refusal would not affect the quality of care received. Strict measures were taken to ensure confidentiality and anonymity. No personally identifiable information was collected on the questionnaires. Data were assigned unique codes and stored securely, accessible only to the principal researcher. Findings are reported in aggregate form.

IV. RESULTS

Section A: Socio-Demographic Characteristics of Respondents

A total of 95 questionnaires were administered, and 83 were properly completed and retrieved, yielding a response rate of 87.4%.

Table 1: Socio-Demographic Characteristics of Respondents (N=83)

Demographic Characteristic	Category	Frequency (n=83)	Percentage (%)
Age (in years)	20-25 years	18	21.7
	26-30 years	24	28.9
	31-35 years	22	26.5
	36-40 years	12	14.5
	41-45 years	5	6.0
	46-49 years	2	2.4
Marital Status	Single	6	7.2
	Married	73	88.0
	Divorced/Separated	2	2.4
	Widowed	2	2.4
Highest Educational Level	No formal education	8	9.6
	Primary education	19	22.9
	Secondary education	31	37.4
	Tertiary (OND/NCE)	15	18.1
	University (BSc/HND+)	10	12.0
Occupation	Unemployed/Housewife	24	28.9
	Farmer	11	13.3
	Trader/Business	26	31.3
	Civil servant	8	9.6
	Artisan	9	10.8
	Professional	5	6.0
Religion	Christianity	79	95.2
	Islam	2	2.4
	Traditionalist	2	2.4
Number of Pregnancies	1 (Primigravida)	15	18.1
	2-4 (Multigravida)	48	57.8
	5+ (Grand multigravida)	20	24.1
Number of Live Children	1 child	19	22.9
	2-4 children	45	54.2
	5+ children	19	22.9

History of Miscarriage/Stillbirth	Yes	27	32.5
	No	56	67.5
Antenatal Care Visits (Last Pregnancy)	None	4	4.8
	1-3 visits	18	21.7
	4-6 visits	41	49.4
	7+ visits	20	24.1
Knowledge of Blood Group and Rh	Yes, both known	38	45.8
	Blood group only	14	16.9
	Rh factor only	7	8.4
	Neither known	24	28.9

The majority of respondents (56.6%) were within the active reproductive age range of 26-35 years. Most were married (88.0%) and had secondary education (37.4%). Trading/business (31.3%) and unemployment/housewife (28.9%) were the most common occupations. A significant finding was that 32.5% reported a history of miscarriage or stillbirth. Antenatal care attendance was suboptimal, with only 24.1% achieving the WHO-recommended 7 or more visits. Most concerning, only 45.8% knew both their blood group and Rhesus factor, while 28.9% knew neither.

Section B: Knowledge of Haemolytic Disease of the Newborn

Table 2: Knowledge of Haemolytic Disease of the Newborn (N=83)

S/N	Statement	Mean Score (M)	Standard Deviation	Knowledge Level
B1	Heard about HDN before today	1.81	0.92	Poor
B2	HDN affects only the baby	2.02	0.98	Poor
B3	HDN caused by blood incompatibility	1.90	0.94	Poor
B4	Rh incompatibility is most common cause	1.80	0.88	Poor
B5	Rh-negative mother + Rh-positive father = Rh-positive baby possible	1.98	0.96	Poor
B6	Mother's blood attacks baby's blood cells	1.86	0.91	Poor
B7	Mother can become sensitized after birth	1.83	0.87	Poor
B8	Miscarriage/abortion can lead to antibodies	1.76	0.83	Poor
B9	Incompatible transfusion can cause sensitization	1.87	0.92	Poor
B10	Baby with HDN develops severe jaundice	2.10	1.01	Poor
B11	Paleness is a sign of HDN	2.00	0.95	Poor
B12	Swelling of baby's body can occur	1.94	0.92	Poor
B13	Untreated HDN can cause brain damage	2.04	0.99	Poor
B14	HDN can cause permanent hearing loss	1.83	0.87	Poor
B15	Untreated severe HDN can cause death	2.13	1.03	Poor
Section B Total		1.92	0.93	Poor

Table 3: Summary of Knowledge Levels for Section B (N=83)

Knowledge Level	Frequency (n=83)	Percentage (%)
Good Knowledge (70% and above)	5	6.0
Fair Knowledge (50% - 69%)	12	14.5
Poor Knowledge (Below 50%)	66	79.5

Total	83	100%

The findings reveal profoundly low knowledge about HDN, with an overall mean score of 1.92 (on a 4-point scale). An alarming 79.5% of respondents demonstrated poor knowledge. The lowest mean scores were observed for B8 (miscarriage leading to antibodies, M=1.76) and B4 (Rh incompatibility as most common cause, M=1.80), representing critical knowledge gaps directly related to prevention.

Section C: Knowledge of Preventive Measures for HDN

Table 4: Knowledge of Preventive Measures for HDN (N=83)

S/N	Statement	Mean Score (M)	Standard Deviation	Knowledge Level
C1	Important to know Rhesus factor status	2.52	1.08	Fair
C2	Blood group/Rh should be checked early	2.36	1.06	Poor
C3	There is an injection to prevent HDN	2.02	0.98	Poor
C4	Injection name is Anti-D immunoglobulin	1.76	0.84	Poor
C5	Anti-D should be given during pregnancy	1.72	0.80	Poor
C6	Anti-D should be given within 72 hours postpartum	1.77	0.86	Poor
C7	Anti-D should be given after miscarriage	1.69	0.78	Poor
C8	Anti-D needed for each at-risk pregnancy	1.82	0.89	Poor
C9	Routine Rh testing helps prevent HDN	2.43	1.06	Poor
C10	Antibody testing during pregnancy is important	1.98	0.94	Poor
C11	Ultrasound monitoring helps manage risk	2.02	0.98	Poor
C12	Immediate jaundice treatment is prevention	2.23	1.04	Poor
C13	HDN can occur in first pregnancy (rare)	1.87	0.90	Poor
C14	Once sensitized, Anti-D cannot prevent HDN	1.71	0.80	Poor
C15	Rh-positive babies need special observation	2.07	1.00	Poor
C16	Rh-positive mother can develop ABO HDN	1.81	0.86	Poor
Section C Total		1.98	0.94	Poor

Table 5: Summary of Knowledge Levels for Section C (N=83)

Knowledge Level	Frequency (n=83)	Percentage (%)
Good Knowledge (70% and above)	3	3.6
Fair Knowledge (50% - 69%)	14	16.9
Poor Knowledge (Below 50%)	66	79.5
Total	83	100%

Knowledge of preventive measures was equally concerning, with an overall mean score of 1.98 and 79.5% demonstrating poor knowledge. The highest score was for C1 (importance of knowing Rh status, M=2.52, fair), suggesting general awareness without specific knowledge. The lowest scores were for C7 (post-miscarriage prophylaxis, M=1.69), C5 (antenatal timing, M=1.72), and C4 (Anti-D name,

M=1.76), indicating profound gaps in actionable prevention knowledge.

Section D: Barriers to Effective Prevention of HDN

Table 6: Barriers to Effective Prevention of HDN (N=83)

S/N	Statement	Mean Score (M)	Standard Deviation	Barrier Level
D1	Never received information from health workers	3.29	0.87	High
D2	Cost of blood typing too high	2.83	1.02	Moderate
D3	Cannot afford Anti-D injection	2.98	0.95	Moderate
D4	Hospital runs out of Rh typing kits	3.13	0.93	High
D5	Hospital lacks Anti-D when needed	3.19	0.92	High
D6	Travel distance to facility	2.61	1.05	Moderate
D7	Health workers don't explain Rh importance	3.18	0.90	High
D8	Long waiting time at clinic	2.87	1.02	Moderate
D9	Fear of injections/side effects	2.39	1.05	Low
D10	Husband doesn't support spending on tests	2.70	1.04	Moderate
D11	Family doesn't see need for blood tests	2.54	1.05	Moderate
D12	Belief in spiritual causes	1.96	0.99	Low
D13	Preference for traditional birth attendants	1.90	0.95	Low
D14	Didn't know Rh-negative need special care	3.25	0.89	High
D15	Started antenatal care late	2.99	0.96	Moderate
D16	Health workers lack HDN training	3.08	0.94	High
Section D Total		2.86	0.98	Moderate-High

Table 7: Summary of Barrier Levels for Section D (N=83)

Barrier Level	Frequency (n=83)	Percentage (%)
High Barriers (70% and above)	41	49.4
Moderate Barriers (50% - 69%)	32	38.6
Low Barriers (Below 50%)	10	12.0
Total	83	100%

Table 8: Rank Order of Barriers by Mean Score

Rank	Barrier Statement	Mean (M)	Barrier Level	Category
1st	D1: Never received information from health workers	3.29	High	Information/Education
2nd	D14: Didn't know Rh-negative need special care	3.25	High	Knowledge/Awareness
3rd	D5: Hospital lacks Anti-D when needed	3.19	High	Health System/Supply
4th	D7: Health workers don't explain Rh importance	3.18	High	Provider-Patient Communication
5th	D4: Hospital runs out of Rh typing kits	3.13	High	Health System/Supply
6th	D16: Health workers lack HDN training	3.08	High	Health System/Training
7th	D15: Started antenatal care late	2.99	Moderate	Individual/Behavioral

8th	D3: Cannot afford Anti-D	2.98	Moderate	Financial
9th	D8: Long waiting time	2.87	Moderate	Health System/Access
10th	D2: Cost of blood typing too high	2.83	Moderate	Financial
11th	D10: Husband lacks support	2.70	Moderate	Social/Family
12th	D6: Travel distance	2.61	Moderate	Geographic Access
13th	D11: Family doesn't see need	2.54	Moderate	Social/Family
14th	D9: Fear of injections	2.39	Low	Individual/Psychological
15th	D12: Belief in spiritual causes	1.96	Low	Cultural/Belief
16th	D13: Preference for traditional birth attendants	1.90	Low	Cultural/Practice

The barriers assessment revealed moderate-to-high obstacles (overall mean=2.86), with 49.4% reporting high barriers. The top six barriers were all health system-related: lack of information from providers (M=3.29), unawareness of Rh-negative care needs (M=3.25), Anti-D unavailability (M=3.19), poor provider explanation (M=3.18), stock-outs of Rh typing kits (M=3.13), and inadequate provider training (M=3.08). Notably, cultural barriers ranked lowest (D12 M=1.96, D13 M=1.90), indicating mothers are not resistant to biomedical approaches.

Table 9: Summary of Overall Findings (N=83)

Section	Mean Score (M)	Standard Deviation	Level	Percentage with Poor Knowledge/ High Barriers
Section B: Knowledge of HDN	1.92	0.93	Poor	79.5%
Section C: Knowledge of Preventive Measures	1.98	0.94	Poor	79.5%
Section D: Barriers to Prevention	2.86	0.98	Moderate-High	49.4% (High Barriers)

V. DISCUSSION

Discussion of Socio-Demographic Findings

The socio-demographic characteristics reveal important contextual factors for understanding knowledge levels about HDN prevention. The majority of respondents (56.6%) were within the active reproductive age range of 26-35 years, consistent with the typical childbearing population in Nigeria. Educational attainment was varied, with 37.4% having secondary education, 22.9% primary education, and 9.6% no formal education, highlighting the need for health education approaches accessible to women with varying literacy levels.

A significant finding was that 32.5% of respondents reported a history of miscarriage or stillbirth. This is clinically important because these events can lead to Rh sensitization if the mother is Rh-negative and did not receive appropriate Anti-D prophylaxis. Additionally, 24.1% had 5 or more pregnancies (grand multigravida), placing them at higher cumulative risk for sensitization.

Most concerning, only 45.8% of respondents knew both their blood group and Rhesus factor, while 28.9% knew neither. Among those who knew their status, Rh-negative status was reported by 13.2%, slightly lower than the expected 15-20% prevalence in African populations, suggesting possible under-identification or recall issues.

Knowledge of Haemolytic Disease of the Newborn

The findings reveal profoundly low knowledge about HDN, with 79.5% of respondents demonstrating poor knowledge (overall mean=1.92). This aligns with Agim et al. (2024), who found that only 26.7% of mothers in rural Imo State had heard of HDN, with knowledge of preventive measures even lower (18%

knew about anti-D immunoglobulin, 12% understood Rh typing importance). The current study's finding that 79.5% demonstrated poor knowledge confirms the "critical gap in maternal health literacy regarding HDN" in this same geographical area.

The lowest mean scores were for statements about post-miscarriage sensitization risk (M=1.76) and Rh incompatibility as the most common cause (M=1.80). The post-miscarriage knowledge gap is particularly alarming given that 32.5% of respondents reported a history of miscarriage or stillbirth. Each of these events represents a missed opportunity for prevention, as women may now be sensitized, putting all future Rh-positive pregnancies at risk. This finding directly connects to Pegoraro et al. (2020), who estimated that approximately 50% of women worldwide who require anti-D immunoprophylaxis do not receive it due to lack of awareness, availability, or affordability.

The findings also resonate with Opara et al. (2025), who found that while mothers were knowledgeable about general causes of infant mortality, specific knowledge about less commonly discussed conditions like HDN was markedly lower, suggesting that general maternal health education may not adequately cover specialized topics.

The Health Belief Model (Jones et al., 2021) is particularly relevant here. The very low knowledge scores indicate that mothers have low perceived susceptibility to HDN (they do not understand their risk, particularly if Rh-negative) and low perceived severity (they do not fully grasp the potential consequences). These perceptions are necessary for health behavior change; their absence helps explain the low utilization of preventive services.

Knowledge of Preventive Measures for HDN

Knowledge of preventive measures was equally concerning, with 79.5% demonstrating poor knowledge (overall mean=1.98). The highest score was for C1 (importance of knowing Rh status, M=2.52, fair), suggesting general awareness without specific knowledge. However, scores for specific, actionable knowledge were extremely low: name of Anti-D injection (M=1.76), antenatal timing (M=1.72), postnatal timing (M=1.77), and post-miscarriage indication (M=1.69).

These findings align with Ibrahim and Adeoye (2023), who found that among identified Rh-negative mothers, only 34% received anti-D immunoglobulin postpartum, and only 45% of those who received it did so within the recommended 72-hour window. The knowledge deficits identified in the current study regarding the name, timing, and indications for Anti-D help explain such low utilization rates. Mothers cannot demand services they do not know exist or understand.

The very low score on post-miscarriage prophylaxis (M=1.69) is particularly alarming given that 32.5% of respondents reported a history of miscarriage or stillbirth. This finding directly connects to Francesco and Giuseppe (2013), who documented what is possible with systematic prevention in Italy, where comprehensive screening and prophylaxis programs have dramatically reduced HDN incidence. The knowledge gaps in Umuowa represent the opposite end of the implementation spectrum.

Eze and Onyishi (2026) provide a hopeful counterpoint, demonstrating that targeted educational interventions can significantly improve knowledge. Their study found mean knowledge scores increased from 3.2 ± 1.8 to 7.9 ± 2.1 ($p<0.001$) following a brief intervention. The current study's poor baseline knowledge underscores both the need for and the potential impact of such educational interventions in St. Mary's Hospital.

The Knowledge-Attitude-Practice (KAP) Model (Launiala, 2022) is validated by these findings. Even if mothers have some general awareness (C1, C9), the lack of specific, actionable knowledge about preventive measures means the knowledge-to-practice translation cannot occur. The finding that only 3.6% had good knowledge of preventive measures while 79.5% had poor knowledge indicates that the KAP chain is broken at its very first link.

Barriers to Effective Prevention of HDN

The barriers assessment reveals a complex, multi-level set of obstacles, with an overall mean score of 2.86 (moderate-high) and 49.4% reporting high

barriers. Critically, the top six barriers were all health system-related: never receiving information from health workers (M=3.29), unawareness that Rh-negative mothers need special care (M=3.25), Anti-D unavailability (M=3.19), poor provider explanation (M=3.18), stock-outs of Rh typing kits (M=3.13), and inadequate provider training (M=3.08).

The highest-ranked barrier (D1: never received information from health workers, M=3.29) directly explains the poor knowledge levels observed. Despite 75.9% of mothers attending at least 4 antenatal visits, they are not receiving information about HDN. This represents a massive missed opportunity for primary prevention through health education.

These findings are remarkably consistent with Akpan and Udo (2023), who identified three categories of barriers in Cross River State: health system barriers (inconsistent supply of anti-D, lack of Rh testing kits, inadequate staffing), financial barriers (high out-of-pocket costs), and knowledge and attitudinal barriers (low risk perception). Their conclusion that "barriers are interconnected and systemic" is strongly supported by the current findings.

The findings also align with Mohammed et al. (2025), who found drug stock-outs (78%), lack of patient education materials (65%), and insufficient training (60%) as top barriers in Kano State. Similarly, Giwa and Oni (2026) identified ambiguity in clinical guidelines (72%), fear of adverse reactions (58%), and high workload limiting counseling (55%) as significant provider-level barriers, concluding that "even when commodities are available, provider-level barriers can severely impede prevention."

Notably, cultural and belief-based barriers ranked lowest: belief in spiritual causes (M=1.96) and preference for traditional birth attendants (M=1.90). This finding contrasts with assumptions that cultural factors are primary obstacles to maternal health service utilization in rural Nigeria. Rather, mothers in Umuowa are not resistant to biomedical approaches; the primary barriers are systemic (supply shortages, lack of information, inadequate training) and financial, which are more amenable to intervention through health system strengthening. This aligns with Pegoraro et al.'s (2020) global analysis attributing prevention failure to "lack of awareness, availability, and/or affordability" rather than cultural resistance.

The Socio-Ecological Model is strongly validated by these findings, with barriers operating at multiple levels:

- Individual-level: Late antenatal care (D15 M=2.99), fear of injections (D9 M=2.39)
- Interpersonal-level: Husband's lack of support (D10 M=2.70), family attitudes (D11 M=2.54)
- Organizational-level: Stock-outs (D4 M=3.13, D5 M=3.19), long waiting times (D8 M=2.87), lack of provider training (D16 M=3.08)
- Policy-level: Implicit in supply chain failures and lack of systematic screening protocols

Integration of Findings Across Objectives

The findings across all three objectives reveal a coherent picture of HDN prevention failure. The poor knowledge levels (79.5% poor knowledge in both Sections B and C) are directly linked to the top-ranked barrier: never receiving information from health workers (M=3.29). Mothers are attending antenatal care but are not receiving essential health education about HDN. The knowledge deficits are compounded by health system failures: stock-outs of Rh typing kits and Anti-D, lack of provider training, and poor provider-patient communication. Financial barriers add another layer of difficulty, particularly for a population where 28.9% are unemployed and 31.3% are traders with likely irregular incomes.

The finding that 32.5% of mothers have experienced miscarriage or stillbirth, combined with their profound lack of knowledge about post-miscarriage prophylaxis (M=1.69), represents precisely the kind of preventable sensitization events that Pegoraro et al. (2020) describe. Each of these women may now be sensitized, putting all future Rh-positive pregnancies at risk for HDN.

Despite these concerning findings, the low scores on cultural barriers indicate that mothers are not resistant to biomedical prevention on cultural grounds. They are open to hospital-based care and biomedical

explanations; the barriers are primarily systemic and financial. This, combined with high antenatal attendance rates (75.9% with 4+ visits), suggests that targeted interventions could significantly improve HDN prevention in this setting.