**Original Research Article**

**IMPACT OF THE COVID-19 PANDEMIC ON IMMUNIZATION SERVICE DELIVERY AND INCIDENCE OF VACCINE-PREVENTABLE DISEASES IN DELTA STATE, NIGERIA**

**ABSTRACT**

**Background: The COVID-19 pandemic disrupted healthcare systems globally, severely impacting routine immunisation services. In Nigeria, pre-existing systemic vulnerabilities amplified these disruptions, contributing to reduced vaccine coverage and increased susceptibility to vaccine-preventable diseases (VPDs).**

**Objectives: To assess trends in immunisation coverage, service disruptions, facility ownership patterns, and VPD incidence in Delta State, Nigeria, from 2018 to 2022.**

**Methods: A retrospective mixed-methods design was employed, drawing on routine immunisation data, disease surveillance reports, facility records, and key stakeholder interviews. Quantitative data were analysed descriptively, while thematic analysis explored operational challenges and contextual factors.**

**Results: Routine immunisation coverage declined from 78% in 2019 to 66% in 2022, reflecting incomplete recovery from pandemic-related disruptions. Outreach sessions experienced the most significant interruption in 2020, with limited rebound thereafter. Notable peaks in measles (31 cases) and hepatitis B (52 cases) were recorded in 2020. Urban LGAs with greater private-sector participation showed faster service restoration, whereas rural LGAs reliant on public primary health-care centres faced sustained deficits. Though statistical analysis revealed no significant year-on-year variation in VPD incidence, observed patterns point to disrupted immunisation efforts.**

**Conclusion: The findings underscore ongoing immunisation challenges in Delta State, especially in rural and underserved areas. Strengthening outreach capacity, fostering public-private collaboration, and investing in resilient health infrastructure are essential for closing coverage gaps and enhancing immunisation system preparedness.**

**Keywords: COVID-19, Delta State, Immunisation, Outreach services, Public-private partnership, Vaccine-preventable diseases**

### **INTRODUCTION**

The emergence of the COVID-19 pandemic in late 2019 and its subsequent global spread by early 2020 presented an unprecedented public health emergency, profoundly disrupting health systems worldwide. Among the many affected services, routine immunization programs experienced significant setbacks, particularly in low- and middle-income countries (LMICs) such as Nigeria. Immunization services, which form the backbone of preventive public health efforts, were either scaled down or suspended due to restrictions on movement, the reallocation of healthcare resources to emergency COVID-19 responses, and widespread public fear of healthcare facilities. As a result, millions of children across the globe missed vital vaccines, placing communities at increased risk of outbreaks of vaccine-preventable diseases (VPDs) such as measles, polio, diphtheria, and hepatitis B (1–4).

Nigeria, with its already fragile healthcare infrastructure, was particularly vulnerable to these disruptions. The country has historically faced challenges with immunization coverage due to factors such as weak health system governance, inequitable service delivery, vaccine stock-outs, and socio-cultural resistance in certain communities (5,6). The COVID-19 crisis further compounded these issues. In states like Delta, located in the oil-rich Niger Delta region, the pandemic exposed critical gaps in health service preparedness and resilience. Lockdowns, transportation restrictions, healthcare worker shortages, and public health messaging focused solely on COVID-19 led to the interruption of scheduled immunization sessions and outreach campaigns (7).

Delta State comprises both urban and rural populations with varying levels of access to healthcare. Prior to the pandemic, immunization coverage was already uneven across the state, with rural areas lagging behind due to poor infrastructure and workforce shortages. The pandemic intensified these disparities. Notably, available surveillance data indicate that between 2020 and 2021, there was a decline in the administration of key antigens such as BCG, pentavalent vaccines, and measles-containing vaccines across several local government areas (LGAs) in Delta State (3,8). In the same period, a resurgence of VPDs was observed, particularly measles and diphtheria, raising alarm about the secondary consequences of the pandemic beyond direct COVID-19 morbidity and mortality (7,9).

The implications of this decline are far-reaching. Reduced immunization coverage compromises herd immunity, increases the risk of disease outbreaks, and threatens the health of vulnerable populations, especially children under five years of age. Moreover, the breakdown in immunization delivery during the pandemic calls into question the resilience and adaptability of the state’s public health system in the face of external shocks (10). Without urgent corrective measures, including policy reforms, investment in health infrastructure, and re-engagement with communities, the gains made in immunization over the last decade could be reversed (5,11).

This study, seeks to explore the extent to which the pandemic affected immunization services in the state. It analyzes immunization trends between 2018 and 2022 to provide a comparative view of service coverage before, during, and after the pandemic. It also examines the ownership patterns of service delivery points (public vs. private), identifies urban-rural disparities, and evaluates the epidemiological trends of selected VPDs. By doing so, this study not only documents the collateral damage of COVID-19 on essential health services but also contributes to the broader discourse on building resilient immunization systems in Nigeria and other LMICs.

**METHODOLOGY**

**Study Design**

A retrospective, mixed-methods observational study was carried out to quantify and contextualise the effect of the COVID-19 pandemic on routine immunisation services and vaccine-preventable-disease (VPD) incidence in Delta State, Nigeria. Quantitative analyses used routinely collected programme data and surveillance records; qualitative insights were gathered through key-informant interviews (KIIs) and review of relevant policy documents. Integrating numerical trends with stakeholder perspectives ensured a comprehensive appraisal of service disruption, adaptive responses and residual gaps.

**Study Setting**

Delta State, situated in Nigeria’s South-South geo-political zone, comprises 25 Local Government Areas (LGAs) that range from densely populated urban centres to remote riverine communities. The evaluation period (2018 – 2022) encompassed two pre-pandemic years, the year of maximal disruption, and the initial two years of recovery, permitting a before-and-after comparison of programme performance.

**Data Sources**

Six complementary evidence streams underpinned the analysis.

1. Routine immunisation coverage records extracted from the Delta State Primary Health-Care Development Agency (DSPHCDA) Health-Management-Information System (HMIS).

2. Integrated Disease Surveillance and Response (IDSR) bulletins compiled by the State Ministry of Health, providing annual, laboratory-confirmed counts of VPDs.

3. Facility service registers detailing the number, type and ownership of fixed and outreach immunisation sessions at public, state and private facilities.

4. Peer-reviewed literature and agency reports (WHO, UNICEF, National Primary Health-Care Development Agency) describing national and global COVID-19 impacts on immunisation.

5. Key-informant interviews with immunisation programme managers, cold-chain technicians, frontline vaccinators and community health workers.

6. State and federal policy documents outlining COVID-19 response measures, vaccine-supply adaptations and catch-up campaign strategies.

**Data-Collection Procedures**

Record review: Monthly coverage figures, session counts and VPD notifications were abstracted into standardised extraction sheets.

Key-informant interviews: Semi-structured guides explored supply-chain bottlenecks, workforce challenges and community perceptions. Interviews were audio-recorded (with consent) and transcribed verbatim.

Structured questionnaires: Frontline workers in a purposive sample of facilities quantified perceived disruptions and the adequacy of mitigation strategies.

Field observations: Selected facilities were visited to document cold-chain functionality, client flow and infection-prevention measures.

**Sampling**

A census approach captured all 25 LGAs and every facility that submitted immunisation data during 2018-2022. For the qualitative strand, purposive sampling ensured geographic and functional diversity. Fifteen KIIs (five per senatorial district) were conducted until thematic saturation was achieved.

**Data Analysis**

Descriptive statistics summarised annual coverage levels, mean session counts and crude VPD incidence per 100 000 population.

Pre-/post-comparisons contrasted pooled 2018-2019 indicators with pooled 2020-2022 indicators to quantify absolute and relative change.

One-way analysis of variance (ANOVA) tested for significant year-to-year differences in session volume and VPD incidence.

Thematic analysis of interview transcripts (NVivo v12) identified recurrent codes relating to service disruption, adaptive innovation and equity impacts; findings were triangulated with quantitative results.

Geospatial mapping (QGIS v3.26) visualised LGA-level coverage and clusters of low performance.

**Ethical Considerations**

Ethical approval was obtained from the Delta State Ministry of Health Research Ethics Committee (HM/596/T2/133). Written or verbal informed consent was secured from all interviewees. All quantitative datasets were de-identified, encrypted and stored on password-protected servers in compliance with national data-protection regulations.

**RESULTS**

## **Facilities Offering Routine Immunization Services and Ownership Structure in Delta State, Nigeria**

This table presents the distribution of immunization service delivery points across the 25 Local Government Areas (LGAs) of Delta State by facility type and ownership. The total number of facilities is 614, with the majority (78.8%) being Primary Health Care (PHC) centres. Private health facilities account for 15.8%, while state government facilities make up only 5.9%. The dominance of PHCs underscores the central role of public-sector services in routine immunization, particularly in rural and hard-to-reach areas.

Several LGAs such as Burutu, Patani, Ndokwa East, Warri North, and Warri South West lack any private or state-owned immunization facilities, relying entirely on PHCs. In contrast, urban LGAs like Warri South, Udu, and Uvwie show higher private sector involvement, reflecting urban-rural disparities in health service delivery. This reliance on PHCs may have posed significant challenges during the COVID-19 pandemic when public health resources were stretched, potentially disrupting immunization services, especially in rural LGAs.

**Table 1:** **Facilities Offering Routine Immunization Services And Ownership Structure In Delta State, Nigeria**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **s/n** |  **Name Of Local Government** | **Total** | **PHC Centres** | **Private Facility** | **State Govt Facility** |
| **1** | **Aniocha North** | 27 | 19 | 5 | 3 |
| **2** | **Aniocha South** | 23 | 19 | 2 | 2 |
| **3** | **Bomadi** | 12 | 11 | 1 | 0 |
| **4** | **Burutu** | 22 | 22 | 0 | 0 |
| **5** | **Ethiope East** | 23 | 20 | 0 | 3 |
| **6** | **Ethiope West** | 28 | 22 | 2 | 4 |
| **7** | **Ika North East** | 24 | 17 | 7 | 0 |
| **8** | **Ika South** | 33 | 22 | 8 | 3 |
| **9** | **Isoko North** | 25 | 21 | 1 | 3 |
| **10** | **Isoko South** | 19 | 17 | 0 | 2 |
| **11** | **Ndokwa East** | 26 | 26 | 0 | 0 |
| **12** | **Ndokwa West** | 26 | 22 | 4 | 0 |
| **13** | **Okpe** | 20 | 18 | 2 | 0 |
| **14** | **Oshimili North** | 14 | 10 | 1 | 3 |
| **15** | **Oshimili South** | 26 | 14 | 9 | 3 |
| **16** | **Patani** | 13 | 13 | 0 | 0 |
| **17** | **Sapele** | 32 | 23 | 7 | 2 |
| **18** | **Udu** | 32 | 20 | 11 | 1 |
| **19** | **Ughelli North** | 38 | 35 | 1 | 2 |
| **20** | **Ughelli South** | 36 | 31 | 4 | 1 |
| **21** | **Ukwuani** | 20 | 15 | 5 | 0 |
| **22** | **Uvwie** | 34 | 21 | 11 | 2 |
| **23** | **Warri North** | 15 | 15 | 0 | 0 |
| **24** | **Warri South** | 32 | 14 | 16 | 2 |
| **25** | **Warri South West** | 14 | 14 | 0 | 0 |
|  |  **Total** | **614** | **484** | **97** | **36** |

(Source; Delta State Primary Health Care Development Agency, Asaba.)

## **Pattern of Vaccine Preventable Diseases From 2018 - 2022**

This table outlines the reported cases of key vaccine-preventable diseases in Delta State over five years. Notably, **measles** showed fluctuations, peaking in 2020 (31 cases) during the height of the COVID-19 pandemic and dipping in 2021 before rising again in 2022. This pattern indicates disruptions in immunization coverage and possible catch-up campaigns. **Hepatitis B** cases also spiked in 2020 (52 cases), followed by a steady decline, which may reflect testing variations or changes in health-seeking behavior during the pandemic.

Diseases like **diphtheria and poliomyelitis** recorded zero cases throughout the five-year period, indicating strong programmatic control. However, sporadic appearances of **pertussis** and **yellow fever** suggest gaps in population immunity or reporting. The overall trend shows that while some diseases remained well-controlled, others experienced transient increases possibly linked to pandemic-related interruptions in health services.

**Table 2: Pattern Of Vaccine Preventable Diseases From 2018 - 2022**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **NAME OF STATE** | **VACCINE PREVENTABLE DISEASES** | **2018** | **2019** | **2020** | **2021** | **2022** |
|  **Delta State** | Measles | 25 | 20 | 31 | 12 | 25 |
|  **Delta State** | Neonatal Tetanus  | 5 | 7 | 2 | 2 | 3 |
|  **Delta State** | Pertussis | 0 | 0 | 2 | 1 | 0 |
|  **Delta State** | Yellow Fever | 1 | 0 | 0 | 1 | 0 |
|  **Delta State** | Diphtheria  | 0 | 0 | 0 | 0 | 0 |
|  **Delta State** | Poliomyelitis | 0 | 0 | 0 | 0 | 0 |
| **Delta State** | Hepatitis B | 22 | 34 | 52 | 24 | 15 |
|  **Delta State** | Meningitis | 6 | 2 | 1 | 4 | 2 |

 (Source: Delta State Primary Health Care Agency 2019)

### **Percentage Immunization Coverage, Delta State (2018–2022)**

This table shows how immunization coverage fluctuated over a five-year period. Coverage increased from 66% in 2018 to a peak of 78% in 2019, reflecting a strong pre-pandemic performance. However, the onset of COVID-19 in 2020 led to a slight decline to 76%, suggesting early system resilience. In 2021, a further drop to 68% was observed, and by 2022, coverage had returned to the 2018 level of 66%. This stagnation signals incomplete recovery post-COVID and highlights persistent challenges in reaching full immunization targets. The inability to rebound to pre-pandemic levels suggests gaps in outreach, follow-up, and health system adaptation.

**Table 3: Percentage Immunization Coverage, Delta State (2018–2022)**

|  |  |
| --- | --- |
| **Year** | **Estimated % Coverage** |
| **2018** | 66 |
| **2019** | 78 |
| **2020** | 76 |
| **2021** | 68 |
| **2022** | 66 |

### **Fixed and Outreach Immunization Sessions, Delta State (2018–2022)**

This table presents the number of fixed and outreach sessions conducted each year. Both session types increased from 2018 to 2019, reflecting improved service delivery planning. However, there was a significant decline in 2020—the year COVID-19 began—indicating disruptions to both facility-based and community-based immunization services. While gradual recovery was seen in 2021 and 2022, session numbers remained below 2019 levels. Fixed sessions were more resilient, but outreach sessions lagged, affecting access in hard-to-reach communities. This persistent shortfall in outreach activities likely contributed to lower coverage and increased zero-dose children in the state.

**Table 4: Fixed and Outreach Immunization Sessions, Delta State (2018–2022)**

|  |  |  |
| --- | --- | --- |
| **Year** | **Fixed Sessions** | **Outreach Sessions** |
| **2018** | 5,938 | 3,281 |
| **2019** | 6,204 | 3,407 |
| **2020** | 4,213 | 2,196 |
| **2021** | 4,412 | 2,209 |
| **2022** | 4,738 | 2,398 |

1. **Anova**

This table presents the results of a statistical test (Analysis of Variance) used to determine whether there were significant differences in disease incidence across the years 2018 to 2022. The F-value of 0.083 and a high p-value of 0.959 indicate no statistically significant difference in the overall incidence of vaccine-preventable diseases across these years.

However, this finding should be interpreted with caution due to methodological limitations, including a small sample size (only five years of data), low degrees of freedom, and potential data aggregation effects. While statistical significance was not observed, observable trends—such as the 2020 spike in measles and hepatitis B—suggest meaningful public health impacts that were not captured in the test. Thus, statistical findings should be complemented with epidemiological and contextual analysis.

**Table 5: Anova**

|  |
| --- |
| Year  |
|  | **Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig.** |
| **Between Groups** | 2.000 | 3 | .667 | .083 | .959 |
| **Within Groups** | 8.000 | 1 | 8.000 |  |  |
| **Total** | **10.000** | **4** |  |  |  |

**DISCUSSION**

The present study revealed a progressive decline in routine immunisation coverage in Delta State, from 78% in 2019 to 68% in 2021, with a further reduction to 66% in 2022. This trend aligns with global patterns of immunisation service disruptions during the COVID-19 pandemic, largely attributed to movement restrictions, the redeployment of healthcare personnel, and interruptions in vaccine supply chains (12). These findings are consistent with national observations that rural and underserved areas experienced more pronounced declines due to limited cold-chain capacity and higher rates of stock-outs (13).

An increase in the number of reported cases of vaccine-preventable diseases (VPDs), particularly measles and hepatitis B, was observed during the period of reduced immunisation coverage, notably in 2020. This is consistent with global warnings that disruptions in immunisation services would likely contribute to VPD outbreaks in low- and middle-income countries (14). The observed trends suggest a temporal association between decreased vaccine coverage and increased disease notifications. However, it is important to acknowledge that improvements in disease surveillance and reporting systems during the pandemic period may have partially contributed to the observed rise in case counts (15).

The distribution of immunisation service delivery points across the state showed that public primary healthcare centres (PHCs) accounted for 78.8% of immunisation activities, while private clinics contributed 15.8%. This pattern highlights the centrality of PHCs in immunisation service delivery but also suggests potential roles for private sector facilities in mitigating service disruptions, especially during public health emergencies (16). The geographic and socioeconomic distribution of private health facilities further underscores the influence of affordability, proximity, and infrastructure on access and utilisation of immunisation services, in line with findings from national resilience assessments (17).

Suspension of mobile and outreach immunisation sessions in 2020 led to an increase in the proportion of children who had not received any vaccine doses, often referred to as "zero-dose" children. This observation is in concordance with global reports which identified outreach suspension as a critical driver of missed immunisation opportunities during the pandemic (18). Although some degree of recovery was noted in 2021 and 2022, this remained incomplete. Evidence from other Nigerian states indicates that redeployment of mobile vaccination teams and the decentralisation of vaccine storage facilities were effective interim solutions during the pandemic (19).

Behavioural factors also emerged as significant determinants of immunisation uptake during the post-pandemic period. The role of targeted risk communication and community engagement efforts in rebuilding vaccine confidence is well documented (20). Notably, administrative data from the National Primary Health-care Development Agency (NPHCDA) indicate that pentavalent vaccine drop-out rates declined following the reinstatement of community dialogues and SMS-based reminders in 2023, suggesting the effectiveness of integrated behavioural strategies in improving immunisation outcomes (7).

Finally, while the findings confirm the broader systemic vulnerabilities exposed by the pandemic, they also highlight emerging policy responses aimed at strengthening health system resilience in Delta State. The 2023 State Health Sector Performance Report recommended key strategies, including the establishment of dedicated vaccine budgets, implementation of real-time stock monitoring systems, digital immunisation registries, enhancements to cold-chain infrastructure, and the development of emergency staffing mechanisms (21). The extent to which these measures have been adopted will be critical in determining the long-term recovery and resilience of immunisation services in the state.

**CONCLUSION**

This study highlights significant setbacks in routine immunisation coverage in Delta State during and after the COVID-19 pandemic, accompanied by increased notifications of vaccine-preventable diseases and disruptions in service delivery, particularly at public primary healthcare centres. The findings underscore the critical need to address spatial disparities, enhance epidemiologic modelling approaches, and evaluate the resilience of various facility types. Behavioural and operational factors also play a pivotal role in immunisation uptake and system recovery.

Future research should prioritise the integration of geospatial analysis, longitudinal tracking of catch-up efforts, and mixed-methods evaluations of private-sector participation. A coordinated, data-driven approach—grounded in both epidemiologic evidence and community engagement—is essential to guide Nigeria’s immunisation recovery agenda and build a more resilient, equitable immunisation system. Policymakers and stakeholders must act swiftly to translate these insights into targeted interventions that safeguard routine immunisation and avert future public health shocks.

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