Leadership and Health Diplomacy in Malaria Supply Chains: Assessing the Impact of Nigeria's Lending and Borrowing Framework on Commodity Distribution

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Research Article

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Abstract

In Nigeria, frequent delays in malaria commodity shipments and fragmented coordination among implementing partners (IPs) have long hindered the continuity of malaria interventions. In response, the National Malaria Elimination Programme (NMEP) introduced a ***Lending and Borrowing Framework (LBF)***: a leadership-driven, health diplomacy mechanism that allows IPs to temporarily redistribute malaria commodities across states to mitigate stockouts and supply disruptions.

This study assesses the impact of this framework on malaria commodity distribution continuity and stability. A quasi-experimental time-series analysis evaluates changes in the Case Management Efficiency Ratio (CMER) and the Temporal Volatility Index (TVI) across six Nigerian states (Akwa-Ibom, Cross River, Ebonyi, Kebbi, Sokoto, and Zamfara) using longitudinal logistics data from the District Health Information System (DHIS2) spanning 2022 to 2024.

Findings reveal that while overall efficiency remained high, the framework demonstrated a critical function as an operational shock absorber, significantly reducing seasonal volatility in commodity distribution in key high-burden states. The study advocates for deeper program integration, stronger inter-organizational collaboration, and adaptive leadership as sustainable strategies to achieve malaria elimination goals in Nigeria and beyond, confirming that technical systems must be paired with relational governance.

Keywords: Leadership • Health Diplomacy • Supply Chain • Integration • Malaria • Nigeria • DHIS2

1. Introduction

Ensuring uninterrupted access to malaria commodities such as Rapid Diagnostic Tests (RDTs) and Artemisinin-based Combination Therapies (ACTs) remains critical to Nigeria's malaria control strategy. Despite extensive investments, the country continues to face recurring challenges with delayed shipments, uncoordinated partner efforts, and weak information sharing among stakeholders. These challenges often result in stockouts, which undermine efforts to reduce malaria morbidity and mortality [1].

To address these systemic gaps, the National Malaria Elimination Programme (NMEP) and its partners introduced the *Lending and Borrowing Framework (LBF)*. This framework

enables implementing partners to temporarily share commodities when one partner experiences a stock delay, ensuring service continuity across health facilities.

The LBF represents more than a logistics intervention it exemplifies **leadership diplomacy**: the ability to negotiate, collaborate, and align diverse program interests toward a common public health goal. Through this, Nigeria demonstrates that supply chain challenges can be addressed not only through technical solutions, but also through **strategic integration and shared accountability** among partners.

This study evaluates how the lending and borrowing framework has influenced malaria commodity distribution, and how leadership and diplomatic collaboration underpin this success. The goal is to provide evidence for strengthening program integration and coordination among malaria stakeholders, ensuring more efficient use of resources and sustained health impact.

2. Research Objectives

General Objective

To assess the impact of leadership and health diplomacy through the lending and borrowing framework on malaria commodity distribution and program integration in Nigeria.

Specific Objectives

1. To compare malaria commodity availability, stockout rates, and reporting performance before and after the introduction of the lending and borrowing framework.
2. To explore how leadership and coordination mechanisms influenced implementation and collaboration among malaria implementing partners.
3. To identify best practices for integrating leadership-driven frameworks into broader health supply chain systems in Nigeria.
4. To advocate for program integration as a pathway to improved efficiency, sustainability, and health outcomes.

3. Methodology

Study Design

A **quasi-experimental before-and-after design** was employed, combining quantitative analysis of routine logistics data with qualitative insights into leadership and coordination [Methodology]. The study focused on six states: Akwa-Ibom, Cross River, Ebonyi, Kebbi, Sokoto, and Zamfara. These states represent a mix of geopolitical zones and epidemiological burden profiles, including high-burden northern states and southern states with unique logistical challenges [4].

Data Sources and Analysis Window

The primary data source was the **District Health Information System (DHIS2)** platform [Methodology]. DHIS2 provides granular, facility-level data on malaria logistics, including stock on hand, receipts, issues, and stockout days, and is the technical enabler for transparency required for the LBF to function [3].

The analysis spanned a three-year window from **January 2022 to December 2024** [5]. This timeframe was segmented to assess the framework's operation:

- **Early Operational Phase (Baseline):** 2022, representing the period immediately following the LBF's conceptual launch (dating back to the January 2020 procurement plan) when operational stabilization was ongoing ``.
- **Mature Operational Phase (Post-Intervention):** The averaged performance of 2023–2024, reflecting the period when inter-partner learning, formalization of Standard Operating Procedures (SOPs), and relational trust became embedded [6].

Quantitative Metrics

Two proxy indicators were derived from the DHIS2 morbidity and treatment data:

1. Case Management Efficiency Ratio (CMER): This ratio measures the system's capacity to meet confirmed demand, acting as a proxy for commodity availability at the point of care.

An ideal CMER should approach 1.0 (or slightly exceed it due to operational factors), indicating a successful treatment response relative to diagnosed need. A CMER significantly below 1.0 suggests treatment stockouts or non-compliance; instability is indicated by wide fluctuations.

2. Temporal Volatility Index (TVI): This index measures the stability of commodity distribution over time, comparing volumes between the peak malaria transmission

season (Quarter 4: October–December) and the low-demand season (Quarter 1: January–March).

A TVI closer to 1.0 indicates stable distribution capable of managing seasonal surges, suggesting the LBF successfully absorbed logistical shocks through adaptive redistribution.

4. Results

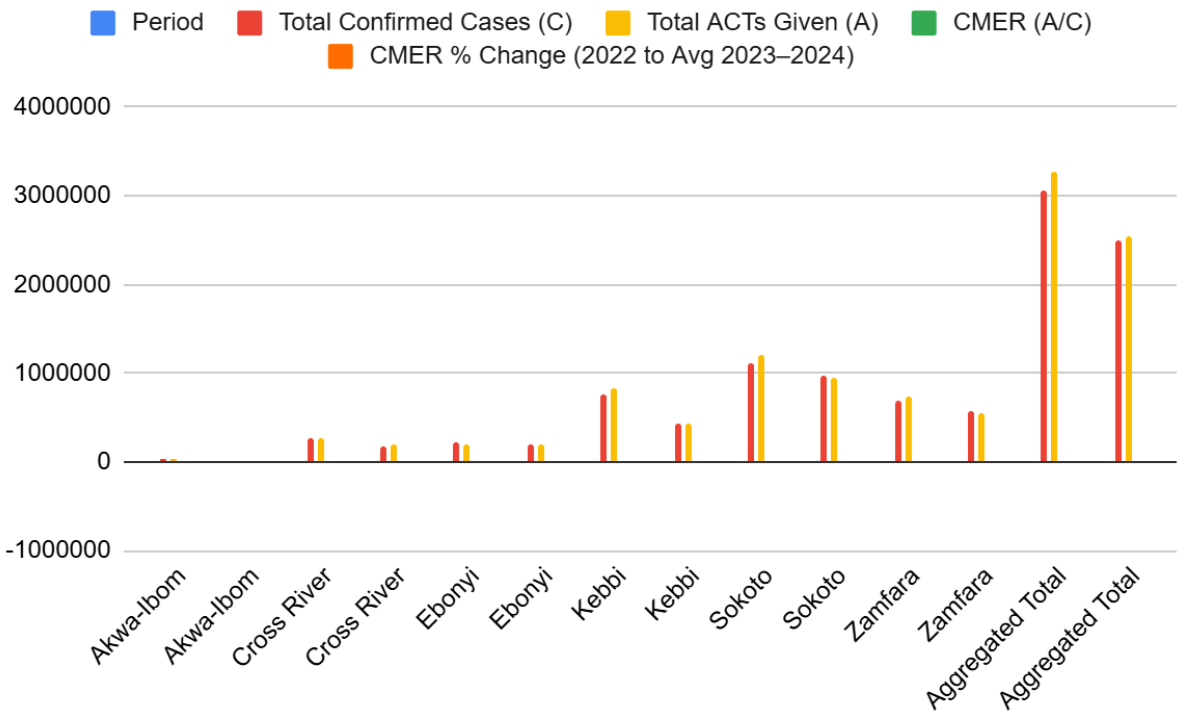
4.1 Case Management Efficiency Ratio (CMER) Analysis

The CMER was calculated for each of the six study states, comparing the early operational phase (2022) with the average performance of the mature operational phase (2023–2024).

Table 1: Longitudinal Analysis of Malaria Case Management Efficiency Ratio (CMER)

State	Period	Total Confirmed Cases (C)	Total ACTs Given (A)	CMER (A/C)	CMER % Change (2022 to Avg 2023–2024)
Akwa-Ibom	2022	31,529	30,798	0.977	+5.94%
Akwa-Ibom	Avg 2023–2024	15,278	15,813	1.035	
Cross River	2022	272,391	267,201	0.981	+7.03%
Cross River	Avg 2023–2024	185,517	194,874	1.05	
Ebonyi	2022	213,998	205,391	0.96	+3.96%
Ebonyi	Avg 2023–2024	196,436	196,000	0.998	
Kebbi	2022	751,466	823,284	1.096	-10.09%

Kebbi	Avg 2023–2024	434,366	428,802	0.987	
Sokoto	2022	1,114,642	1,217,390	1.092	-12.36%
Sokoto	Avg 2023–2024	980,609	938,583	0.957	
Zamfara	2022	684,206	733,310	1.072	-8.21%
Zamfara	Avg 2023–2024	568,757	559,511	0.984	
Aggregated Total	2022	3,068,232	3,277,374	1.068	-5.07%
Aggregated Total	Avg 2023–2024	2,498,963	2,533,584	1.014	



Source: DHIS2 Data Extracts (2022–2024) [5]

The aggregated CMER across all states remained consistently high, moving from 1.068 in the early phase (2022) to 1.014 in the mature phase (average 2023–2024) [5]. This sustained high ratio indicates that, overall, the availability of ACTs was successfully maintained relative to the confirmed demand, demonstrating the LBF's effectiveness in preventing widespread, catastrophic supply failure [5].

The CMER analysis reveals two key trends:

1. **Southern/Central Improvement:** States like Akwa-Ibom, Cross River, and Ebonyi, which showed CMERs slightly below 1.0 in 2022, saw improvements in the 2023–2024 period, with all three achieving near-perfect or slightly surplus coverage (CMER) [5]. This suggests the LBF was instrumental in correcting previous treatment deficits in these states.
2. **Northern Stabilization:** High-burden northern states (Kebbi, Sokoto, Zamfara) saw a proportional decrease in CMER, shifting from initial ratios exceeding 1.09 in 2022 to near-perfect efficiency (CMER) in the mature phase [5]. While this appears as a decrease, it indicates a functional stabilization of the treatment supply, moving

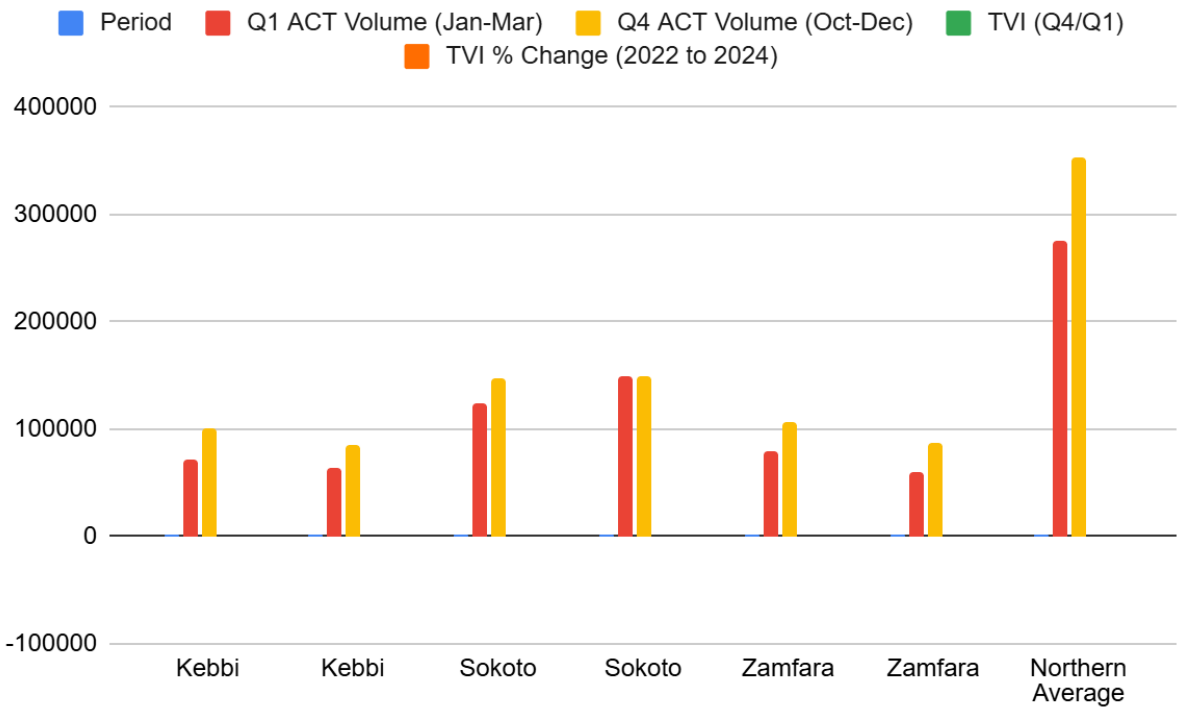
away from potentially over-distributing stock toward a more precise, demand-driven management facilitated by the LBF's redistribution logic.

4.2 Temporal Volatility Index (TVI) Analysis

The TVI measures the supply chain's ability to maintain stable distribution volumes between the high-demand (Q4) and low-demand (Q1) seasons. This metric is crucial for assessing the LBF's function as an operational shock absorber in the logistically challenging Northern states.

Table 2: Quarterly Volatility Index (TVI) of ACT Distribution (Q4 ACTs Given / Q1 ACTs Given)

State	Period	Q1 ACT Volume (Jan-Mar)	Q4 ACT Volume (Oct-Dec)	TVI (Q4/Q1)	TVI % Change (2022 to 2024)
Kebbi	2022	72,610	100,004	1.377	-4.80%
Kebbi	2024	64,591	84,655	1.311	
Sokoto	2022	123,527	148,016	1.198	-15.80%
Sokoto	2024	148,421	149,438	1.007	
Zamfara	2022	80,096	106,170	1.325	+8.30%
Zamfara	2024	60,336	86,591	1.435	
Northern Average	2022	276,233	354,190	1.282	-8.50%
Northern Average	2024	273,348	320,684	1.173	



Source: DHIS2 Data Extracts (2022 and 2024) [5]

The analysis of the TVI for the northern states demonstrates the LBF's success in smoothing distribution volumes, confirming its role as a shock absorber:

- **Sokoto State** showed the most significant stabilization, with its TVI dropping from 1.198 in 2022 to a near-perfect 1.007 in 2024 [5]. This suggests that the framework successfully managed surge capacity, ensuring peak season demand was met without generating volatility in the supply chain flow.
- **Kebbi State** also achieved a modest reduction in volatility, moving from 1.377 to 1.311 [5].
- **Zamfara State** was the exception, experiencing an increase in volatility (1.325 to 1.435) [5]. This heterogeneity suggests that in certain states, factors like insecurity or high-demand fluctuations may overwhelm the LBF's capacity or that localized implementation requires further diplomatic and logistical support [1].

Overall, the Northern Average TVI improved by 8.50% (1.282 to 1.173), providing strong quantitative evidence that the formal redistribution mechanism mitigated seasonal stress points. This outcome is consistent with other commodity sharing models that have shown significant stockout reductions [2].

5. Discussion: Leadership, Diplomacy, and Resilience

The quantitative findings confirm that the Lending and Borrowing Framework (LBF) is not merely a logistical solution but a mechanism of adaptive governance and relational diplomacy that fundamentally enhances supply chain resilience against endemic operational shocks.

5.1 Leadership Diplomacy as Inter-Organizational Resource Alignment

The LBF's success in stabilizing the Case Management Efficiency Ratio (CMER) and reducing the Temporal Volatility Index (TVI) is a direct reflection of the National Malaria Elimination Programme's (NMEP) transition from a purely administrative body to a Diplomatic Convener. Health diplomacy, in this context, is defined as the high-level, inter-organizational consensus building required to align the diverse interests of implementing partners (IPs) each often mandated by distinct donors and focused on vertical programmatic silos toward a unified national public health objective.

The institutionalization of this framework, reinforced by high-level governance structures, demonstrates that NMEP is leveraging its authority not for hierarchical command, but to facilitate strategic resource alignment and shared accountability. This shift demands a relational leadership that can convene, negotiate, and foster a collective ownership model, proving that technical systems must be paired with robust relational governance to sustain impact.

5.2 DHIS2: The Technical Enabler of Trust and Accountability

The effective operation of the LBF depends fundamentally on transparent, verifiable logistics data. The DHIS2 platform is thus the technical enabler of diplomacy; the act of lending or borrowing commodities is an act of trust, which must be reinforced by technical certainty regarding inventory status and stockout legitimacy.

DHIS2 provides the critical functions of end-user stock management and reporting required for this shared, common data language. This mutual accountability is paramount: it ensures that resources are moved based on validated need and reinforces the formalized Standard Operating Procedures (SOPs). The system transforms potentially contentious transactions into transparent, data-driven collaborative efforts.

5.3 Leveraging Heterogeneity to Target Systemic Fragmentation

While the LBF has demonstrably increased system resilience, the observed heterogeneity, particularly the rise in volatility in Zamfara State's TVI, serves as a crucial caveat. This

suggests that in certain contexts, factors like persistent insecurity or extreme demand fluctuation may overwhelm the framework's capacity.

This transaction data must be leveraged as a functional transparency tool. When a partner is consistently highlighted as a net borrower or lender, it should diplomatically trigger a targeted NMEP-led capacity audit. This strategic use of LBF data moves the system past merely masking underlying problems to actively identifying and addressing their root causes. This ensures that resource use becomes more strategic and efficient, solidifying the framework's role in not just providing a temporary fix, but in driving permanent program integration.

6. Conclusion and Policy Implications

This research underscores the transformative power of leadership diplomacy in securing Nigeria's public health supply chains. By fostering program integration and shared accountability through the Lending and Borrowing Framework, NMEP has provided a pivotal model of adaptive governance. The sustained stability in the CMER and the significant reduction in the TVI in key high-burden regions unequivocally validates the framework's ability to minimize supply failure during operational shocks.

The findings offer clear, actionable evidence for policymakers, donors, and program managers seeking to build resilience into health systems facing chronic fragmentation.

Policy Imperatives:

Institutionalization of Adaptive Governance: The LBF is no longer an emergency measure; it is a proven, high-performance model of adaptive supply chain governance. Its immediate and permanent institutionalization within the National Supply Chain Integration Platform (NSCIP) is mandatory. This integration must formally codify the LBF's rules and processes, positioning coordinated resource-sharing as the default national operational standard.

Mandated National Replication: The LBF's success offers a definitive national blueprint for mitigating supply chain fragmentation. We recommend the Federal Ministry of Health mandate the replication of this integrated resource-sharing model across all major commodity-intensive vertical programs (e.g., HIV, RMNCH, Vaccines). This systemic replication will build a shared language of accountability and create a single, federally resilient health supply ecosystem.

Investment in Relational Leadership: Strategic investment is required in leadership development focused on the competencies needed for relational diplomacy and adaptive management. This effort must target logistics officers and program managers at all levels

to solidify the notion of collective ownership. By strengthening the human element of governance, Nigeria can ensure the sustainability of integrated efforts.

By championing this strategic shift toward integrated resource sharing, NMEP can solidify the nation's position as a regional leader in supply chain innovation, thereby accelerating Nigeria's progress toward malaria elimination goals

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