Health Desert Scorer (Nigeria)

A Decision-Support System for LGA-Level Healthcare Access Barriers

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Abstract

The Health Desert Scorer is a Nigeria-focused decision-support application that identifies Local Government Areas (LGAs) with higher relative barriers to healthcare access. The system combines survey outcomes, facility distribution, distance proxies, and network connectivity signals to generate a comparative planning score. The tool is designed for prioritization and program planning by NGOs, clinics, policymakers, and research teams. It is explicitly not a diagnostic system and should not be used for individual-level prediction.

Contents

1 Executive Summary

Healthcare access constraints are often driven by distance, facility scarcity, and weak connectivity, not only by clinical factors. This project provides an LGA-level prioritization layer for Nigeria so partners can:

- identify highest-need LGAs with transparent criteria,
- compare risk dimensions (all-risk, child mortality, facility access, connectivity, 5km coverage),
- export planning-friendly artifacts for field operations and policy discussions.

The current model card reports:

- Accuracy: 0.82
- Precision: 0.79
- Recall: 0.84
- F1: 0.81
- ROC-AUC: 0.88

2 Problem Statement

Many allocation decisions in public health are made with limited spatial synthesis across outcomes, services, and infrastructure. Existing dashboards can be difficult for non-technical users to operationalize into concrete outreach or deployment steps.

The Health Desert Scorer addresses this gap with a lightweight and shareable interface that ranks LGAs by relative access barriers and supports rapid planning conversations.

3 System Overview

3.1 Product Scope

The system is a map-first web application with:

- state and year filtering,
- LGA search and comparison workflow,
- multiple focus modes for barrier-specific prioritization,
- downloadable outputs for meetings and offline review.

3.2 Intended Users

- NGOs and implementation partners: intervention targeting and campaign planning.
- Primary care and clinic operators: outreach and catchment prioritization.
- Government stakeholders: transparent resource prioritization discussions.
- Researchers: hypothesis generation and sensitivity analysis support.

3.3 Out of Scope

- Clinical diagnosis
- Individual-level risk prediction
- Use as sole basis for high-stakes funding decisions

4 Data Inputs and Governance

4.1 Primary Data Inputs

Source	Dataset	Year(s)	Role in System
DHS	Survey outcomes	2013, 2018	Outcome and risk proxy signals at aggregated level
NHFR	Facility registry	2020	Facility density and access proxy features
WorldPop	Population estimates	2020	Population-normalized metrics (e.g., facilities per 10k)
OpenCellID	Connectivity proxy	2019	Tower density and mobile connectivity context

4.2 Data Protection and Ethics

The repository stores aggregated outputs only. Restricted microdata and sensitive coordinates are not committed. This design supports safer sharing and reproducibility for collaborative planning.

5 Methodology

5.1 Feature Engineering

The current model family relies on core LGA-level features, including:

- under-5 mortality proxy,
- facilities per 10k population,
- average distance to facilities,
- towers per 10k population,
- 5km coverage proxy,
- additional normalized contextual terms.

5.2 Modeling

The production model card describes a gradient boosted tree model (versioned artifact `risk_model_v1.2`) with 5-fold cross-validation stratified by state.

5.3 Evaluation Metrics

Metric	Value
Accuracy	0.82
Precision	0.79
Recall	0.84
F1 Score	0.81
ROC-AUC	0.88

Table 2: Current performance snapshot from `models/risk_model_v1.2/metrics.json`.

5.4 Interpretability

The application supports feature-attribution views for selected LGAs using SHAP-like local explanation payloads where available. Interpretability is included to improve trust in planning conversations, not to imply causal inference.

6 User Workflows

6.1 NGO Workflow

1. Filter to state and year.
2. Rank LGAs by selected focus (e.g., facility access).
3. Export top-priority list and map snapshot.
4. Validate with field and partner constraints.

6.2 Clinic and Frontline Workflow

1. Select service area state.
2. Compare 2–4 LGAs for outreach sequencing.
3. Use barrier-specific recommendations as planning prompts.

6.3 Research Workflow

1. Export model and feature outputs.
2. Reproduce scores and inspect feature importances.
3. Run sensitivity checks by year, source coverage, and thresholds.

7 Limitations

Known limitations include:

- no direct encoding of conflict and insecurity constraints,
- no seasonal road accessibility model in current release,
- care quality and staffing adequacy are not directly modeled,
- source completeness can vary across states and years.

8 Deployment and Operations

8.1 Current Deployment

The live system is delivered as a Streamlit-hosted app with an embedded custom HTML/JavaScript frontend.

8.2 Operational Readiness Checklist

- versioned model artifact and model card published,
- data freshness metadata visible in UI/export artifacts,
- per-LGA quality flags surfaced to end-users,
- pilot governance process for partner sign-off and review.

9 Pilot Design for External Partners

9.1 Proposed Pilot Structure (90 Days)

- Week 1–2: stakeholder alignment and success metric definition.
- Week 3–6: deployment, onboarding, and scenario testing.
- Week 7–10: live planning use during at least one campaign cycle.
- Week 11–12: evaluation, refinement, and scale decision memo.

9.2 Pilot Success Metrics

- reduction in planning cycle time,
- percentage of outreach plans supported by explicit spatial evidence,
- adoption rate among intended user roles,
- qualitative trust and usability scores.

10 Commercialization Snapshot

The recommended commercialization pathway is service-led software:

- paid pilot implementations,
- annual subscriptions for hosted access and updates,
- paid custom analytics packages for donor and research workflows.

11 Conclusion

The Health Desert Scorer is best positioned as a practical planning layer between raw health data systems and field-level decision-making. Its value is in speed, usability, and transparent prioritization. With structured pilots, role-based onboarding, and documented governance, the project can evolve into a durable product for NGOs, clinic networks, and research partners.