

NIHR Global Health Research Group on Vaccines for Vulnerable people in Africa (Vanguard)

Utilizing the Community Vaccine Impact Vulnerability Index (CVIVI) to manage vaccination impact disparities in Uganda and Kenya



1. Background

Vaccination is one of the most effective public health interventions, preventing an estimated 37 million deaths between 2000 and 2019 across low- and middle-income countries (LMICs), particularly among children under five. Despite this progress, disparities in both vaccine access and impact remain a persistent challenge in Africa.

In Kenya, full immunization coverage stood at 80% in 2022, but county-level rates varied widely, from 29% to 94.9%, reflecting deep social and structural inequalities. Similarly, in Uganda, vaccination has significantly reduced child mortality from 151 deaths per 1,000 live births in 2000 to 52 in 2022 yet only 63% of children are fully vaccinated, with district-level coverage ranging from 33% to 84%.

Children in remote or marginalized regions face greater barriers to completing vaccination schedules due to factors such as poverty, maternal education, and limited access to health services. Biological factors such as malnutrition, and exposure to infections can weaken immune responses, limiting the full benefits of immunisation. These social, structural, and biological vulnerabilities interact in complex ways, leaving certain communities at higher risk of reduced vaccine impact.

Recognizing these challenges, global initiatives such as the WHO Immunization Agenda 2030 (IA2030) and Gavi 5.0 emphasize the need for equity-focused approaches that go beyond national averages to prioritize vulnerable populations. To support this effort, the Community Vaccine Impact Vulnerability Index (CVIVI) was developed under the [NIHR Vanguard project](#).

Vanguard is a collaborative, multidisciplinary project that brings together leading institutions from the UK and East Africa like LSHTM, UVRI, KEMRI-Wellcome, and others to investigate the biological, social, and structural factors influencing vaccine responses in vulnerable populations. By engaging communities and analyzing biological samples collected in Uganda and Kenya, the team aims to develop integrated strategies to optimize vaccine impact.

2. Aim

The CVIVI is a data-driven tool that integrates biological, social, and structural indicators to generate district-level vulnerability scores. It reveals disparities in vaccine impact and social risk factors into a single district-level score to map and compare vulnerability across Uganda and Kenya. By highlighting these regional disparities and identifying key drivers such as poverty, malnutrition, and low maternal education, the CVIVI provides evidence to guide district-specific immunisation strategies and outreach. It is designed to support policymakers and implementers in prioritising resources for communities least likely to benefit from current vaccination programs.

3. Methodology

The CVIVI was developed using 17 indicators identified from scientific literature and grouped into three domains: biological, social, and structural. Secondary data was sourced from the 2016 Uganda Demographic and Health Survey (UDHS) and the 2022 Kenya Demographic and Health Survey (KDHS), supplemented with immunisation coverage and malaria prevalence data from the Ministries of Health.

Indicators were standardized, equally weighted, and combined into both domain-specific and overall composite scores, ranging from 0 (least vulnerable) to 1 (most vulnerable). To visualize inequalities, 123 districts in Uganda and 47 counties in Kenya were classified into quintiles from least to most vulnerable using geo-spatial analysis. Additionally, correlation analysis was conducted to examine the relationship between CVIVI scores and vaccination coverage, providing insights into how different vulnerabilities influence immunisation outcomes.

4. Key findings

Reduced benefits from vaccines are evident in both Uganda and Kenya, though patterns vary across regions. In Uganda, vulnerabilities are widespread but uneven, affecting both remote districts with refugee populations (e.g., Amudat, Lamwo, Buliisa, Kyenjojo) and more urbanized areas like Kampala. Some, like Lamwo, have recently experienced measles outbreaks pointing to underlying vulnerabilities despite ongoing immunisation efforts. In Kenya, the most vulnerable counties are in the northwest and southeast such as Turkana, Mandera, and West Pokot.

Each district and county shows a distinct vulnerability profile shaped by biological, social, and structural factors, that collectively affect vaccine impact. In Uganda, for example, Buliisa ranks among the most vulnerable (CVIVI score, 76.4%), with high rates of malaria prevalence (603.9 cases per 1000 population), anaemia (53%), and stunting (33.3%), limited access to postnatal care (80.8%), widespread poverty and low maternal education. Kampala, scored among the least vulnerable districts due to better maternal education and health service access, still faces challenges such as moderate malaria burden (218.5 cases per 1000 population) and limited mass media access (58.6%), suggesting that even lower-risk areas require targeted support.

In Kenya, Turkana ranks among the most vulnerable, with widespread poverty, long travel distances to health facilities, and limited access to postnatal care, alongside high levels of child stunting and anaemia, which likely contributes to low vaccine coverage reported at 29% (KDHS, 2022). Kilifi shows high overall coverage (89.8%) but remains highly vulnerable due to severe biological and social challenges, including anaemia prevalence among children (45%), poverty (69%), low maternal education (69%), and poor sanitation (80%).

Importantly, high vaccine coverage does not always translate into high vaccine impact. For instance, in Uganda, most vulnerable districts reported vaccine coverage estimates above 100%, likely due to data quality issues, yet these districts still struggle with structural, social and biological vulnerabilities such as malnutrition or poor health access. In Kenya, most vulnerable counties like Turkana also had low vaccine coverage, although counties like Garissa were ranked less vulnerable and had low vaccine coverage.

5. Recommendations to put into practice

a. Integrate CVIVI into immunisation planning

CVIVI should be used alongside existing tools such as the Reach Every District (RED) strategy to improve planning, outreach, and campaign targeting. It allows for prioritization based on vulnerability, not just coverage.

b. Tailor interventions to local needs

Different vulnerability profiles call for context-specific responses. For example, mobile teams in physically isolated districts, health education campaigns in areas with low maternal education, and integrated services (e.g., vaccination with deworming) in biologically at-risk communities.

c. Invest in data systems and capacity building

To institutionalize CVIVI, both countries need stronger data-sharing systems, multi-sector collaboration, and capacity building at national and district levels to analyze and apply vulnerability data effectively.

6. Conclusion

The CVIVI provides both countries with an important tool for contributing to make immunisation more equitable and effective. It moves beyond static coverage data to uncover hidden vulnerabilities and ensure that no community is left behind. Institutionalizing CVIVI will support the health systems to deliver more impactful, inclusive, and data-informed vaccination programs.

References:

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2. Li, X., Mukandavire, C., Cucunubá, Z. M., et al. (2021). [Estimating the health impact of vaccination against ten pathogens in 98 low-income and middle-income countries from 2000 to 2030: a modelling study - PMC](#)

