



# Analyzing the Early Warning Indicators of HIV Drug Resistance among Antiretroviral Sites in Northeastern Namibia in 2014



## Background

Population-level emergence of HIV drug resistance (HIVDR) has been an imminent consequence associated with the global scale-up of antiretroviral therapy (ART)<sup>1,2,3,4,5</sup>. Especially within the context of resource-limited settings, HIVDR and related treatment failure pose significant threats to successful ART scale-up and sustainability, if not promptly and adequately addressed. It is essential to monitor the World Health Organization's (WHO) Early Warning Indicators (EWIs) of HIVDR among patients on ART to best understand emerging patterns of HIVDR, identify opportunities to optimize the quality of care, and minimize preventable HIVDR<sup>2,3,4,5</sup>. EWIs are site-level factors that create situations favorable to the emergence of HIVDR, such as on-time pill pick-up, retention in care, pharmacy stock-outs, dispensing practices, and virological suppression<sup>2,3,4,5</sup>.

Namibia, a resource-limited country in sub-Saharan Africa, has been severely affected by the HIV epidemic<sup>1,2,4,5,6,7</sup>. Fortunately, the country has been successful in scaling up ART coverage to all patients eligible for therapy<sup>1,2,4,5,6,7</sup>. Therefore, ongoing surveillance of population-level HIVDR is necessary to best preserve the efficacy and sustainability of the national ART program. Namibia is divided into 13 administrative regions, which are further subdivided into 34 health districts<sup>6,7</sup>. The northeast Kavango region, which consists of the Andara, Nyangana, Rundu, and Nankudu districts, is the focus of this study<sup>6,7</sup>.

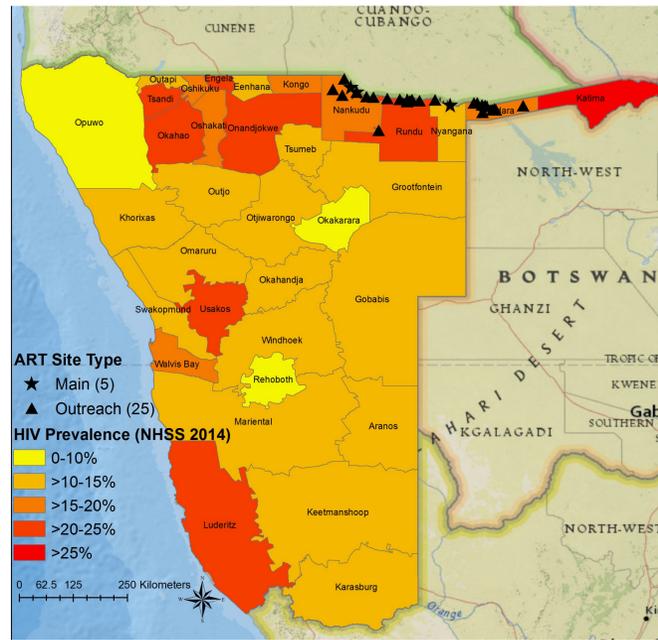
Applying GIS technology to HIVDR analysis offers great potential to understanding the spatial dimensions of the HIV epidemic and care continuum. Furthermore, spatial analysis is an essential informative tool for monitoring the epidemic, identifying problematic program factors, predicting future program demands, and targeting areas requiring intervention. Integrating GIS into HIVDR surveillance can inform how Namibia's ART program can be optimized in the future and how it can be used as a model for other resource-limited settings.

## Methodology

Site-level geocoded and de-identified clinical EWI data from 2014 on the national ART program were collected from Namibia's Ministry of Health and Social Services (MoHSS). Regional HIV and ART program data were extracted from the MoHSS' 2013 National Demographic and Health Survey (NDHS), 2014 National HIV Sentinel Survey (NHSS), and 2015 National AIDS Response Progress Report. All data were organized in MS Excel and joined to site-level XY coordinates or Namibia regions shapefiles to plot and assess HIV prevalence and site-level EWI performance by geographical location and region using ArcGIS. After performing the join, 30 ART sites with both EWI and geocoded data in Kavango region were chosen as the focus of this project. 5 EWIs were analyzed for each ART site and site-level performance for each EWI was characterized by color according to WHO's EWI score card: "Red" indicates poor performance (below desired level); "Amber" demonstrates fair performance (not yet at desired level); and "Green" reflects excellent performance (achieving desired level). Choropleth maps were created to show HIV prevalence by administrative health district across Namibia, overlaid with color-coded graduated symbols to portray site-level EWI performance data. A map with multiple-distance ring buffers highlighting distances from each site was created to provide context in terms of access to care upon assessing performance relative to retention in care and virological suppression.

HIV Drug Resistance Early Warning Indicator Score Card	
Early Warning Indicator	Target
1. On-time pill pick-up	Red: <80% Amber: 80-90% Green: >90%
2. Retention in care	Red: <75% retained after 12 months ART Amber: 75-85% retained after 12 months ART Green: >85% retained after 12 months ART
3. Pharmacy stock-outs	Red: <100% of a 12 month period with no stock-outs Green: 100% of a 12 month period with no stock-outs
4. Dispensing practices	Red: >0% dispensing mono or dual therapy Green: 0% dispensing mono or dual therapy
5. Virological suppression	Red: <70% viral load suppression within 12 months of starting ART Amber: 70-85% viral load suppression within 12 months of starting ART Green: >85% viral load suppression within 12 months of starting ART

## Map 1: HIV Prevalence by Health District in Namibia & ART Sites in Kavango Region Discussion



Given that HIV has burdened particular health districts more so than others throughout the country, it is essential for Namibia's MoHSS to focus its efforts on ensuring the efficacy of the national ART program, especially within areas where the population is most vulnerable to the transmission of HIV and HIVDR. The health districts within the Kavango region, namely Andara, Nyangana, Rundu, and Nankudu, have been disproportionately burdened by the HIV epidemic, as exemplified by their relatively high prevalence of HIV relative to the rest of the country. Upon assessing site-level performance with regards to the EWIs of HIVDR among 30 ART sites within Namibia's Kavango region, it is possible to understand which site-level factors seem up to par with WHO's recommended targets and which demand further attention and improvement.

It is particularly concerning that 28/30 (93.3%) of ART sites within Kavango achieved either poor or fair performance in terms of EWIs 1 and 2. The suboptimal performance with respect to on-time pill pick-up may be influenced by the rural environment of the Kavango region; however, this EWI has important implications in terms of proper adherence to ART protocols, which will likely affect the efficacy of the treatment and potential development of HIVDR. The substandard performance regarding retention in care faces and poses similar problems. Since 15/30 (50%) of ART sites exhibited at least one pharmacy stock out within 1 year, as exemplified by EWI 3 performance, it is important for the MoHSS and the individual ART sites to determine why pharmacy stock-outs have occurred and how they can be prevented in the future. It is promising that all 30/30 (100%) ART sites have achieved excellent performance for EWI 4 in terms of dispensing practices, which has important implications in terms of preventing the emergence of population-level HIVDR. Of the 5 Main ART sites for which data was available for EWI 5, no sites attained excellent performance with respect to virological suppression, so it is critical for future research to determine why patients have not been able to achieve satisfactory suppression of viral loads within 12 months of starting ART. The 30 ART sites studied in this project were mostly situated along the border with Angola, while few were located more centrally within each health district. It is worthwhile for future research to explore what other ART sites are available within these rural health districts, if any, or if there is a need for additional sites to serve the HIV-affected population. This study is limited in terms of the scope of the project, but it is hopeful that future research will continue to evaluate the EWIs of HIVDR in the context of GIS and spatial analysis.

## Results

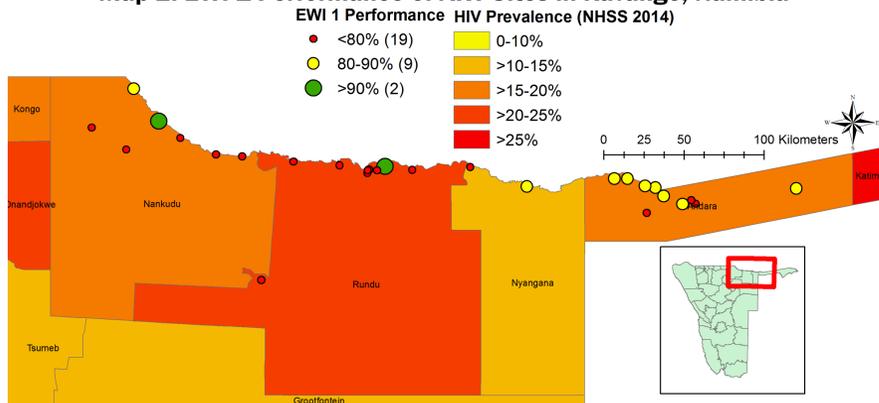
It is clear that the burden of the HIV epidemic, as approximated by prevalence estimates, is disproportionately distributed across the 34 health districts within the country of Namibia. The northern region along the border with Angola, in particular, carries a disproportionately higher burden of HIV relative to other regions within Namibia. It is also evident that most of the 30 ART sites assessed within the Kavango region are situated near the border that Namibia shares with Angola. Among the 30 ART sites included in this study, 5 were classified as Main sites, whereas 25 were classified as Outreach sites. With respect to EWI 1 (on-time pill pick-up), 19 sites achieved poor performance, 9 sites achieved fair performance, and 2 sites achieved excellent performance. In terms of EWI 2 (retention in care), 22 sites attained poor performance, 6 sites attained fair performance, and 2 sites attained excellent performance. With regard to EWI 3 (pharmacy stock-outs), 15 sites demonstrated poor performance, while the other 15 sites demonstrated excellent performance. All 30 sites achieved excellent performance for EWI 4 (dispensing practices). Data regarding EWI 5 (virological suppression) was only available for the 5 Main ART sites, 2 of which exhibited poor performance, and 3 of which exhibited fair performance. Analysis of distances to ART sites in Kavango showed significant overlapping of ART site coverage within a 10 km radius of sites in the Andara and Rundu districts; however, sites in the Nyangana and Nankudu districts were more spaced out.

## References

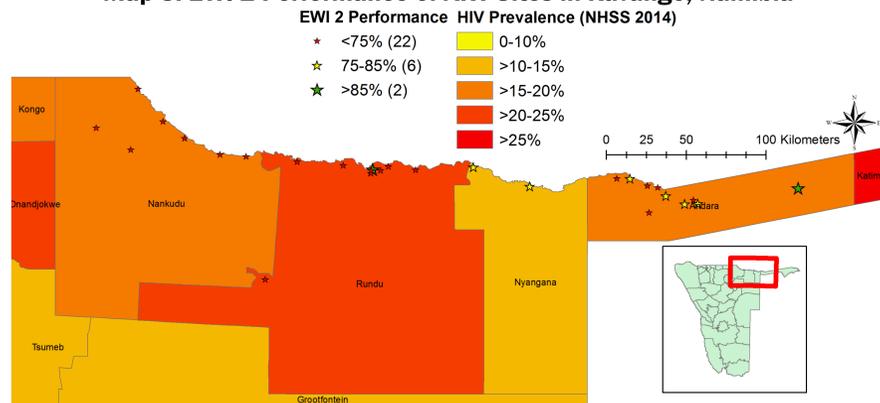
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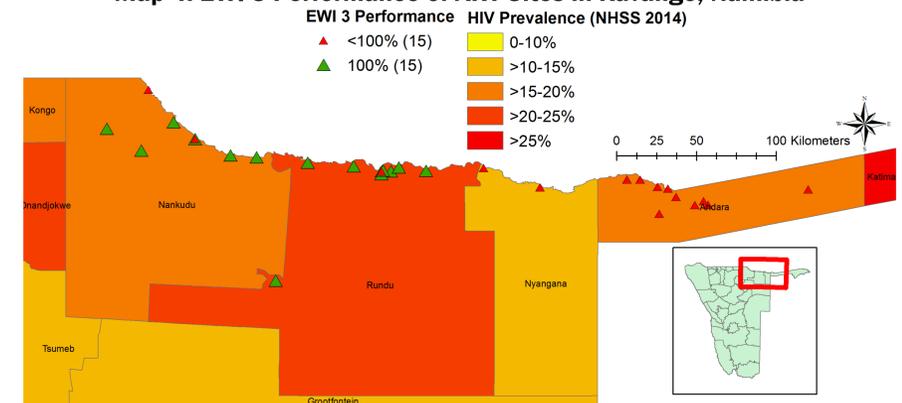
Map 2: EWI 1 Performance of ART Sites in Kavango, Namibia



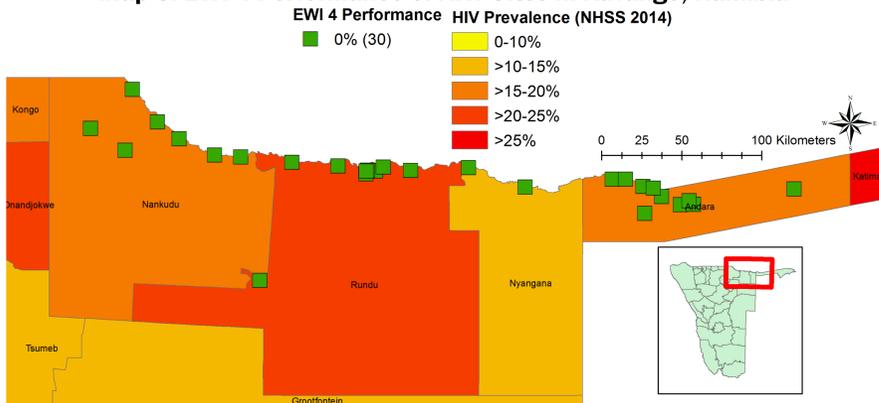
Map 3: EWI 2 Performance of ART Sites in Kavango, Namibia



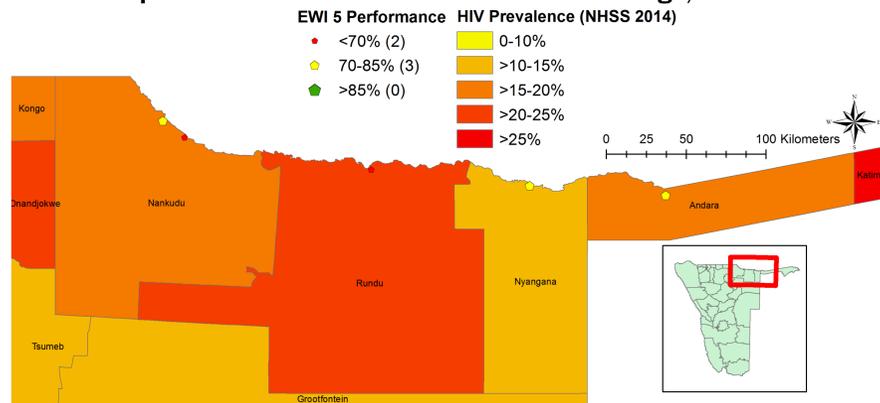
Map 4: EWI 3 Performance of ART Sites in Kavango, Namibia



Map 5: EWI 4 Performance of ART Sites in Kavango, Namibia



Map 6: EWI 5 Performance of ART Sites in Kavango, Namibia



Map 7: Distances to ART Sites in Kavango, Namibia

