Mapping and characterising HIV transmission hotspots in sub-Saharan Africa

Caroline A. Bulstra[1,2*], Jan A. Hontelez[1,2*], Federica Giardina[1], Richard Steen[1], Nico J.D. Nagelkerke[1], Till Bärnighausen[2,3,4], Sake J. de Vlas[1]

1 Department of Public Health, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands; **2** Heidelberg Institute of Global Health, Heidelberg University Medical Center, Heidelberg, Germany, Department of Global Health and Population; **3** Harvard T.H. Chan School of Public Health, Boston, USA; **4** Africa Health Research Institute (AHRI), KwaZulu-Natal, South Africa

1. BACKGROUND

- In the generalised epidemics of sub-Saharan Africa (SSA), HIV prevalence shows **patterns of clustered micro-epidemics** or 'hotspots'.
- These hotspots are **likely important drivers of the epidemic**
- Identifying their location and underlying determinants is essential to **further optimise HIV prevention and treatment interventions**.

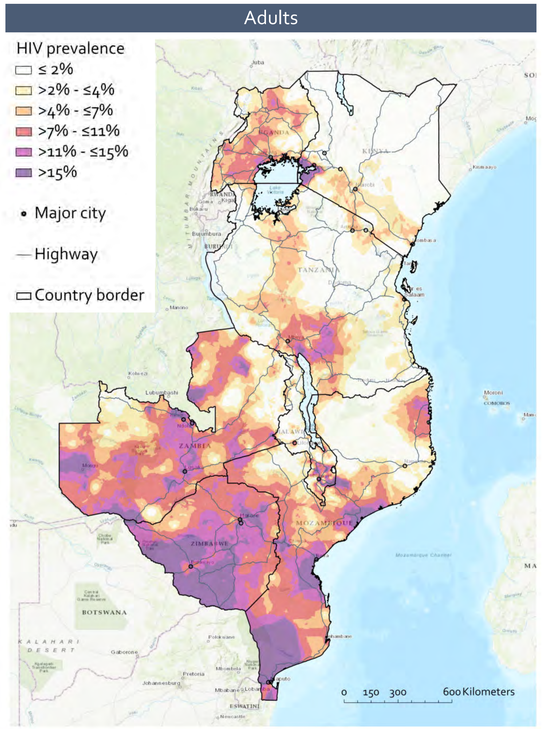
2. AIM

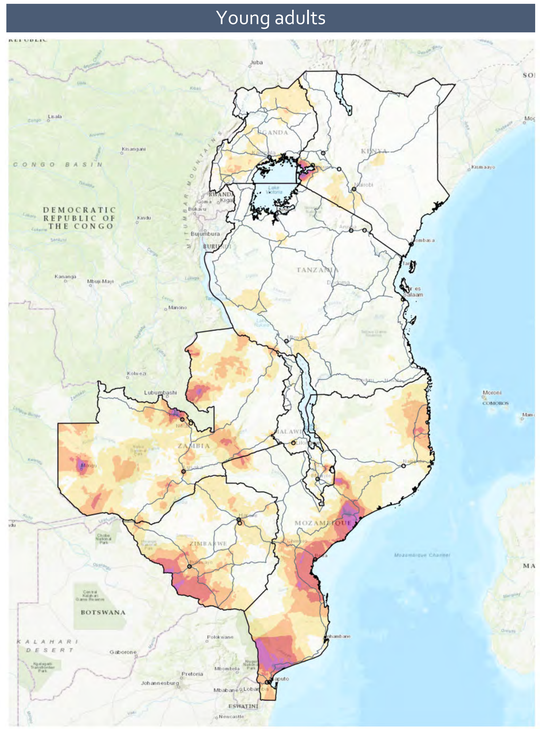
- To **map and characterise high prevalence areas for young adults** (15-29 years of age), as a proxy for areas with high levels of transmission, for seven countries in Eastern and Southern Africa: **Kenya, Malawi, Mozambique, Tanzania, Uganda, Zambia, and Zimbabwe**.
- To **explore to what extent sexual behavioural, socioeconomic and environmental factors explain the geospatial heterogeneity** in young adults, and what heterogeneity remains unexplained.

3. METHODS

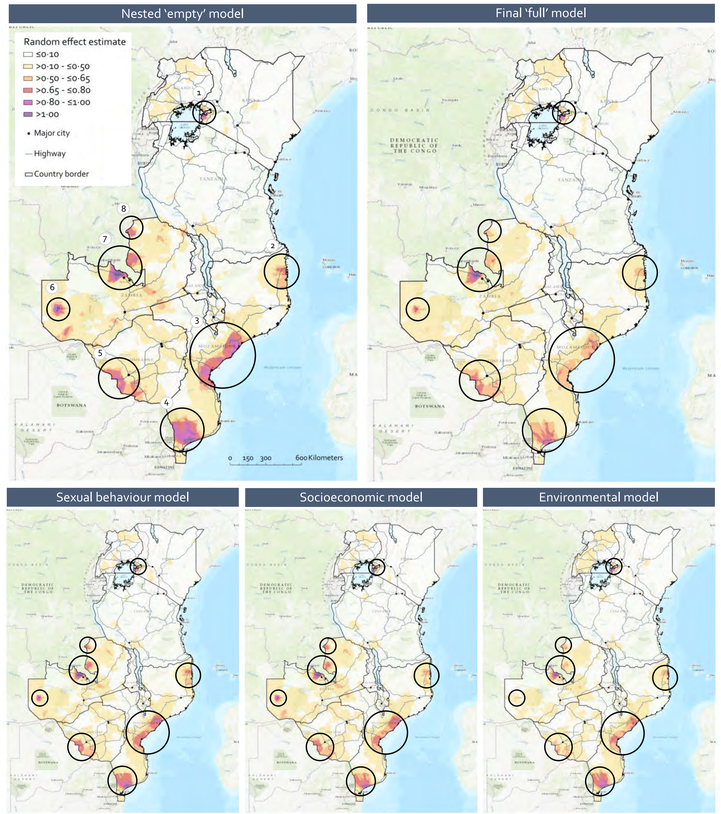
- We used geolocated survey data from the most recent **USAID Demographic and Health Surveys and AIDS Indicator Surveys** (collected between 2008-2009 and 2015-2016), which included about 113,000 adults, of which about 53,000 young adults, from over 3,500 sample locations.
- **I** Ordinary kriging was applied to predict HIV prevalence at unmeasured locations.
- **II** We developed a series of multilevel multivariable logistic regression models and geospatially visualising unexplained model heterogeneity to explore to what extent behavioural, socioeconomic and environmental factors explain HIV prevalence at the individual- and sample location-level.

4. RESULTS





- **National-level HIV prevalence** for young adults ranged from **2.2% in Tanzania** to **7.7% in Mozambique**.
- At **the subnational level** we found areas with prevalence among young adults **as high as 11% or 15% alternating with areas with prevalence between 0% and 2%**, suggesting the existence of areas with high levels of transmission.



- Overall, **15.6% of heterogeneity** could be **explained by an interplay of known behavioural, socioeconomic and environmental factors**.

5. CONCLUSIONS

- We found that among young adults, micro-epidemics of relatively high HIV prevalence alternate with areas of very low prevalence, clearly **illustrating the existence of areas with high levels of transmission**.
- These areas are partially **characterised by high economic activity, relatively high socioeconomic status, and risky sexual behaviour**.
- **Targeted localised HIV prevention interventions** specifically tailored to the populations at risk will be **essential to curb transmission**.