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METHODS NOTE · Peer-reviewed · Published · Live dashboard figures

The Network Entropy and Structural Disorder in African Clinical Research: A Meta-Analysis Review

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KEY WORDS Network Entropy; structural Disorder; Information-theoretic Metrics; Herfindahl-Hirschman Index (HHI); Organizational Complexity; Diversity; Concentration

Background

Understanding the structure and resilience of clinical research networks is critical for strengthening equitable health systems. In Africa, persistent challenges include fragmentation, external dependency, and limited coordination compared to more mature systems. Information theory provides a quantitative framework to assess diversity, concentration, and organizational complexity (Mazibuko and Govender, 2017)

Methods

We applied information-theoretic metrics to 23,873 trials from ClinicalTrials.gov. Sponsor distribution across African countries was analyzed using Shannon entropy relative to a theoretical maximum, while network concentration was assessed using the Herfindahl-Hirschman Index (HHI) (Schmallenbach et al., 2025)

Results

Africa's sponsor entropy was 3.1 bits versus a maximum of 5.8, yielding normalized entropy of 0.53, indicating moderate diversity with substantial concentration. The HHI of 0.315 suggests that fifty-four countries functionally resemble about 3.2 equally sized research systems, reflecting clustering around dominant hubs. Limited inter-country collaboration weakens resilience, increasing vulnerability to disruption (Capoani and Martini, 2024).

In Uganda, reliance on externally funded trials and weak integration across institutions constrains nationally driven priorities, including nutrition and infectious disease research (Fergus, 2022)

Conclusion

Africa's research ecosystem shows limited organizational complexity relative to its scale. Strengthening intra-African collaboration, institutional linkages, and domestic funding is essential for building resilient, locally driven research systems(OPERATING and PORT)

Interactive dashboard figures

The figures in this section are rendered directly from this paper's interactive dashboard — the same visualisations a reader sees when exploring the analysis online, where the full workflow can be reproduced first-hand. **Interactive dashboard:** https://mahmood726-cyber.github.io/africa-e156-students/methods-systems/dashboards/network-entropy.html

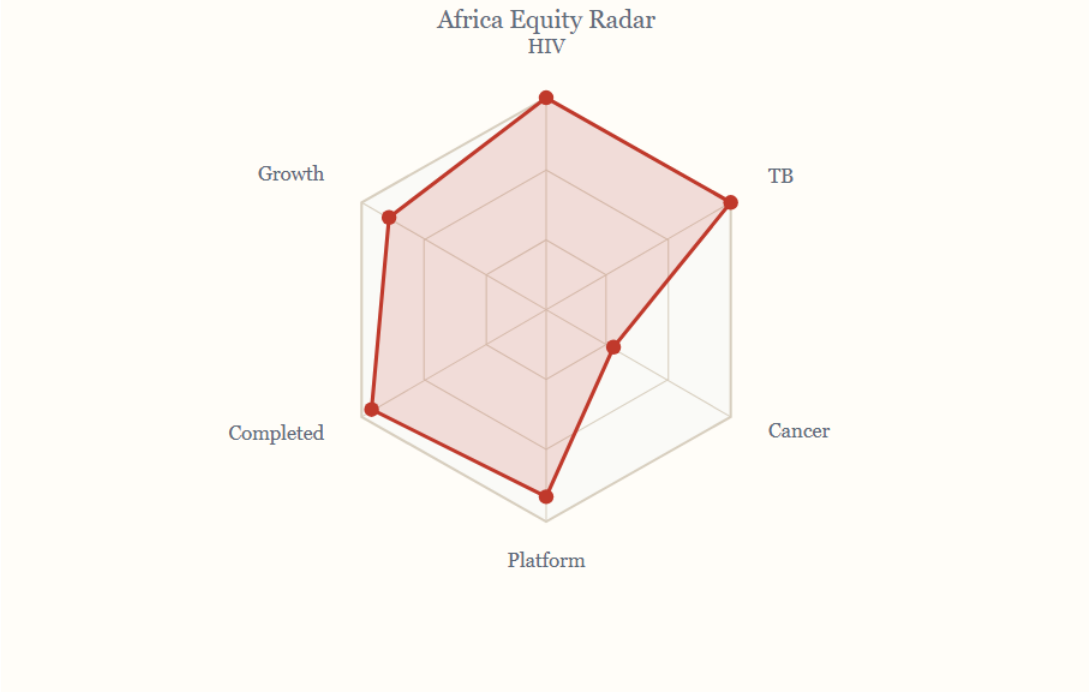

Figure 1. Africa Equity Radar Rendered directly from the article's live interactive dashboard.

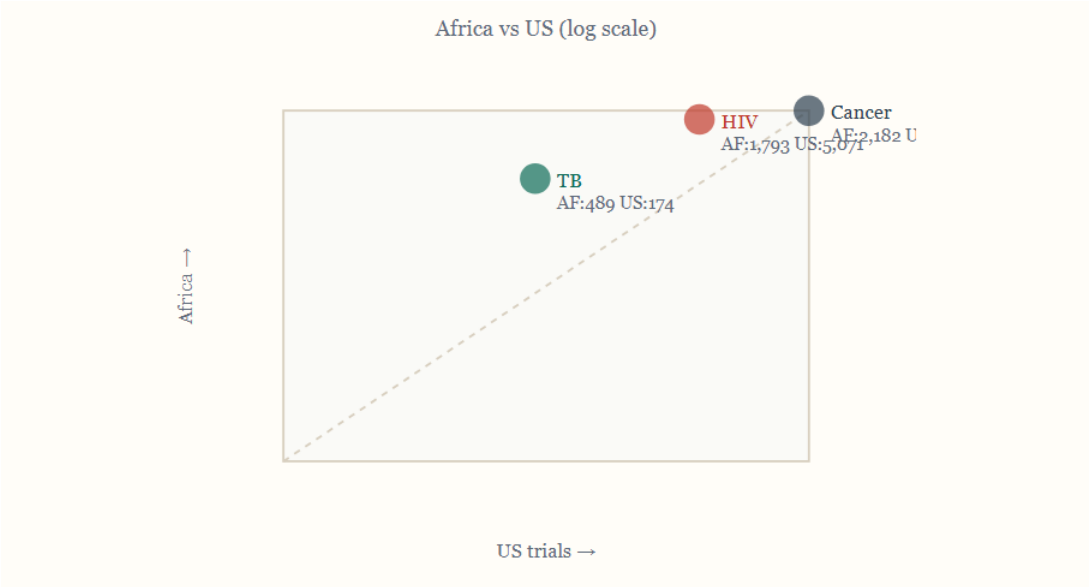

Figure 2. Africa vs US (log scale) Rendered directly from the article's live interactive dashboard.

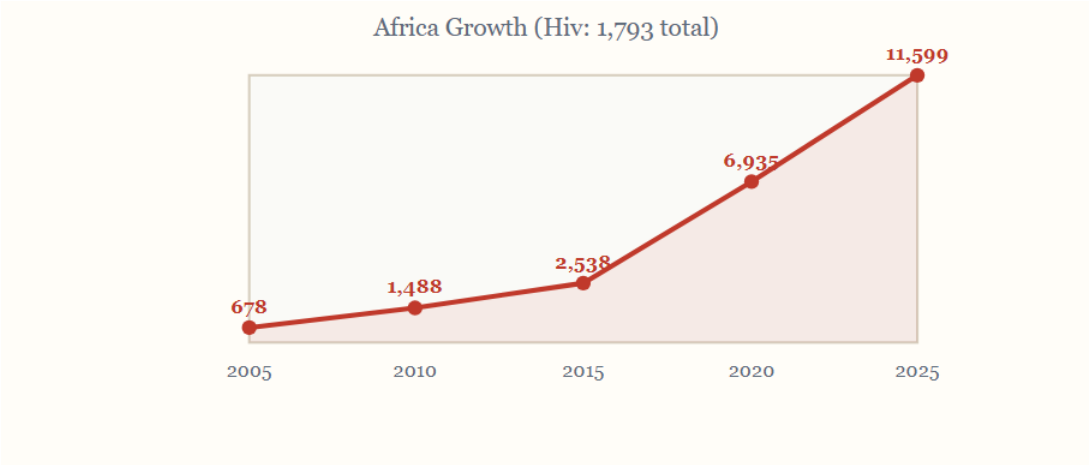

Figure 3. Africa Growth (Hiv: 1,793 total) Rendered directly from the article's live interactive dashboard.

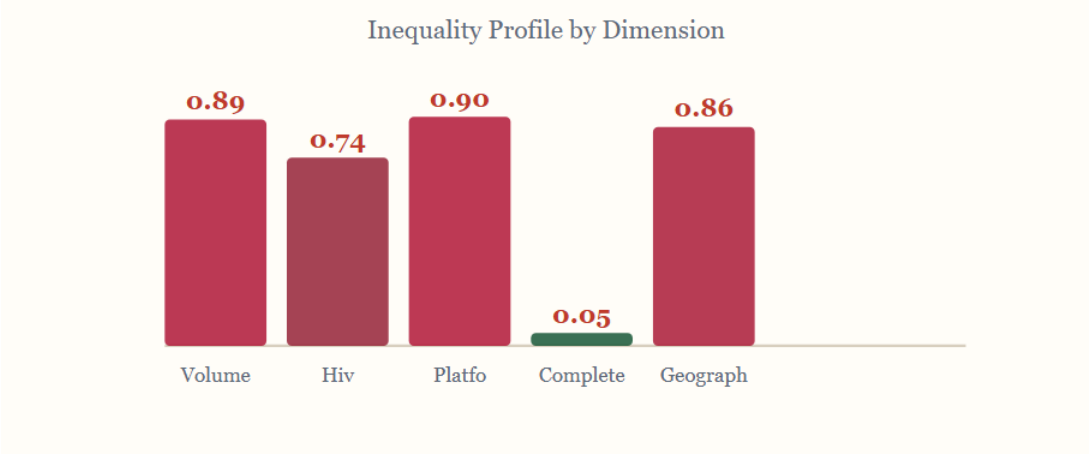

Figure 4. Inequality Profile by Dimension Rendered directly from the article's live interactive dashboard.

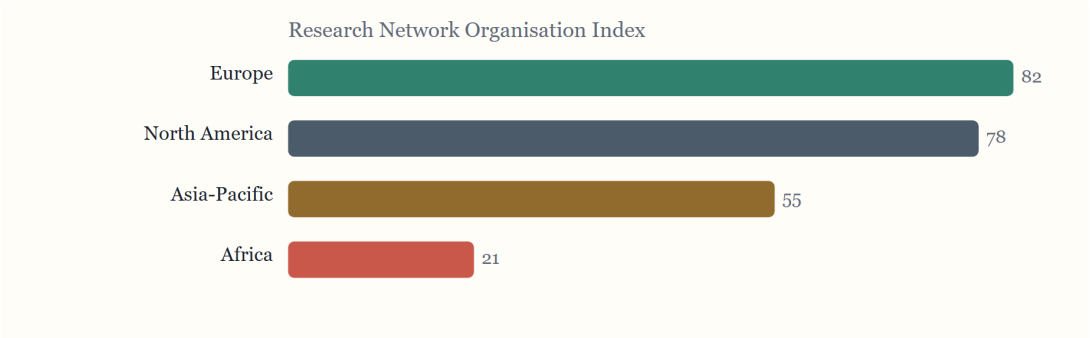

Figure 5. Research Network Organisation Index Rendered directly from the article's live interactive dashboard.

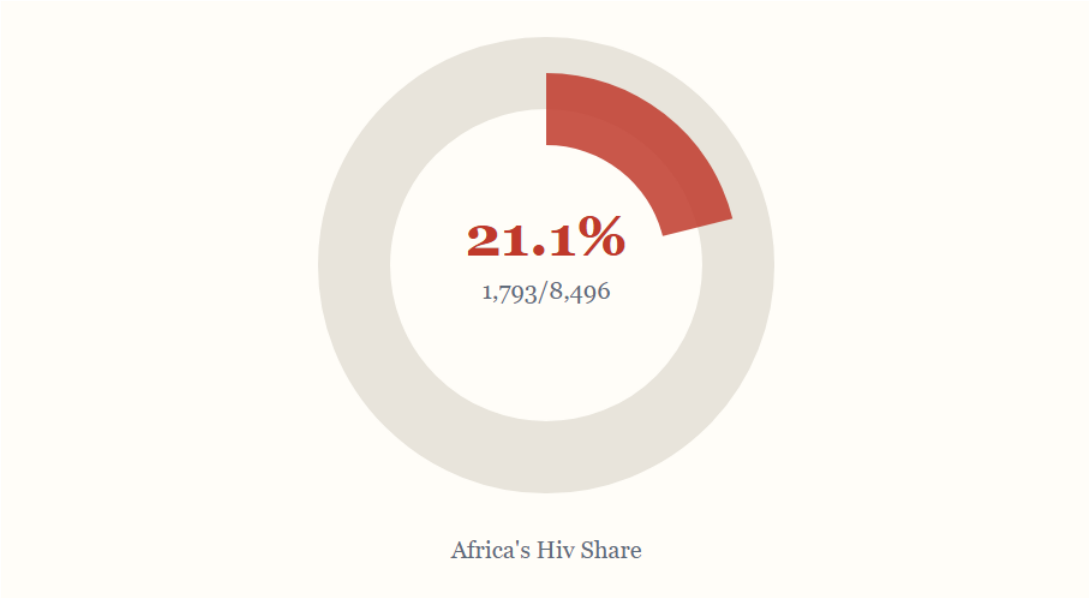

Figure 6. Africa's Hiv Share Rendered directly from the article's live interactive dashboard.

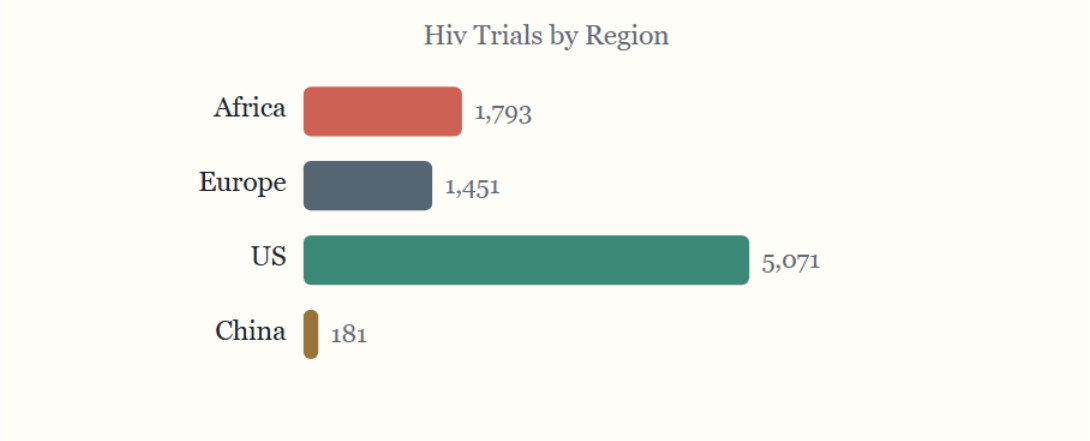

Figure 7. Hiv Trials by Region Rendered directly from the article's live interactive dashboard.

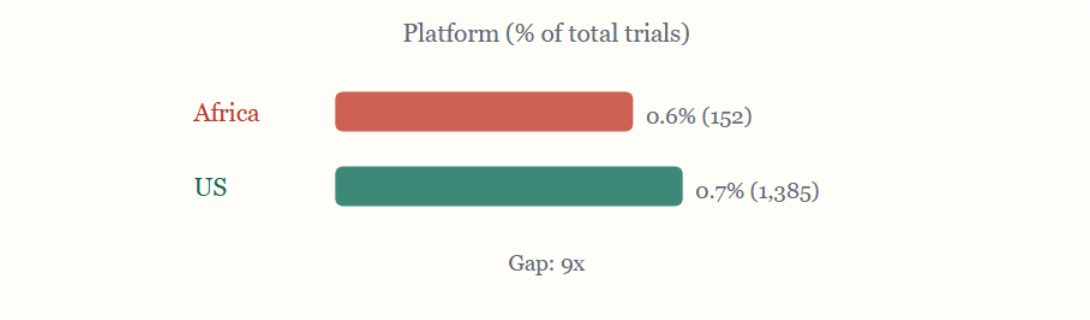

Figure 8. Platform (% of total trials) Rendered directly from the article's live interactive dashboard.

HOW TO CITE

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