Digital Health at the African Frontier

Building evidence where it matters most

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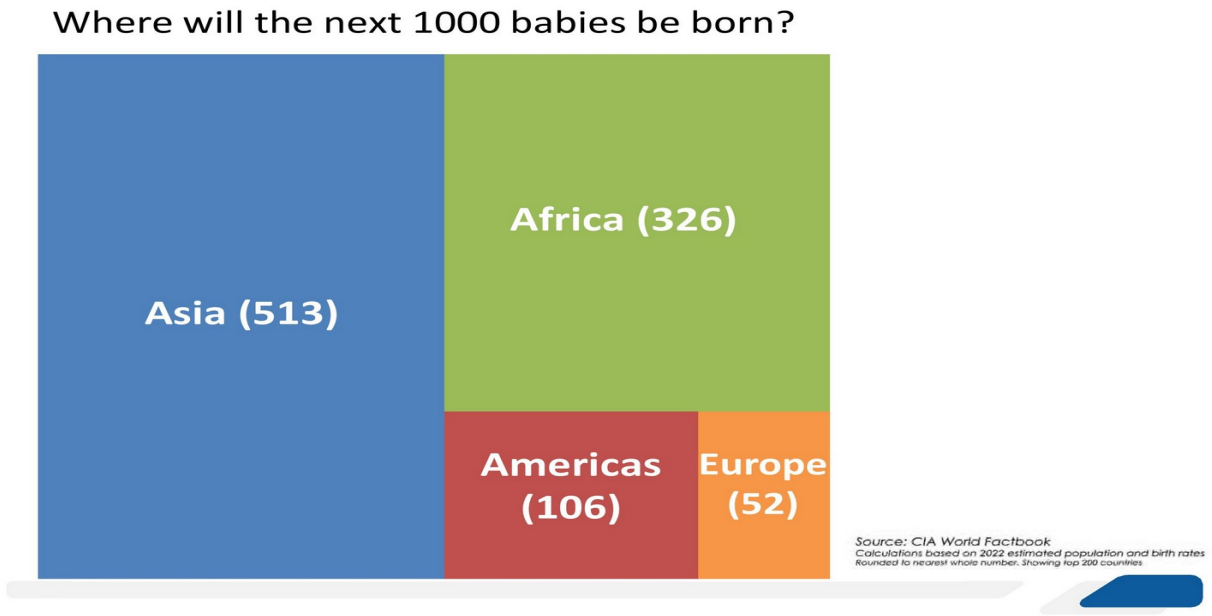
Where Will the Next 1,000 Babies Be Born?



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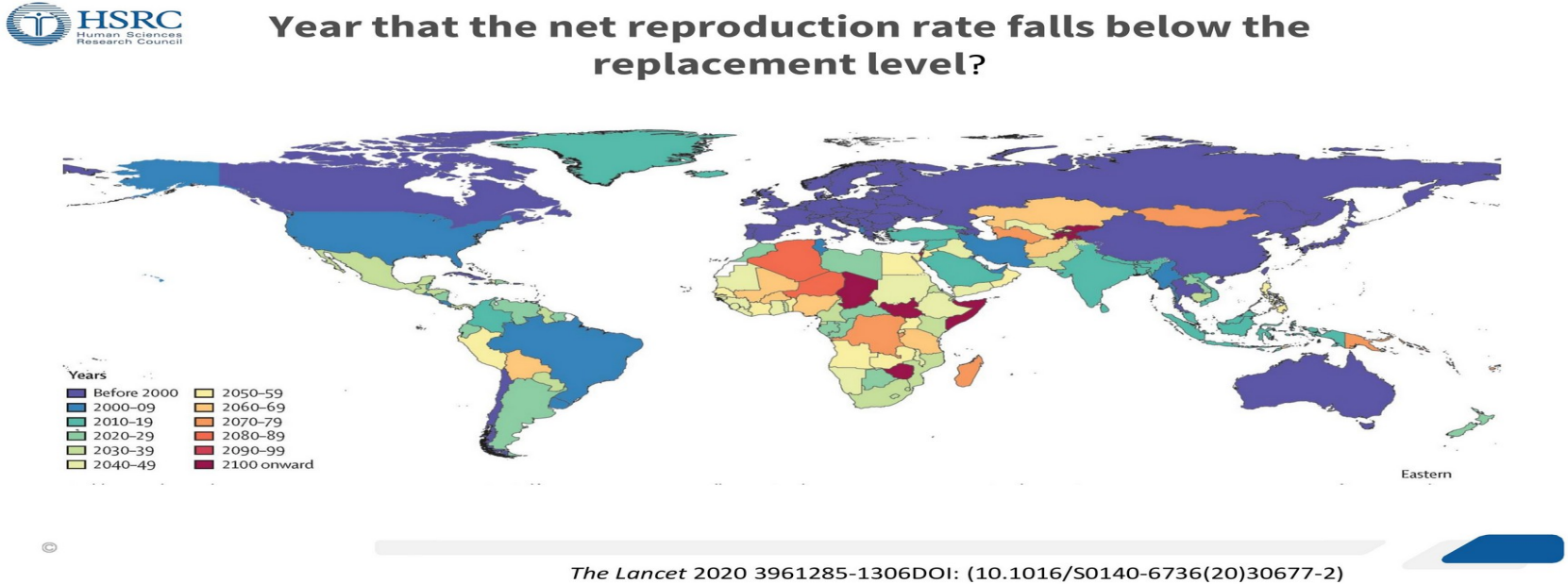
The Demographic Pivot



Vollset SE et al. Lancet. 2020;396(10258):1285-1306

Africa Is Not a Country

54

countries

2,000+ languages spoken across the continent

16M

in Lagos

vs a 2-hour walk to the nearest clinic in rural KZN

$280–$23K

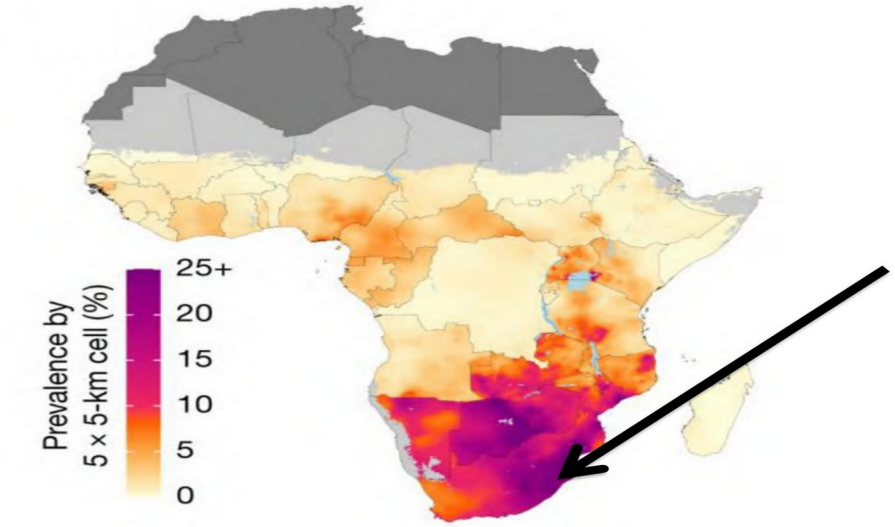
GDP/capita

Burundi to Seychelles — 100x variation

The continent is not homogeneous — and neither are its health challenges.

The Quadruple Burden of Disease

HSRC Human Sciences Research Council



South Africa

HIV prevalence: 27%

One of 16 countries that account for 93% of the global TB burden.

Half of all adults in South Africa are overweight (23%) or obese (27%)

Southern Africa reports the highest age standardised incidence rate of Cervical Cancer worldwide (43.1 per 100,000)

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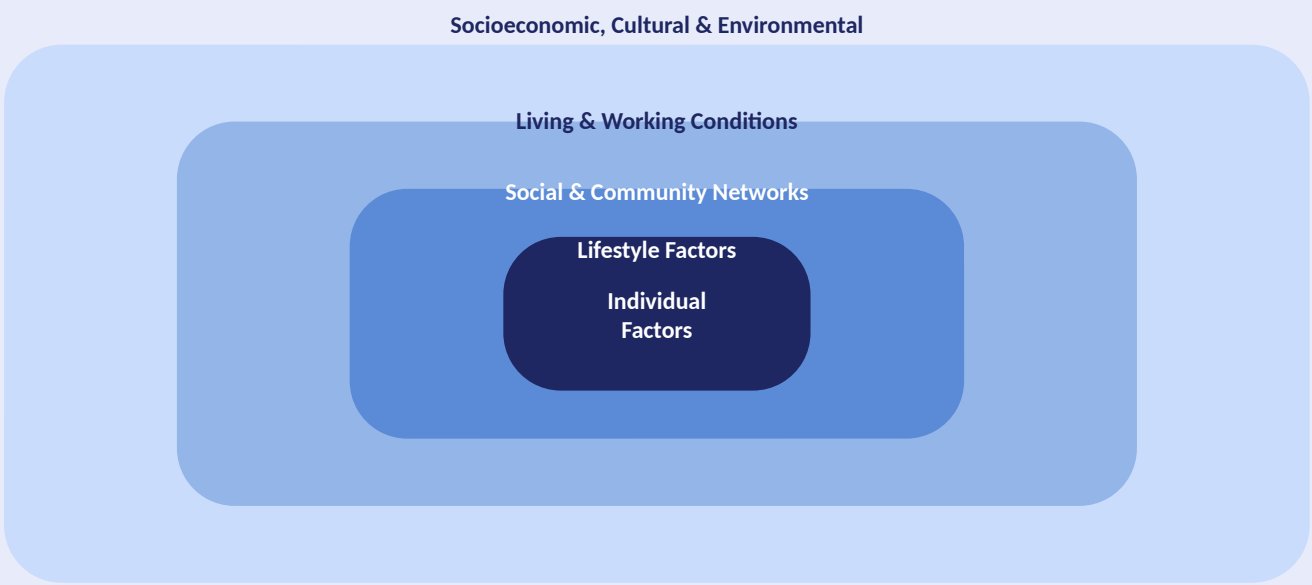
Dwyer-Lindgren, Nature, 2019; WHO, 2020; World Bank, 2022; Elima Jedy-Agba, 2020

It's Not Just Biology — It's Everything Else



Dahlgren & Whitehead (1991)

Barriers to Care: Distance

2+

hours

Average travel time to clinic in rural KwaZulu-Natal

- 60% of sub-Saharan Africans live in rural areas
- Health facilities concentrated in urban centres
- Travel costs can exceed the cost of the medicine itself
- For chronic conditions requiring monthly visits, the burden compounds

88% of patients in our study reported experiencing rude, judgmental, or dismissive attitudes from healthcare workers.

— Khumalo et al., community photovoice study, Sweetwaters

- Stigma around HIV, mental health, sexual orientation
- Youth particularly reluctant to access SRH services
- Trust deficit compounds geographic and economic barriers

Barriers to Care: Economic Reality

$15+

Cost of a single clinic visit

Transport + lost wages + medicine — in settings where daily income is $2–5

40%

Out-of-pocket health expenditure

In sub-Saharan Africa, nearly half of health spending comes directly from families

∞

Catastrophic health spending

Medical costs push vulnerable families deeper into poverty — a devastating cycle

The Digital Divide Is Not What You Think

84%

Mobile broadband
coverage in sub-Saharan Africa

65%

“Usage gap”
covered but not connected

The problem isn't coverage. It's affordability.

GSMA State of Mobile Internet Connectivity 2023

The Cost of Being Connected

3.9% of monthly income for 1GB of data in sub-Saharan Africa

87% of monthly income for a smartphone (poorest 20%)

4–7x more per MB paid by prepaid users vs contract users

Alliance for Affordable Internet / GSMA

So what can we actually do?

Community-centred digital health research
from KwaZulu-Natal

OUR RESEARCH SITE

Our Home Base: Sweetwaters, KwaZulu-Natal

STUDY 1: MENTAL HEALTH

Scaling Mental Health Support with Digital Tools

PROBLEM

- Depression affects ~25% of SA adolescents
- Only 10% receive treatment
- 0.31 psychiatrists per 100,000 (vs 16 in the US)

MEASURE

- DoBAt — gamified behavioural activation app for adolescents
- Kuamsha — culturally adapted for Uganda
- AI chatbots — LLM-powered support (JAMA Psychiatry)

OUTCOME

- Pilot RCT: feasibility & acceptability (JAACAP Open 2025)
- Kuamsha: promising engagement (JMIR Serious Games 2024)
- LLMs: potential for empathetic response (JAMA Psych 2023)

CONSTRAINTS

- Validated digital therapeutics scarce in LMICs
- Cultural adaptation is labour-intensive
- No regulatory frameworks for AI mental health tools
- StandStrong requires smartphones patients don’t own

Where the Frontier Lies

Open Research Questions

1. **Validation at scale**
   Can digital therapeutics match face-to-face therapy outcomes in LMIC settings?

2. **Cultural adaptation vs. fidelity**
   How much can you change an EBI before it's no longer evidence-based?

3. **AI safety and regulation**
   Who regulates an AI chatbot providing mental health support in Nairobi?

4. **Passive sensing ethics**
   StandStrong detects relapse via phone patterns — what are the consent implications?

5. **Sustainability**
   When the grant ends, who maintains the app? Digital tools need continuous engineering.

STUDY 2: HIV

Reimagining How People Access HIV Care

PROBLEM

- 5.5M South Africans on ART — largest programme globally
- Monthly clinic refills → transport costs, lost wages, queues
- 15–25% disengage from care within the first year

MEASURE

- DO ART — mobile van ART delivery into communities
- Nolwazi_bot — conversational agent for HIV self-testing
- Fee-for-home-delivery — user fee to test sustainability

OUTCOME

- DO ART: non-inferior viral suppression (Lancet Glob Health 2020)
- Nolwazi_bot: feasible & acceptable (JMIR 2022)
- Fee-for-delivery: patients willing to pay (Lancet HIV 2022)

CONSTRAINTS

- Supply chain logistics for community delivery are complex
- Chatbots can't replace clinical judgment — triage pathways critical
- Sustainability requires gov’t health system integration

Where the Frontier Lies

Open Research Questions

1. **Integration vs. disruption**
   How do you move community delivery into the national health system at scale?

2. **Chatbot limitations**
   When does a chatbot conversation become a clinical encounter? Triage is critical.

3. **Differentiated service delivery**
   Can digital tools enable stable patients to self-manage while high-risk get intensive support?

4. **Long-term retention**
   We have 12-month data. What happens at 5 years? Digital tools must support lifelong adherence.

5. **Social network effects**
   Peer-driven testing works (AIDS 2024). Can the same model drive treatment retention?

STUDY 3: WEARABLES

Wearable Biosensors for Pregnancy Complications

PROBLEM

- GDM affects 5–15% of pregnancies, higher in LMIC populations
- Standard screening is a single snapshot — misses variability
- GDM raises risk of preeclampsia, macrosomia, T2DM postpartum

MEASURE

- CGM in pregnancy — FreeStyle Libre sensors in SA
- ML prediction — CGM + clinical data to predict GDM

OUTCOME

- Successfully deployed CGM in resource-limited settings (SAJCN 2022)
- ML achieved clinically useful GDM prediction (IEEE JBHI 2024)
- Glycaemic variability differs between GDM and non-GDM women

CONSTRAINTS

- CGM sensors cost $50–70 each — prohibitive for public health
- Data transmission requires smartphone + connectivity
- Clinical integration: what does a nurse do with CGM data?
- No regulatory pathway for CGM-based screening in LMICs

Where the Frontier Lies

Open Research Questions

1. **Cost reduction**
   Can CGM costs drop enough for public health screening? What's the minimum monitoring window?

2. **Algorithmic fairness**
   Models trained on HIC data may not generalise. Validation across diverse LMIC populations is essential.

3. **Clinical actionability**
   Prediction without a clear intervention pathway is just surveillance. What protocols should follow?

4. **Beyond glucose**
   Can the same wearable infrastructure monitor other pregnancy complications?

5. **Data governance**
   Continuous physiological data from vulnerable populations raises ownership and privacy questions.

Designing With, Not For, Communities

Photovoice
Community members as co-researchers (Khumalo 2018)

HCD methodology
Integrating human-centred design (with Densmore & Till)

Scoping review
HCD in digital health for chronic disease in LMICs (Till et al. JMIR 2023)

AfriCHI / DIS / CSCW
Community connectivity, power dynamics, decolonising design

HSRC
Human Sciences Research Council

"When I'm on the Internet I don't live in a shack anymore

Participant 17
17 years
Female

> ***"When I'm on the Internet I don't live in a shack anymore."***
> — Photovoice participant, Sweetwaters

Where the Frontier Lies

Open Research Questions

1. **Power and participation**
   Do communities actually shape the research agenda, or just validate researchers' ideas?

2. **QualCAPT and passive data**
   How do communities understand and consent to passive data collection? Consent models must evolve.

3. **HCD beyond the prototype**
   Most HCD stops at the prototype. How do we carry participatory principles through to scale?

4. **Decolonising design**
   Can we develop methodologies rooted in African epistemologies rather than imported frameworks?

5. **Sustaining partnerships**
   Long-term community partnerships require trust and resources beyond individual grants.

The Frontier Is Here

1. Africa’s demographic trajectory makes it the most important place for health innovation this century
2. Digital tools can leapfrog infrastructure gaps — but only if designed for affordability, trust, and context
3. The hardest problems are not technical; they’re about power, sustainability, and integration
4. The research questions are wide open — and the stakes are enormous

Thank you