Computerised Adaptive Testing for Depression and Anxiety amongst adolescents

AfriCAT-DA

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The Challenge

The solution

Need for early identification

- Most adolescents with depression and anxiety remain **<u>undiagnosed</u> and untreated**
- **Overdiagnosis/ self-diagnosis** could lead to inappropriate treatment
- Efficient use of limited resources: **stratified care** based on severity
- **Brief, validated mental health screening/diagnostic tools** could address this gap…
- **BUT**… which tool? Conditions? By whom? Where? When? Competing health priorities?



Computerised Adaptive Testing

- a *novel paradigm* of mental health assessment
- based on advanced statistical and machine learning techniques
- more ***personalized***, ***precise***, ***efficient*** and ***scalable*** screening AND diagnosis
- <u>In a nutshell</u>:
  - Item Response vs. Classical Test Theory: *not every item contributes equally*
  - Large item banks
  - Individual items **calibrated**
  - After each item: **a severity score & precision estimate**
  - Subsequent **items are adaptively selected**
  - Testing continues until a **prespecified precision level** is achieved

Advantages of CATs



Personalised

Items varied based on responses



Precise

By design, achieve high precision

Can be used as diagnostic tools



Efficient

Compared to clinician diagnosis & non-adaptive tools



Scalable

Decreased respondent & administrator burden



Monitoring change

Items varied at each timepoint

Objectives & Methods

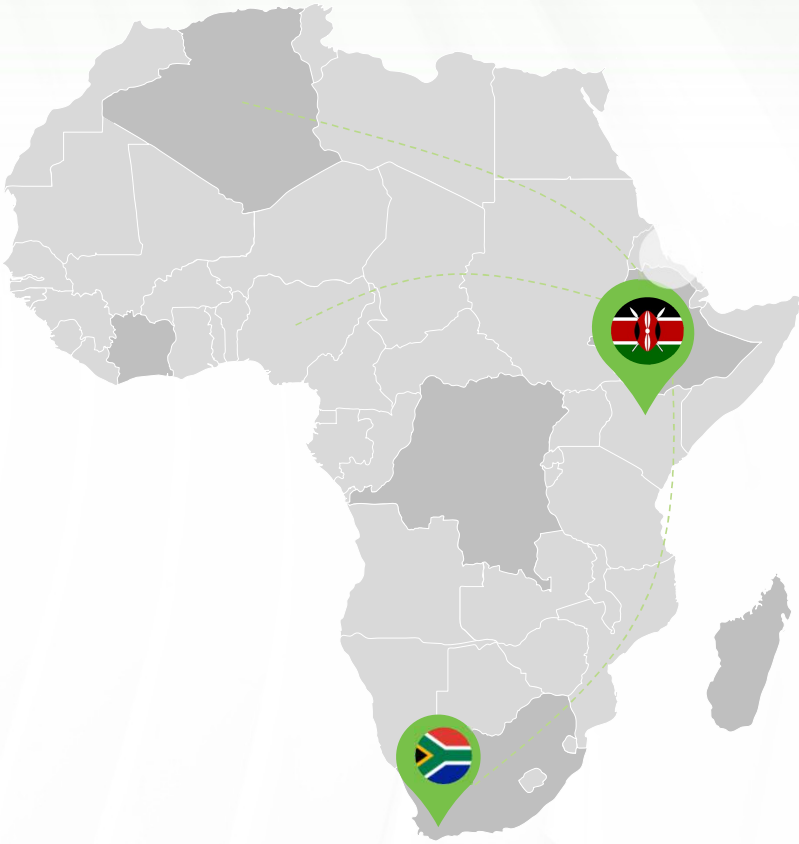
- Utilising data from **adolescent mental health surveys*** Kenya, South Africa

1. **Develop a Computerised Adaptive Test** for depression and anxiety amongst adolescents using existing data from African populations (AfriCAT-DA)
   - ➢ Miltidimensional Item Response Theory (MIRT)
   - ➢ Modular Clinical Decision Support Networks (MODN)
2. **Assess the efficiency and precision** of the AfriCAT-DA, compared to:
   - Gold-standard measures: K-SADS, DISC-5
   - Non-adaptive measures: e.g. PHQ-9, GAD-7

   Metrics:
   - ➢ **Diagnostic predictive accuracy**: sensitivity, specificity, AUROC
   - ➢ **Efficiency**: # items; time to administer
   - ➢ **Convergent/ divergent validity**

3. Assess opportunities for implementation & scale-up

- ➢ Community, stakeholder & lived-experience engagement



Objectives

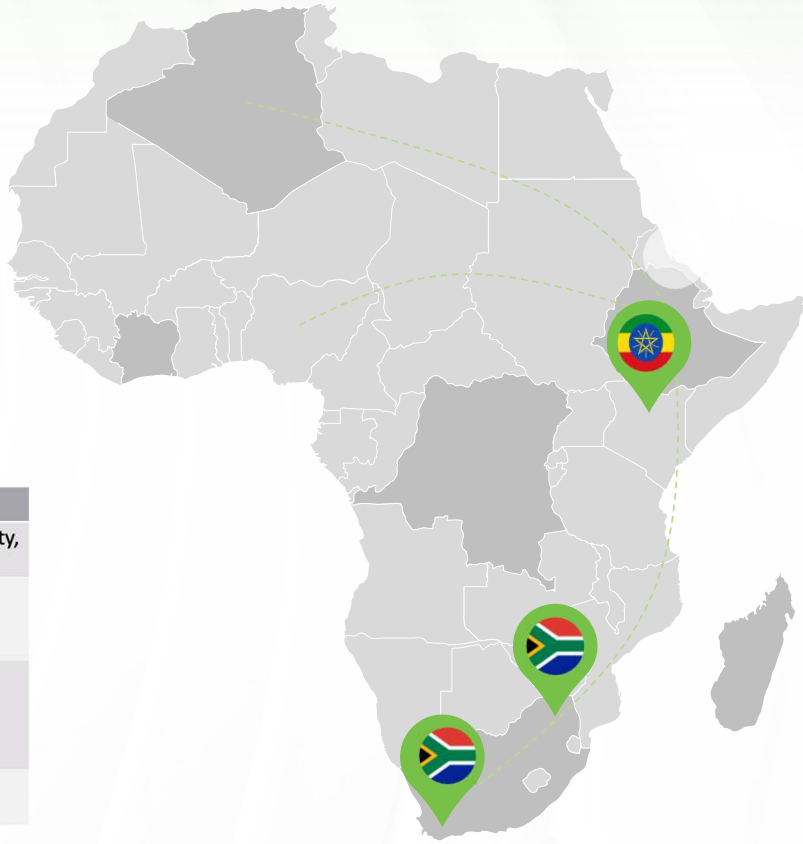
1. **Develop a Computerised Adaptive Test** for depression and anxiety amongst adolescents in an African population (AfriCAT-DA).
2. **Assess the efficiency and precision** (diagnostic predictive accuracy) of the AfriCAT-DA compared to non-adaptive instruments (e.g PHQ-9, GAD-7)

Hypothesis:

- The AfriCAT-DA will be more precise and efficient than non-adaptative measures

Methods - Detail

- Utilise data from **4 adolescent mental health surveys**:
- A subset of the data will be used to **develop the AfriCAT-DA** (Objective 1)
- The remaining data will be used to **simulate a validation study** (Objective 2)



Study	Setting	Study Design	Sample	Population	Outcomes
MMAP	Cape Town, South Africa	Cross-sectional survey	302	Adolescents 10-19 years	Depression, anxiety (generalized anxiety, separation anxiety, social anxiety)
ALIVE	Cape Town, South Africa	Baseline data from pilot RCT	240	Adolescents 13-15 years	Depression, generalized anxiety, disability, disruptive behaviour
K-NAMHS	Kenya	Cross-sectional survey	5155	Adolescents 10–17 years	Depression, anxiety (social phobia, generalised anxiety), PTSD, conduct disorder, ADHD, suicidal behaviours & self-harm
DOBAT	Mpumalanga South Africa	Baseline data from pilot RCT	195	Adolescents 15-19 years	Depression, generalized anxiety, resilience, wellbeing, rumination

Methods

Objective 1:
Development of the AfriCAT-DA

MIRT-CAT approach:

1. **Item bank generation**
2. **Item classification into meaningful subdomains**
3. **Individual item calibration**
4. **Selection of CAT algorithm**

Methods

Assess alternate modelling approach

- Modular decision support networks (MoDN)
  - a novel decision tree composed of a collection of question specific neural network modules
  - can be combined in any number or combination to make any number or combination of diagnostic predictions.

Methods

Objective 2:
Validation of the AfriCAT-DA

- **Comparing the AfriCAT-DA to:**
  - Gold-standard measures: K-SADS, DISC-5
  - Non-adaptive measures: e.g. PHQ-9, GAD-7
- **Metrics of evaluation:**
  - **Diagnostic predictive accuracy:**
    - **Sensitivity**
    - **Specificity**
    - **AUROC**
  - **Efficiency:**
    - Number of items
    - Time to administer
  - **Convergent validity**

Community, Stakeholder & Lived-experience Engagement



Objectives:

1. Ensure AfriCAT-DA tool *meets the needs of users*
2. *Optimize uptake & dissemination* of project insights & outputs
3. Enhance research efficiency and *foster collaboration*

Ethical issues

Risk	Mitigation strategies
1) Breeches to **data privacy & confidentiality**	• **De-identified participant da**ta. • Encryption & storage
2) Risk of **encoding bias** into the CAT algorithm	• Use of **source data from 2 African populations**. • *Future work: should investigate AfriCAT-DA in other African populations*
3) The**oretical risks** related to **administration of AfriCAT-DA**: Self-diagnosis, medication Over/ under-diagnosis Stigma *Demand & supply mismatch*[12,13]	• **Analytical dataset** & **source-code & user interface** <u>are</u> made accessible to other researchers (not to general public until efficacy & safety testing)

Ethical approval will be obtained from the University of the Witwatersrand Human Research Ethics Committe

Timelines

May-July 2025

Milestone 1

Study set-up:
- Contracts
- Protocol
- Ethics
- Kickoff workshop

Aug-Oct 2025

Milestone 2

Produce analytical dataset
- Data transfer, storage, harmonisation

Nov-Jan 2025

Milestone 3

Develop AfriCAT-DA algorithm
- MIRT
- MODN

Assess efficiency and precision (diagnostic predictive accuracy)

Feb-April 2026

Milestone 4

Dissemination & engagement
- Develop user interface
- Explore implementation use-cases