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Health, Economic and Equity Impact of Cardiovascular Disease Prevention in Kenya

James Oguta, MSc, BScN., CPA

Supervisors: Prof. Pete Dodd and Dr. Penny Breeze

Presentation at IHEA Webinar **28/11/2023**

About myself

- Second year Wellcome Trust PhD candidate in Public Health Economics and Decision Science at the University of Sheffield, UK

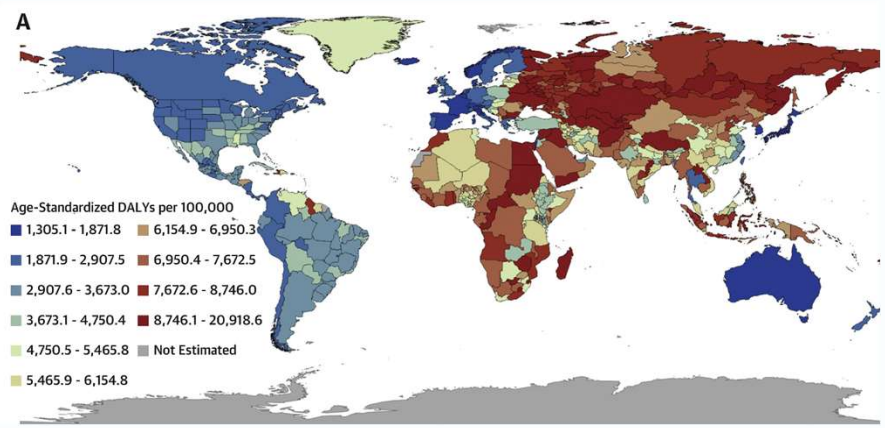
- **Academic background**: BSc. Nursing, MSc. Health Economics and Policy, Certified Public Accountant

- About 15 years of working experience in public health, health economics, health financing, PFM, banking, clinical practice and research in 10 low- and middle-income countries (LMICs)

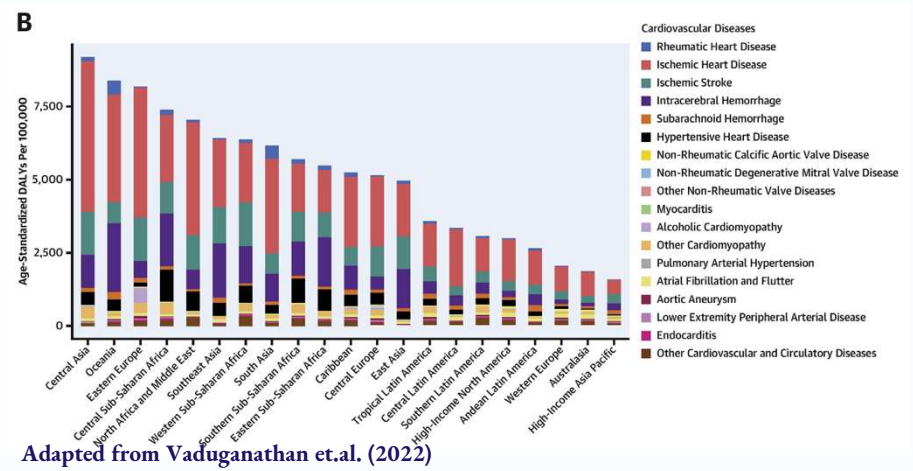
- Over 5 years as Health Economist/Health Financing Specialist at UNICEF

- **Career Goal:** Contributing to the design of HSS and health financing mechanisms that can lead the attainment of UHC in LMICs.

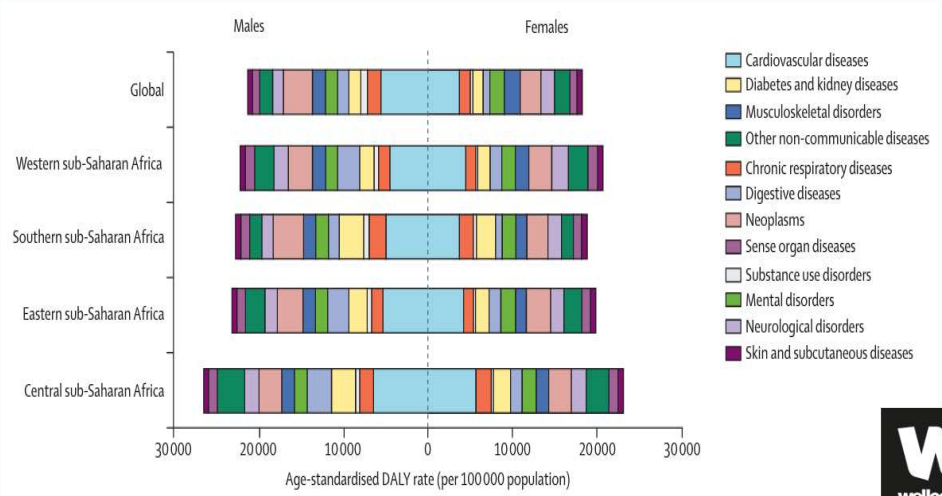
Background: Burden of Cardiovascular diseases



- Cardiovascular diseases (CVDs) are the leading causes of death and disability globally, and in all WHO regions.
- The burden is higher in low- and middle-income countries (LMICs)

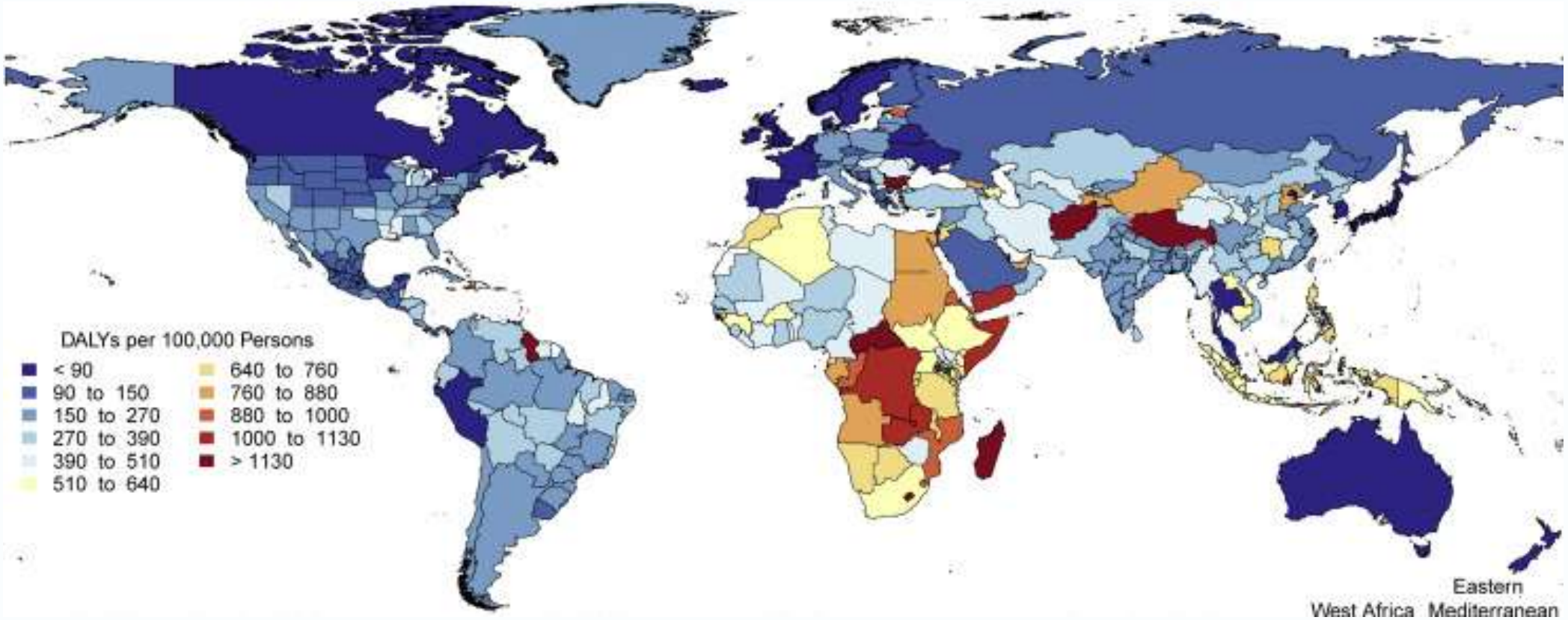


Adapted from Vaduganathan et.al. (2022)



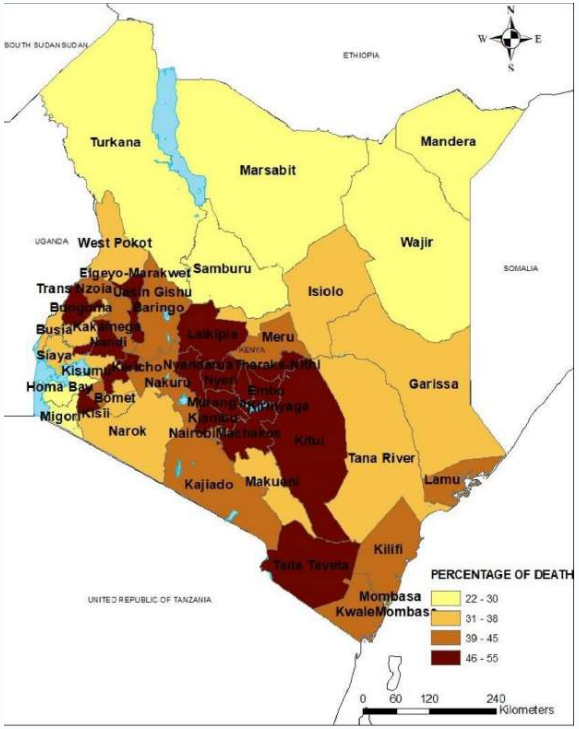
Adapted from Gouda et.al. (2019)

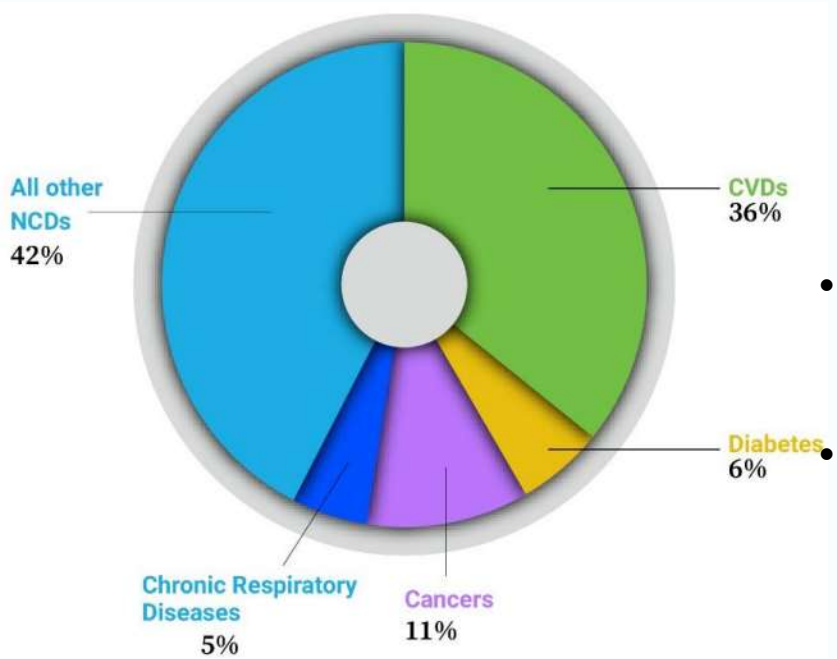
Background: Burden of Hypertensive Heart Disease in 2019



Adapted from Roth et.al. (2020)

Kenya: NCD and CVD burden





- Kenya is a lower middle-income country located in East Africa with 2022 GDP per capita of US$2099.3 [5]
- 39% of all deaths attributed to NCDs [6]
- CVDs (stroke and ischemic heart disease) are the leading causes of NCD deaths

Adapted from Kenya NCD Strategy 2021-2025

Kenya: The problem

- There is poor access and utilisation of CVD risk factor screening and treatment, which hinders progress towards reversing the CVD burden.
- The 2015 STEPS survey found that only 44%, 12.2% and 2.3% of adults in Kenya reported previous screening for hypertension, diabetes and hypercholesterolemia, respectively.
- Of those with a previous diagnosis of hypertension, only 22% were on treatment, of whom 51.7% had blood pressure control.
- Inequalities exist in access to CVD prevention interventions in Kenya, with 73.3% of the poorest quintile reporting never having blood pressure (BP) measurements compared to 38.4% in the richest quintile.
- There are significant catastrophic and impoverishing health expenditures attributed to NCDs in Kenya despite the government's commitment towards Universal Health Coverage (UHC)

The PhD Project

- This PhD project will examine the health, economic and equity impact of CVD prevention using a multicomponent community-based hypertension and diabetes screening and management intervention (EMPOWER HEALTH) in Kenya.

- The EMPOWER HEALTH intervention is implemented by the Ministry of Health, Kenya, with the support of Medtronic LABS, a technology not-for-profit organization, that provides and maintains the digital health component (SPICE digital platform).

- The intervention is implemented across 94 health facilities in 9 counties and has about 76000 enrolled patients since 2019.

- The intervention is due for scaleup to 35 additional counties as from 2024

The Intervention: EMPOWER HEALTH

COMMUNITY-BASED SCREENING

Community-based screening enables identification of a cohort of patients to be linked to a facility for confirmatory diagnosis

PERSONALIZED CARE PLANS

Algorithm driven follow-up planning provide patients with personalized care plans

COMMUNITY-BASED BP / GLUCOSE CHECKS

Community-based blood pressure checks enhance patient convenience and conserve facility resources

REMOTE MANAGEMENT AND FOLLOW-UP

Longitudinal data tracking, notifications for referrals, and tele-counselling allow for improved remote management

E-PRESCRIPTIONS

Digital prescriptions enhance patient convenience and conserve facility resources

The PhD Project: Specific Objectives

- To evaluate the relative cost effectiveness and budget impact of EMPOWER HEALTH intervention for CVD prevention compared to usual care in Kenya.

- To examine the financial risk protection benefits of scaling up the intervention in Kenya

- To investigate the equity impact of intervention scale-up in Kenya.

The PhD Project: Overview of Methods

- Systematic review- Application of decision analytic modelling in CVD prevention in SSA and model-based economic evaluations of community-based hypertension interventions in LMICs **(Completed)**
- Conceptual modelling and developing individual patient level simulation model (microsimulation) model to evaluate the cost effectiveness of the intervention **(To start in January 2024)**
- Extended cost effectiveness analyses to assess the financial risk protection benefits of intervention scale up
- Subgroup analyses and distributional cost effectiveness analyses to assess the equity impact of scaleup
- Potential outcomes-DALYs averted, CVD cases averted, deaths averted, cost saved, household out of pocket spending averted, Catastrophic health spending averted, money-metric value of insurance provided.

The PhD Project: Modelling methods

- The Kenya STEPs survey dataset will be used to generate a synthetic population stratified by the 10-year CVD risks based on behavioural and metabolic CVD risk factors, with possible use of iterative proportional fitting (IPF) for reweighting.

- The 10-year CVD profiles will be estimated using the 2019 WHO CVD Risk Equations for Eastern SSA, with sensitivity analysis performed using Globorisk and Framingham algorithms.

- Treatment effect to be estimated as the combined effect of the intervention on blood pressure and sugar over time.

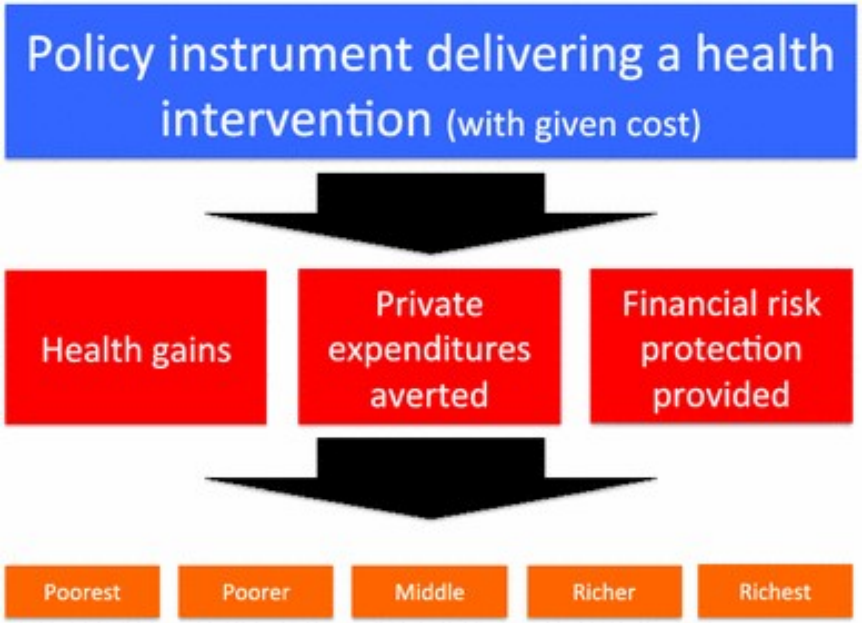
- Causal inference methods to be used to estimate treatment effect in the counterfactual arm of the study.

- Model to be implemented in R/Python software (to be decided after conceptual modelling)

- Uncertainty to be handled through deterministic (DSA) and probabilistic sensitivity analyses (PSA) and value of information (VOI) methods.

The PhD Project: Equity Analysis Methods

ECEA Methodology



Adapted from Verguet et.al. (2016)

- ECEA and DCEA to follow standard methodology provided by Verguet et al and Asaria et al., respectively
- I will do ECEA to estimate the FRP benefits of different intervention scaleup scenarios
- Yet to decide whether I will do a full DCEA, but this will depend on the time availability-To be carried on after the PhD
- Subgroup analyses to be done to explore impact of the intervention on different population groups e.g. by region, age, sex etc.

The PhD project: Work Packages

Aim: Health, economic and equity impact of CVD prevention in Kenya

Intervention

EMPOWER HEALTH intervention

Activity 1- Review of policy targets, plans, consultation
- **To inform choice of interventions and data sources**

Activity 2- Systematic review of CVD prevention models in SSA
- Overview of existing decision analytic models

Model Population Characteristics

Population characteristics
- Disease (CVD) burden-ideal cardiovascular health
- CVD risk factor profiles-smoking, physical activity and diet
- Age and Sex

Metabolic/Intermediate factors
- Hypertension
- BMI
- Cholesterol
- Diabetes

Equity stratifiers (risk factors & CVD outcomes)
- Socioeconomic status-Wealth quintiles
- Education
- Place of residence- rural/urban
- County/region

Other key data points
- DALYs
- 10-year CVD risk to be estimated using the WHO CVD risk calculator with sensitivity analyses performed using the Globorisk/Framingham risk calculators
- Transition probabilities to be derived from longitudinal datasets (TBD) and literature review

Financial burden attributable to CVDs-FRP metrics
- Health system costs
- Household direct and indirect costs
- Out of pocket spending
- Catastrophic health spending
- Impoverishing health spending

Data

- 2015 WHO STEPs survey
- KDHS- 2022

Activity 3- Secondary data analyses to inform the synthetic population

Activity 4- Model building and analysis
- **Coding and parameterization**

Activity 5- Model validation, calibration and scenario analysis

- 2018 KHHEUS
- 2015/16 KIHBS
- Literature reviews

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The PhD Project: Acknowledgements

- **Supervisors:** Prof. Pete Dodd & Dr. Penny Breeze (University of Sheffield)

- **Collaborators:**
  - Medtronic LABS: Dr. Oren Ombiro (Chief Medical Officer)
  - Ministry of Health , Kenya: Dr. Gladwell Gathecha (Head, NCD Division, MOH, Kenya)
    Dr. Elizabeth Onyango (Head, NCD Prevention and Control)
    Dr. Yvette Kisaka (Head of Cardiovascular Disease Unit)

  - Kenya Cardiac Society (KCS): Dr. Lilian Mbau (Chief Executive Officer of KCS)

  - Prof Stephane Verguet (Havard University)

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Asante sana/ Thank you

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Any questions?

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Economic evaluations of novel malaria vector control strategies in Uganda: assessment of costs, effectiveness and equity

IHEA Equity Informative Economic Evaluation SIG Webinar

Katherine Snyman
PhD Candidate, LSHTM
November 28, 2023

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GLOBAL HEALTH ECONOMICS CENTRE

Presentation Objectives

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Why incorporate equity into your PhD?

How can you incorporate equity into your PhD?

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About myself

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- Background in public health
- Based in Uganda for past 10 years working on malaria and HIV/AIDs clinical trials
- Fourth year health economics PhD part-time student at LSHTM
- Expected completion: 2024

PhD Topic: Economic evaluations of novel malaria vector control strategies in Uganda: assessment of costs, effectiveness and equity

Supervisors:
Dr. Catherine Pitt, London School of Hygiene and Tropical Medicine
Prof. Sarah Staedke, Liverpool School of Tropical Medicine
Prof. Grant Dorsey, University of California, San Francisco

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Background

Uganda: 13 million malaria cases per year (pop:48m)

Disease burden concentrated in:

- Children & pregnant women
- Poor households
- Rural populations

PhD work embedded in two cluster-randomized trials:

- Uganda Housing Modification Study
- LLINEUP2

Source: MOH. National Malaria Control Program - Ministry of Health | Government of Uganda [Internet]. [cited 2021 May 17]. Available from: https://www.health.go.ug/programs/national-malaria-control-program/

Aims & Objectives

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Aim

To inform resource-allocation decisions about malaria control in Uganda and elsewhere in sub-Saharan Africa by generating evidence on the cost, efficiency, and equity of innovative vector control strategies.

Objectives

1. To estimate the societal and provider **cost of malaria illness** and treatment and to assess the distribution of the economic burden in Uganda.
2. To conduct a **cost analysis** of implementing housing modifications including a household willingness-to-pay analysis.
3. To conduct an e**conomic evaluation**, including cost and cost-effectiveness analyses, of distributing PBO LLINs, as compared to no LLINs.
4. To extend objectives 2 & 3 to conduct two **equity-informative economic evaluations** incorporating equity concerns into traditional economic analyses
5. To use the findings from this research to generate evidence on the affordability, efficiency, and equity impact of malaria vector control strategies to provide recommendation on policy choices in Uganda.

Result Chapters

cost-of-illness

Concentration curves

cost analysis of housing modification

Descriptive statistics

CEA of next generation LLINs

Process for choosing EIEE methods

Results Chapter 1: Cost-of-illness

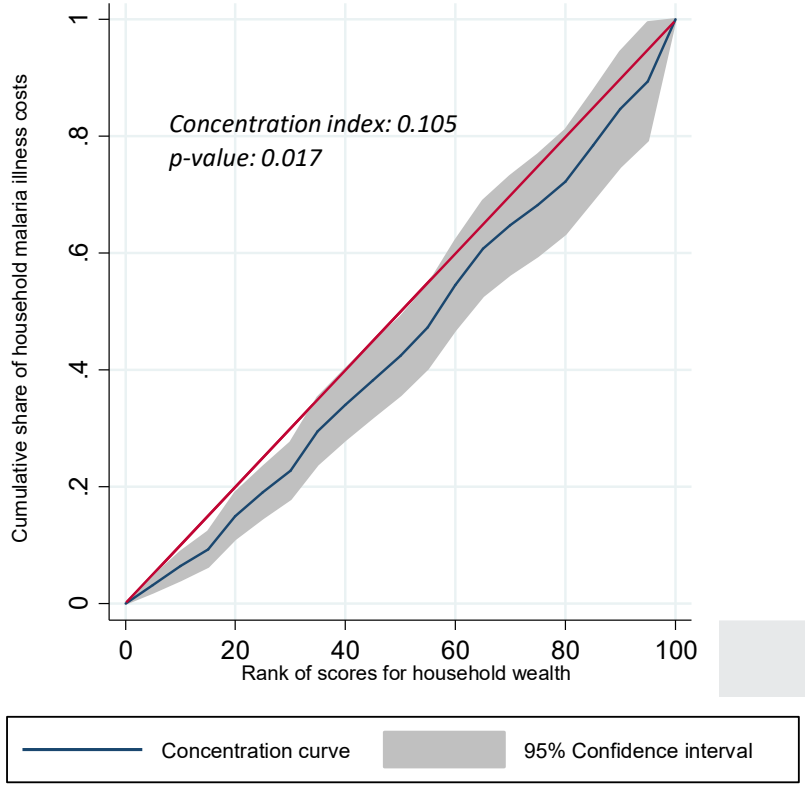
- Societal cost per episode:
  - Health service costs: data from eight health facilities
  - Household costs: cross-sectional survey administered in 3,500 homes
- Output to be used in future malaria CEAs

Equity

Concentration curves and multivariate regression analyses

Richer households only incurred a slightly higher share of household malaria costs than poorer households

Equality in concentration of household cost per malaria episode by household SES for household members with suspected malaria in past 2 weeks (n=614)



Results Chapter 2: Cost analysis of housing modification

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Can small changes to people's houses prevent malaria by reducing mosquito bites in rural Uganda?

Screening

Eave Tubes

Results Chapter 2: Cost analysis of housing modification

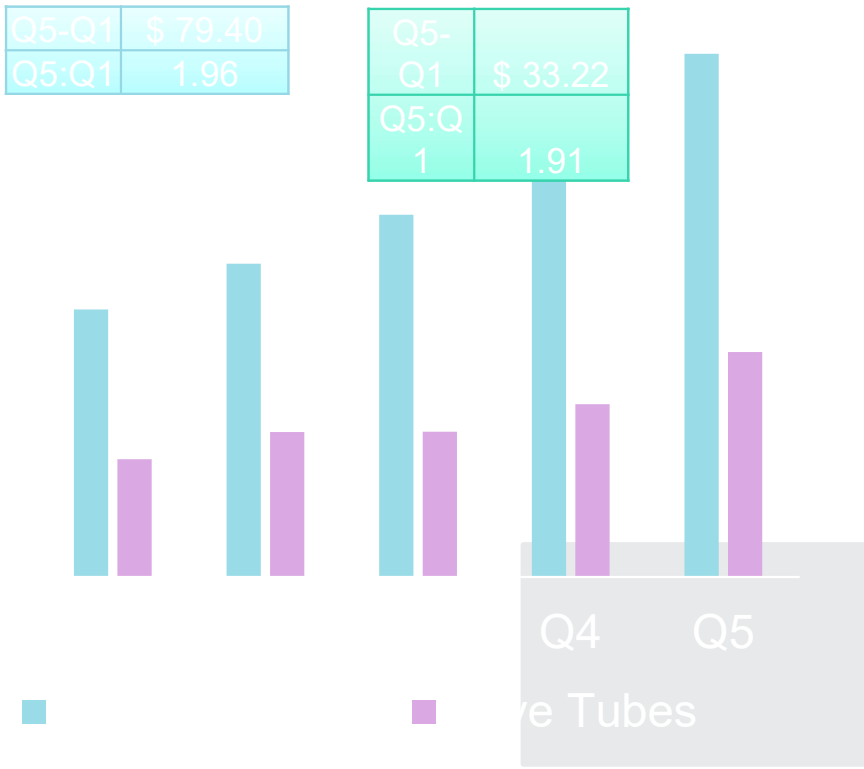
- Cost data collected alongside trial
- Demographic data collected via five household surveys
- High upfront costs, but comparable cost per person-protected per year
    - $115 for full screening installation
    - $50 for eave tubes installation

Equity

Recorded number of modifications per home

Richer homes cost double to modify

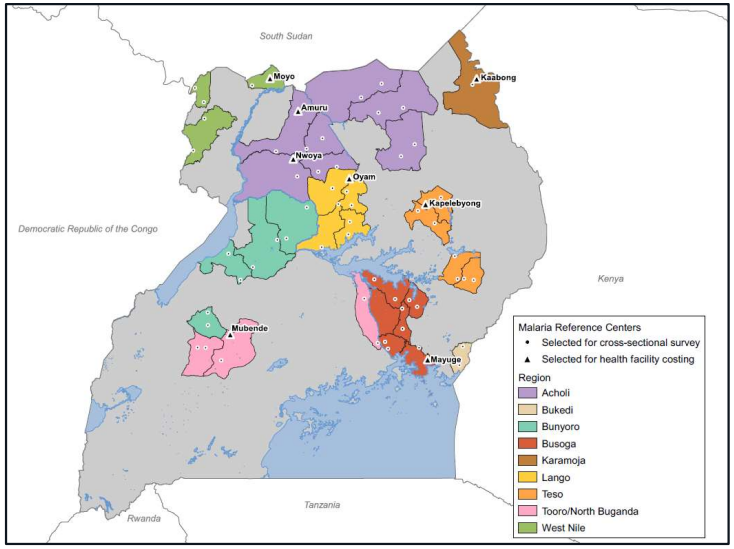
Prioritizing low SES houses would have vertical equity impacts



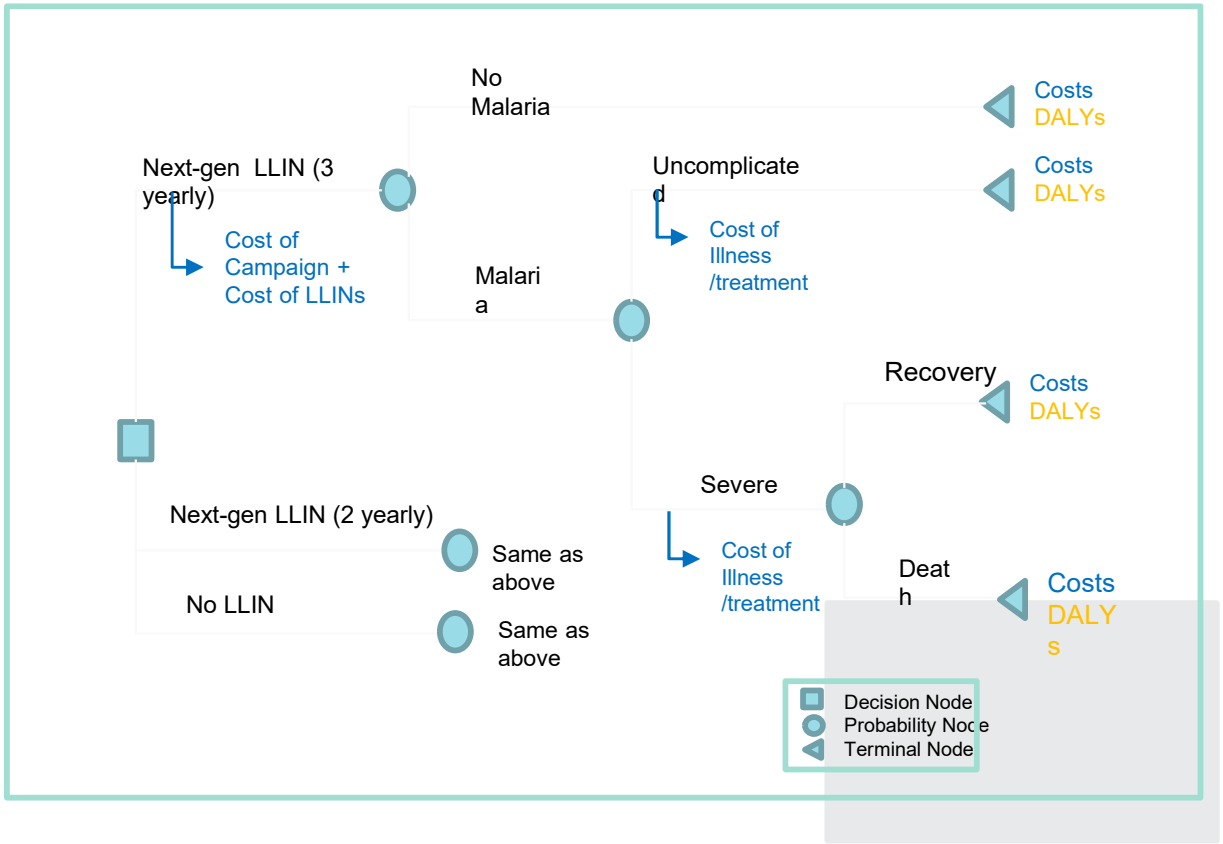
Results Chapter 3: CEA of next-generation LLINs

LLINs distributed to entire country in 2020/2021

Interrupted time series analysis to compare to no LLIN scenario



Decision tree for LLINEUP2 Cost-effectiveness analysis



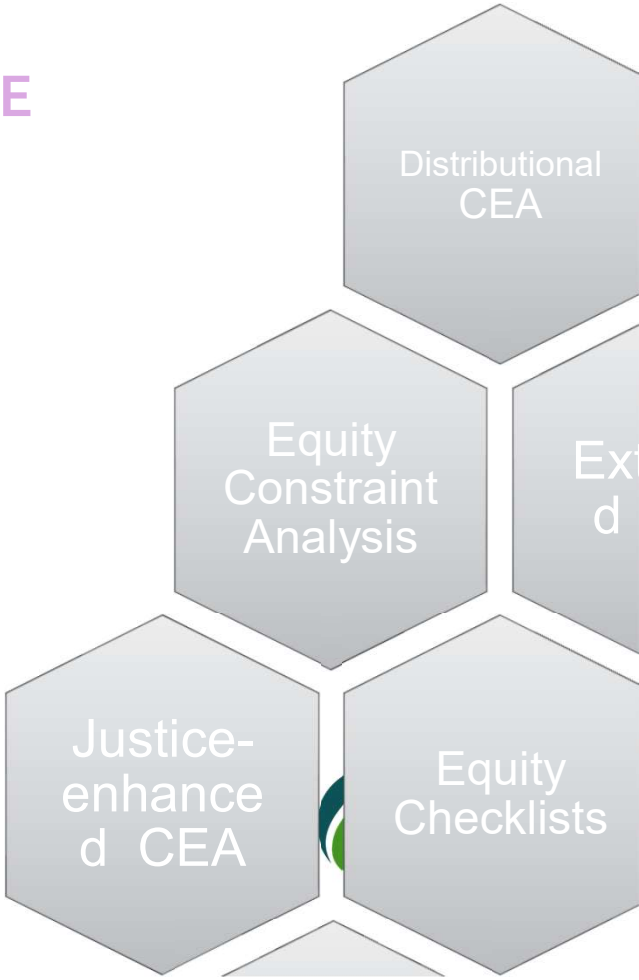
Objective 4: Equity-informed economic evaluation

Criteria for choosing EIEE Methodology:

- Data availability
- Feasibility
- Results Interpretability

Types of EIEE

EIEE Methodology	Reason for Exclusion
Distributional CEA (DCEA)	Not excluded
Equity Constraint Analysis	Results hard to interpret
Direct Equity Weighting Analysis	Not feasible - process too complex
Indirect Equity Weighting Analysis	Results hard to interpret
Extended CEA (ECEA)	Not excluded
Justice-enhanced CEA (JE-CEA)	Data not available
Algorithmic multi-criteria decision analysis (MCDA)	Not feasible - process too complex
Deliberative MCDA	Not feasible - process too complex
Equity checklists	Not feasible - process too complex



Methodology choice criteria 1: data availability

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Data Input	Standard CEA	Level of data disaggregation		
		Community	HH	Individual
Cost of intervention ($cost_i$)	Derived from MoH record	Currently do not have, but potentially possible		
Intervention coverage	Collected via 12 & 24 mo. CSS	By geography	By SES (SES indicator estimated from 12 mo CSS)	
Cost of uncomplicated malaria case ($cost_u$)	Provider cost of care collected at 8 health facilities. Care seeking behavior and household costs collected via 12-month CSS.	By geography	HH-incurred costs by SES	By age and sex
Cost of severe malaria case ($cost_s$)				
OOP expenditure on malaria per household ($cost_{OOP}$)				
Number uncomplicated malaria cases ($case_u$)	Continuous incidence measure for all ages	By geography	TBD †	
Malaria Incidence (I)				
Cost-effectiveness threshold (CET)	Options in Chi et al.			
Probability of seeking care (P_{CS})	Care seeking behavior collected via 12-month CSS.	By geography	By SES	By age and sex
Probability of severe malaria (P_{SM})	Derived from health facility surveillance	By geography	By SES ‡	By age and sex ‡
Case fatality rate for severe malaria (CFR)				
Average age of malaria death (D)				
Average life expectancy (LE)	WHO Life Tables			
Average length of uncomplicated malaria episode (l_U)	Investigator knowledge / Secondary sources		By SES	By age and sex ‡
Average length of severe malaria episode (l_S)				

† Exploring possibility of applying care seeking or prevalence data by SES level distribution to community level incidence measures and/or focusing on SES at the community level.

‡ Variation in probability of severe malaria and average length of episode would depend on variation in care seeking behavior between subgroups (ex: poor subgroup less likely to seek care resulting in longer episode length).

Key messages for why and how to incorporate equity into PhD

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WHY

HOW

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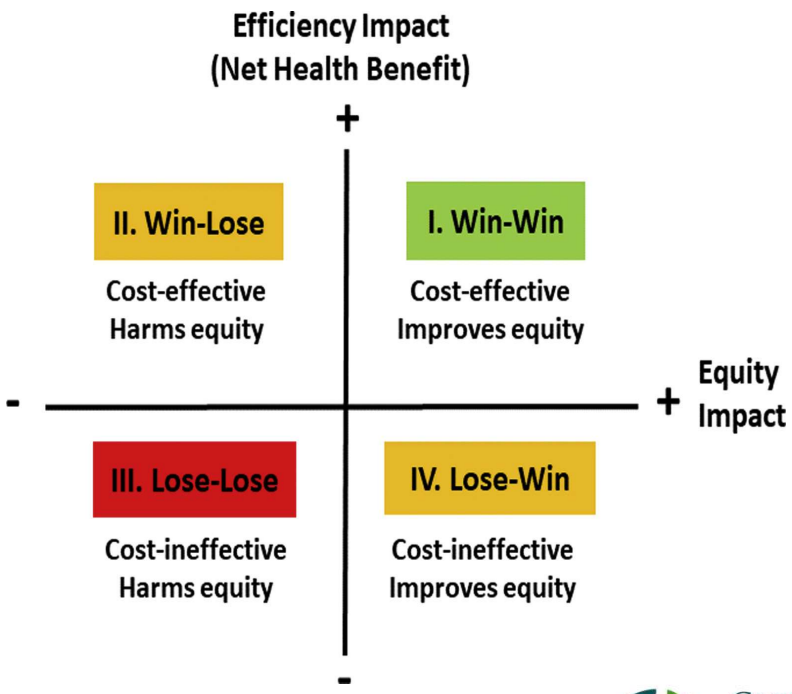

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Source: Cookson R, Griffin S, Norheim OF, Culyer AJ, Chalkidou K. Distributional Cost-Effectiveness Analysis Comes of Age. *Value Heal* 2021; **24**: 118–20

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