The value of digital health technologies investments on the management and outcomes of Non-Communicable Diseases (NCDs) in Sub-Saharan Africa. Assessing the impact of Information and Communication Technologies (ICTS) on service delivery outcomes for diabetes in Kenya

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The frame for the paper

- Noncommunicable diseases (NCDs)
  - “also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors.
  - The main types of NCDs are cardiovascular diseases (such as heart attacks and stroke), cancers, chronic respiratory diseases (such as COPD and asthma) and diabetes.”
- Sub-Saharan Africa
  - “the area and regions of the continent of Africa that lie south of the Sahara. These include Central Africa, East Africa, Southern Africa, and West Africa.”
- Digital health technology:
  - “the use of information and communication technologies to manage illnesses, promote wellness, and improve healthcare delivery.
  - It encompasses a broad range of tools and applications, including mobile health (mHealth) apps, electronic health records (EHRs), telehealth, and wearable devices.”

Key points from Background

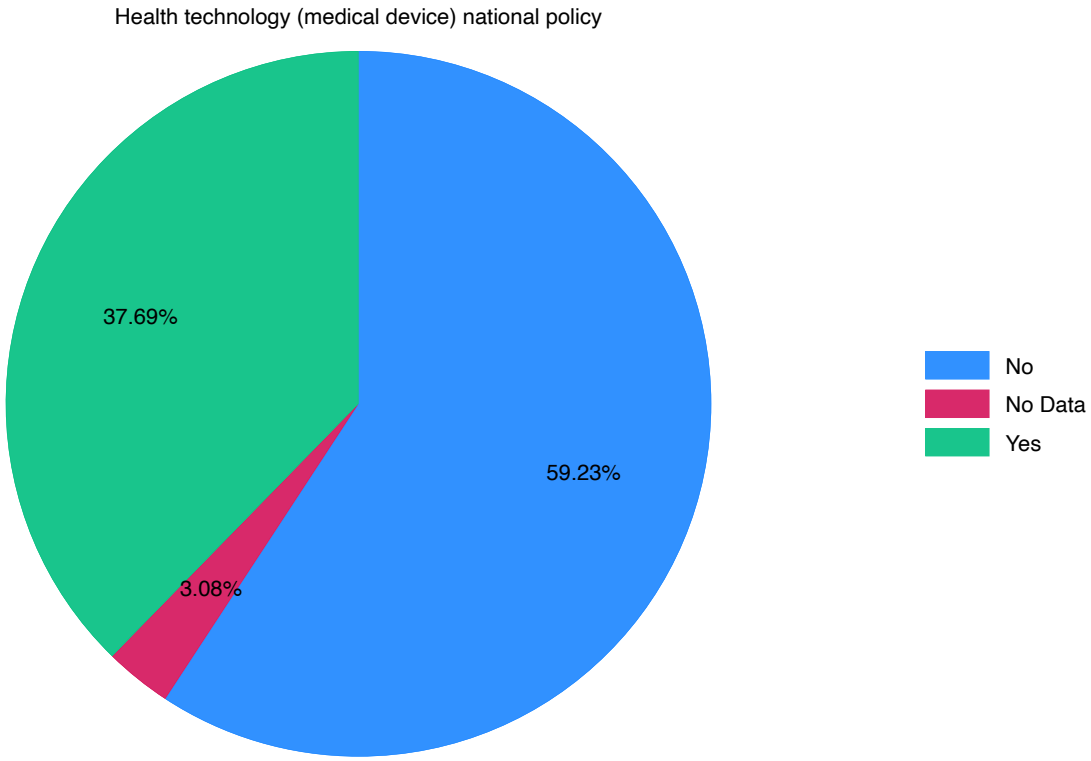
- NCDs
  - In Sub Saharan Africa, demographic transitions are leading to increasing prevalence of NCDs.
  - The burden of NCDs remains under-appreciated.
  - Changes need to be made in how health systems approach NCDs.

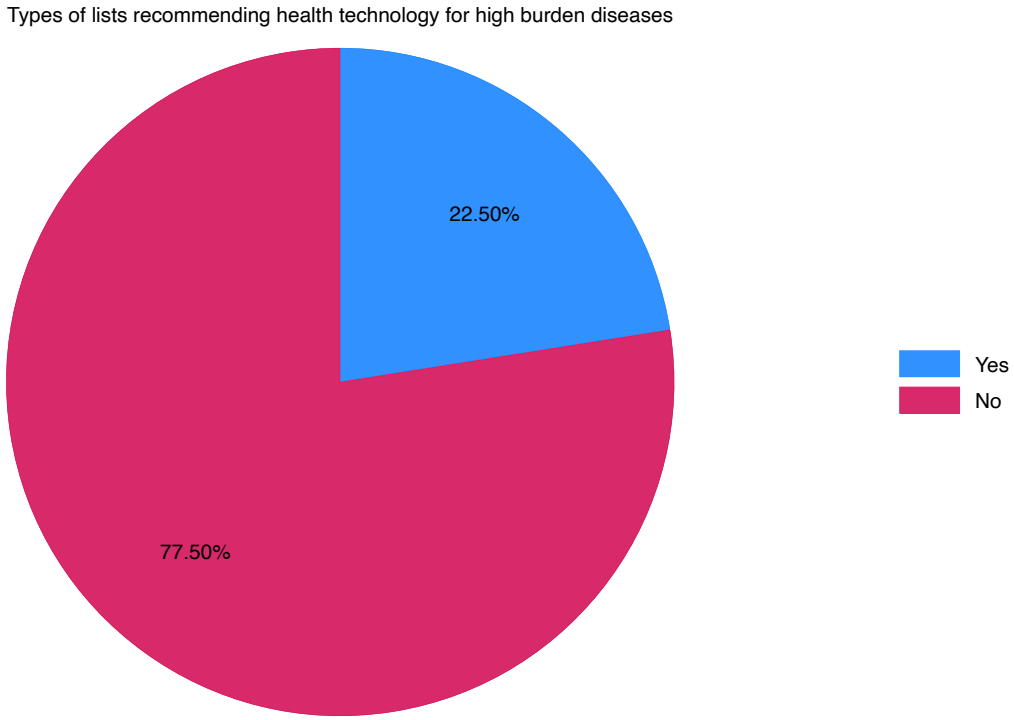
- Digital health technologies
  - They offer a lucrative option that is mostly underutilized in Sub Saharan Africa.
  - They can be employed at all levels of healthcare service delivery: awareness & prevention, screening, diagnostic, treatment and adherence.

Goal and objectives

i. To assess the level of digital health technologies adoption in Sub Saharan Africa

ii. To analyze the impact of digital health technologies investments on NCDs outcomes





- Trends in Adoption of DHTs in Sub-Saharan Africa
  - African countries are lagging behind

- No pie charts, please – “Ink to information ratio”

Empirical work

- Focus:
  - Assessing the impact of Information and Communication Technologies (ICTS) on service delivery outcomes for diabetes in Kenya

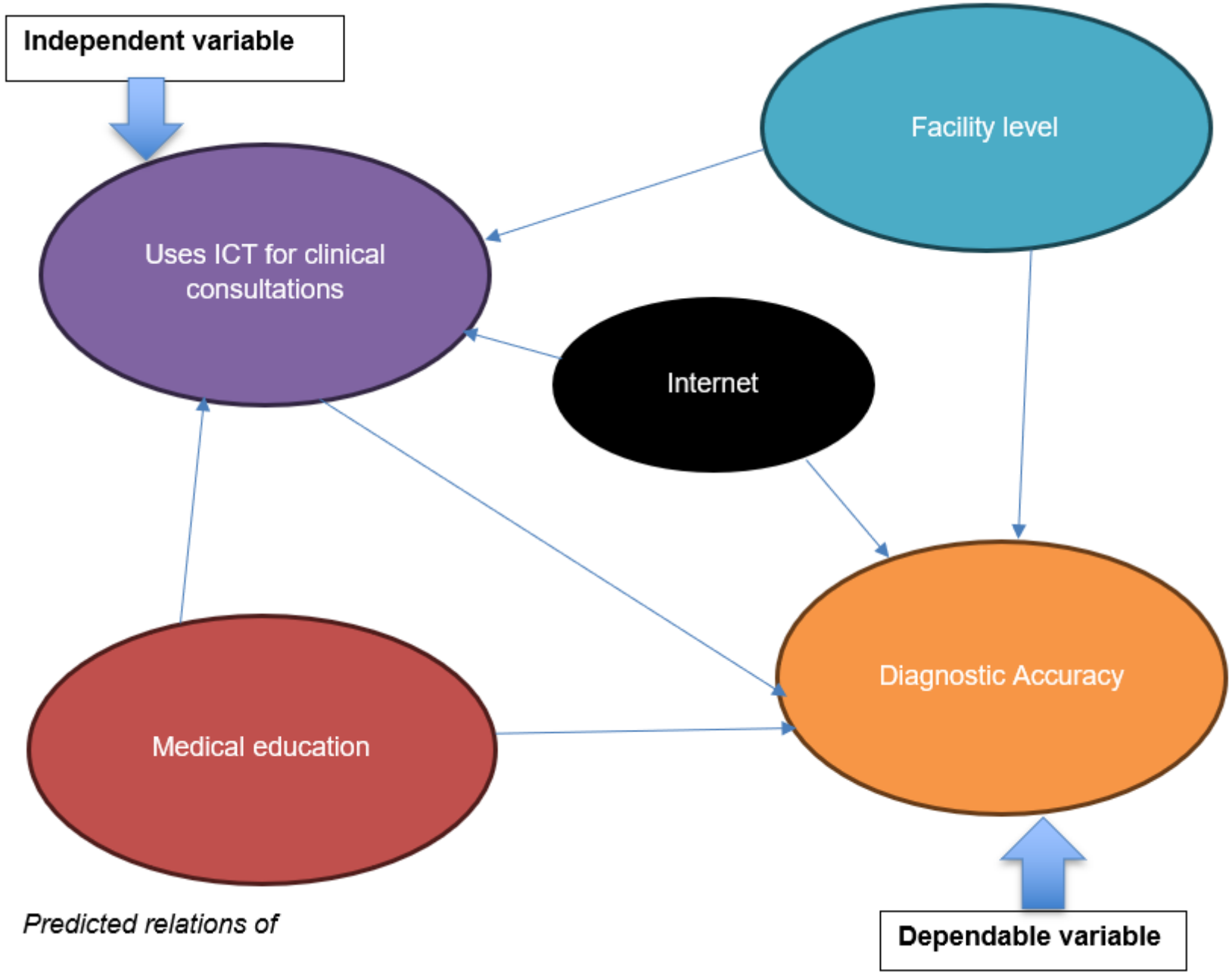
- Data:
  - Source – World Bank service delivery indicators surveys (2018, Kenya); nationally representative, multiple modules, cross-sectional, uses standardized questionnaires
  - Module 3: Data from sampled providers; case vignettes of hypothetical patients; provider diagnoses (history/exams/test), treats and gives education to patient
  - Used only data on diabetes (as only NCD in survey)

Outcome / dependent variable(s)

- Diagnostic accuracy
  - A count variable: created by combining all vignette questions relating to history of patient, examination steps and tests ordered, and diagnosis.
  - Sums the number of Yes/No questions from the provider – higher count is better (?)
  - Appropriate label? Maybe “Compliance with diagnostic protocol”

- Treatment efficiency
  - A dummy variable: Records whether provider has done at least one of the treatments of oral hypoglycemics, insulin or treat as outpatient.
  - Appropriate label? How is this “efficiency”?

- Health promotion
  - A score (count?) variable: Records whether advice given on diet modification, exercise, care of foot and adherence.



Predicted relations of

Table 1: Proportion of health providers in the sample and their associated health facilities

Medical occupation	Type of health facility				Total
	Hospital	**Health Centre**	**Health Post**	**Other**	
Doctor	100	29	58	0	**187**
Clinical officer	372	514	701	1	**1588**
Nurse	97	476	2033	0	**2606**
Other	9	9	74	0	**92**
Total	**578**	**1028**	**2866**	**1**	**4473**

Source: Kenya World Bank SDI data (2018) extracted for providers that had vignettes

Table 2: Descriptive statistics on provider and facilities characteristics

Variable	Frequency	Percent
Location		
Rural	3332	73.3
Urban	1213	26.7
Ownership/ governance		
Public	2808	61.7
NGO, non-profit	91	2
Faith based, non-profit	450	10
Community	2	0.1
Private, for profit	1195	26.2
Providers' medical occupation		
Doctor	188	4.1
Clinical officer	1593	35.5
Nurse	2612	58.2
Other	92	2.1
Provider's medical education		
None	28	0.6
Certificate	614	13.7
Diploma	3490	77.9
Advanced	351	7.8
Facility's computer is available		
No	2312	50.9
Yes (not observed)	29	0.6
Yes(observed)	2204	48.5
Internet access is available		
No	3118	68.6
Yes (not observed)	110	2.4
Yes(observed)	1317	29

N=4546

	Diagnostic Accuracy		
	Coeff.	**IRR**	**p-value**
ICT use for clinical consultations			
Yes	0.063	1.065	0.010
Provider education (None)			
Certificate	0.876	2.402	0.000
Diploma	1.033	2.808	0.000
Advanced	1.171	3.226	0.000
Type of facility (Hospital)			
Health Center	-0.100	0.905	0
Health Post	-0.148	0.863	0
Internet availability (No)			
Yes(not observed)	-0.004	0.996	0.931
Yes(observed)	0.061	1.062	0.003
ICT dummy	-0.007	0.993	0.076

	Diagnostic Accuracy			Treatment Efficiency			Health promotion		
	Coeff.	IRR	p-value	Coeff.	OR	p-value	Coeff.	IRR	p-value
ICT use for clinical consultations									
Yes	0.063	1.065	0.010	0.714	1.074	0.475	-0.294	0.971	0.473
Provider education (None)									
Certificate	0.876	2.402	0.000	-0.759	0.469	0.000	2.338	10.361	0.000
Diploma	1.033	2.808	0.000	-0.233	0.792	0.065	2.430	11.361	0.000
Advanced	1.171	3.226	0.000	0.000	1.000		2.560	12.941	0.000
Type of facility (Hospital)									
Health Center	-0.100	0.905	0	-0.254	0.776	0.032	-0.077	0.926	0.084
Health Post	-0.148	0.863	0	-0.568	0.567	0.000	-0.155	0.857	0.000
									0.983
Internet availability (No)									
Yes(not observed)	-0.004	0.996	0.931	0.060	1.062	0.769	0.119	1.127	0.143
Yes(observed)	0.061	1.062	0.003	0.114	1.121	0.171	0.041	1.042	0.221
ICT dummy	-0.007	0.993	0.076	0.019	1.019	0.267	0.004	1.004	0.556

Key findings

- Higher “diagnostic accuracy” for…
  - Providers at facilities using ICTs for clinical consultations
  - Providers with higher medical education
  - Care provided at a hospital
  - Facilities with internet access

- Using ICTs for clinical consultations **not** associated with improvements in “treatment efficiency” or delivery of “health promotion”

Some reflections

- There's a great paper trying to get out of this manuscript!

- Heterogeneity is on my mind…
  - of digital technologies
  - of NCDs
  - of sub-Saharan Africa

- Ambition of the paper (from first half) is perhaps not delivered through the empirical work
  - Empirical work focused (Kenya, diabetes)
  - Can this be generalized to NCDs in sub-Saharan Africa?
  - Often, "less is more"!

- Literature review section
  - Defining digital health & technologies – why is this important? Feels disconnected.
  - Impact of DHTs on NCD management – highly relevant

Final reflections

- Is this a paper for Health Economics?
  - Reference lists are important to editors to determine “fit”.
  - Note: You cite virtually no economics literature!

- Is this a health economics paper?
  - For me, the case has not been made!
  - The main outcome variable is “diagnostic accuracy”.
  - You have an “efficiency” outcome variable but not sure it really represents efficiency as an economist would understand it.
  - I’m interested in the costs of DHT implementation and the expected health gains.

- Remember: I think there really is a great paper trying to get out of this manuscript!
  - As currently framed, probably more suited to a more specialized journal (DHT, NCDs, sub-Saharan Africa)