

Using statistics to guide response to the HIV epidemic

High Impact Medicine

Adam Howes

Imperial College London

May 2023

Outline

1. Precision public health for HIV
2. Estimating risk group proportions
3. Might you want to do similar work?

1. Precision public health for HIV

What is precision public health

- Precision medicine: the right intervention, at the right time, to the right **individual**
- Precision public health: the right intervention, at the right time, to the right **population**

How can statistics help?

- Requires granular estimates of relevant quantities
- Disaggregated by age group, location, behaviour

What should we estimate

- HIV prevalence: proportion of people who are infected
- HIV incidence: rate of new infections
- Antiretroviral therapy (ART) coverage: proportion of people living with HIV who take ART



Fast-Track Targets

by 2020

90-90-90

Treatment

500 000

New infections among adults

ZERO

Discrimination

by 2030

95-95-95

Treatment

200 000

New infections among adults

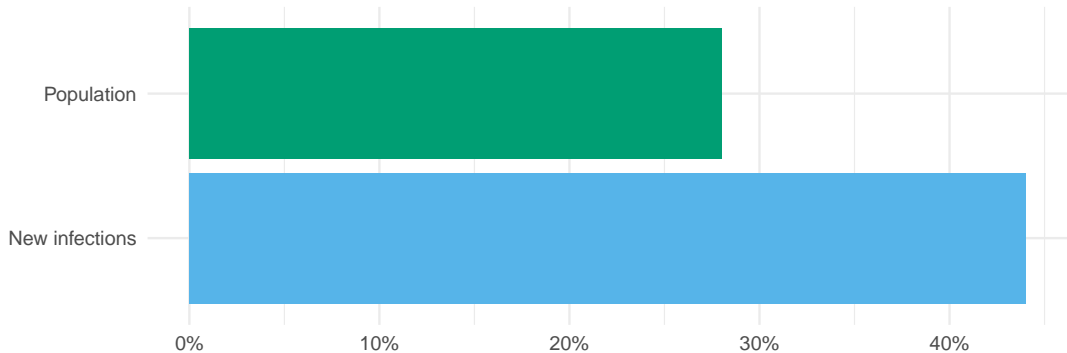
ZERO

Discrimination

Figure 1: Population health goals.

2. Estimating risk group proportions

AGYW* **over-represented** in numbers of new infections



*Adolescent girls and young women, 15–29

Why?

1. Younger age at first sex
2. Age patterns of sexual mixing
3. Structural vulnerabilities and power imbalances
4. Increased susceptibility to HIV infection



UN SECRETARY-GENERAL'S REPORT ON HIV

RECOMMENDATION 5:

Put gender equality and the human rights of women and girls in all their diversity at the forefront of efforts to mitigate the risk and impact of HIV.



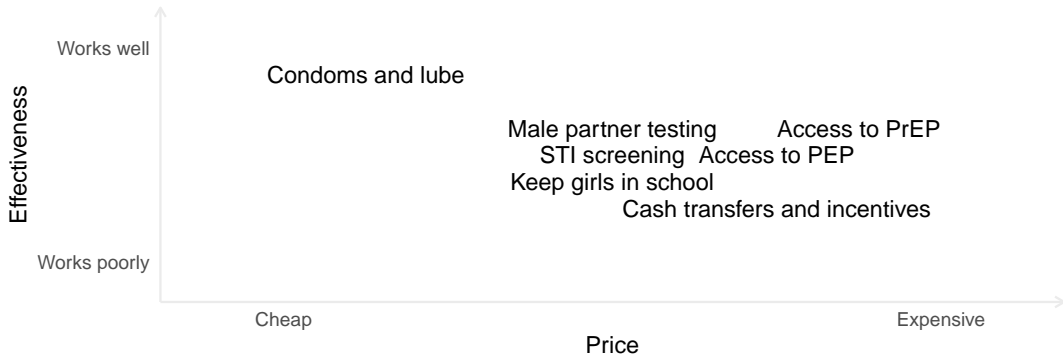
High-Level Meeting on AIDS
END INEQUALITIES. END AIDS.



UNAIDS

Figure 2: HIV is a gender equality issue.

Not all interventions can, or should, be provided to everyone



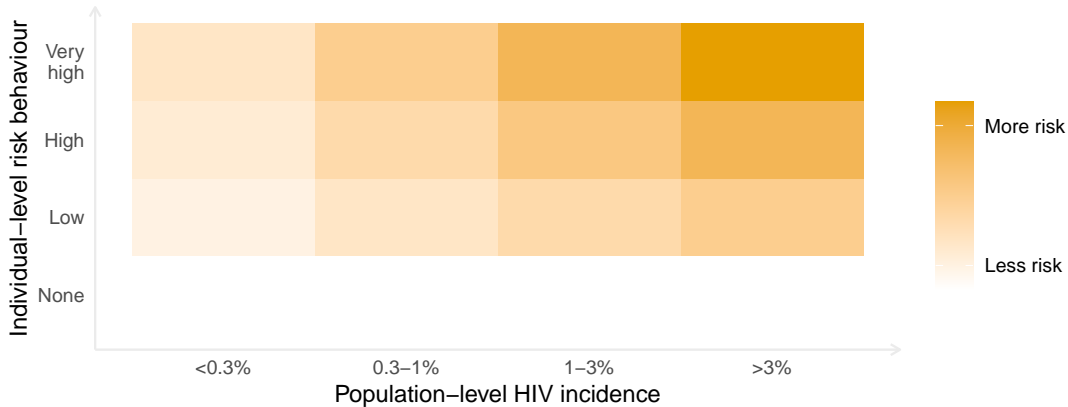
Possible interventions for reducing HIV incidence in AGYW. Positions on plot depend on setting, and is subject to uncertainty, so should not be interpreted too precisely.

How to prioritise interventions?

The **most proximal** drivers of transmission are

$$\mathbb{P}(\text{transmission}) \propto \text{sexual partnerships} \times \mathbb{P}(\text{each partner can transmit})$$

Important we consider **both** population setting and individual behaviour



Population-level HIV incidence

Level	District-level HIV incidence rate
Low	<0.3%
Moderate	0.3% - 1.0%
High	1.0% - 3.0%
Very High	>3.0%

Individual-level behavioural risk

Level	Behavioural risk group	Risk ratio ¹
None	Not sexually active	0
Low	One cohabiting partner	1
High	Multiple or non-regular partner(s)	1.72
Very High	Female sex workers	13

¹From...

- Goal: enable prioritisation of HIV programming for AGYW
- Audience: programme managers, service providers and policy makers
- Plan: estimate district-age behavioural risk group proportions, prevalences and incidences

- Describe data
- Describe model
- Spatio-temporal smoothing

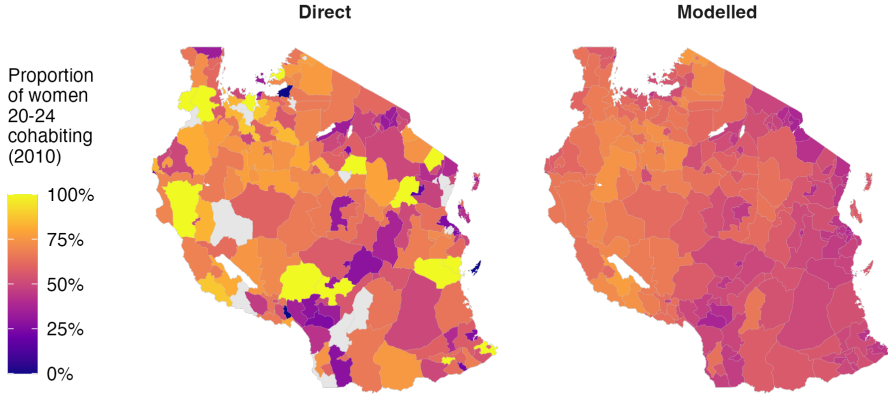


Figure 3: Direct survey estimates are too noisy to work with, but our modelled estimates don't have the same issue.

- Results: geographic discontinuity

- Results: impact of prioritisation

- Where might this work go
- Yearly generation of estimates by country teams
- Extending to adults 15-49

1

2

3

4

5

6

7

Upload inputs

Review inputs

Model options

Fit model

Calibrate model

Review output

Save results

BACK / CONTINUE

Spectrum file (required)

Select new file

Browse

Area boundary file (required)

Select new file

Browse

Population (required)

Select new file

Browse

Household Survey (required)

Select new file

Browse

ART

Select new file

Browse

ANC Testing

Select new file

Browse

BACK / CONTINUE

Figure 4: Example of user interface for estimates generation.

3. Might you want to do similar work?

Possible influence on health outcomes for many people **but** a part of a complex theory of change

$$\begin{aligned}\mathbb{P}(\text{impact}) = & \mathbb{P}(\text{relevant people interact with your work}) \\ & \times \mathbb{P}(\text{what you've done is useful}) \\ & \times \mathbb{P}(\text{message correctly conveyed}) \times \dots \\ & \times \mathbb{P}(\text{intervention technically works}) \\ & \times \mathbb{P}(\text{intervention correctly implemented}) \times \dots\end{aligned}$$

... hopefully you get the point

- Maths undergraduate → statistics masters → statistics PhD
- Involved with Effective Altruism during my masters, and since then I've been interested in impactful applications of statistics

- I have very limited domain knowledge! Important to collaborate
- Broad range of required skills: epidemiology, public health, health economics, behavioural science, implementation science, mathematics, statistics, computer science, software engineering

- How might the skills of medics fit in here?
- Need to think about this!

Thanks for listening!

- More information on my website: athowes.github.io/about
- Feel free to get in contact if I can be useful: ath19@ic.ac.uk
- My PhD is supervised by Seth Flaxman and Jeff Eaton, and the risk group work is in collaboration with Imperial's HIV Inference Group, within the MRC Centre for Global Infectious Disease Analysis, and UNAIDS



MRC Centre for
Global Infectious
Disease Analysis

Imperial College
London




MACHINE LEARNING
& GLOBAL HEALTH NETWORK

Estimating risk group proportions: informal discussion

A summary, some potentially useful takeaways, and reflections on the paper
"Spatio-temporal estimates of HIV risk group proportions for adolescent girls
and young women across 13 priority countries in sub-Saharan Africa"

Figure 5: For more (informal!) take a look at the blog post on my website'

Spatio-temporal estimates of HIV risk group proportions for adolescent girls and young women across 13 priority countries in sub-Saharan Africa

Adam Howes , Kathryn A. Risher, Van K  nh Nguyen, Oliver Stevens, Katherine M. Jia, Timothy M. Wolock, Rachel T. Esra, Lycias Zembe, Ian Wanyeki, Mary Mahy, Clemens Benedikt, Seth R. Flaxman, Jeffrey W. Eaton

Published: April 19, 2023 • <https://doi.org/10.1371/journal.pgph.0001731>

Article	Authors	Metrics	Comments	Media Coverage	Peer Review
					

Figure 6: For more (formal!) take a look at the paper.

Bibliography I