Estimating HIV incidence among young women in HPTN082 using baseline HIV risk scores

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BACKGROUND

HPTN 082 BACKGROUND

Oral pre-exposure prophylaxis (PrEP) is an antiretroviral drug taken daily effective in decreasing HIV acquisition if taken as prescribed. High adherence has been hard to achieve especially among young women. HPTN 082 is a clinical trial aimed at increasing PrEP adherence among young women in sub-Saharan Africa.

MODELING OBJECTIVES

To mathematically model adherence and ensuring PrEP effectiveness, all studies run within HIV. Therefore we use mathematical modeling to simulate a incidence in a counterfactual arm in which no participants receive PrEP. In other words our model allows us to estimate PrEP effectiveness without denying anyone treatment.

VOICE TRIAL AND RISK SCORE

As a basis for our estimate, we use incidence data from the VOICE trial (MTN-2), a clinical trial carried out in South Africa and Uganda from 2009-2013. Although VOICE trial showed no effectiveness it provided valuable data on the relationship between participant characteristics and HIV acquisition risk. This HIV risk has been formulated as a VOICE HIV Risk Score (see below and below). We use the HIV risk scores of individual in the HPTN082 trial to predict their HIV incidence.

VOICE TRIAL VS HPTN 082

Although both the VOICE trial and HPTN 082 studied PrEP use among women in sub-Saharan Africa, the risk profile of the participants, in geographic location, as well as the time of the trial. Notably, HPTN 082 was restricted to women with a risk score of at least 5 just below for the risk score calculated.

VOICE TRIAL

Years: 2009-2012
Intervention: Oral and topical PrEP
Ages: 15-29
Risk Score: 0-50
Prevalence: 0-30%
62% Surin, SA
26% Johannesburg, SA
12% Kampala, Uganda
Annual incidence: 5%
No effectiveness detected: None

HPTN 082 TRIAL

Years: 2014-Present
Intervention: Oral PrEP+Adherence Assistance
Ages: 15-29
Risk Score: 0-30
Prevalence: 0-30%
13% Harare, Zimbabwe
13% Dar es Salaam, Tanzania
13% Johannesburg, South Africa
Annual incidence without PrEP: 7%
Effectiveness: Unknown

SIMULATION PROCEDURE

MODEL INPUTS

1) HIV and ART prevalence in the 15-49 year old population at the time and geographic location(s) of the study.
2) The responses the HIV risk score survey of the VOICE trial.

BEHAVIORAL MODEL

Translates the risk score and male partner population into HIV risk. We calibrate our model to ensure that the risk score matches what is reported from the VOICE trial. We also make sure that the risk score matches what is reported from HPTN082 survey data. This allows a confidence in the relationship between risk score and HIV risk.

Sexual Activity Parameters

Vaginal sex: -3
Genital sex: -2
Anal sex: 0
Condoms at all times: -1
Condoms sometimes: 0
Condoms never: 1

Infection Probability

MP: Not married/living with main partner (+2)
FN: Receives financial support from partner (+1)
DF: One or more drinks per week (+1)
ST: Treatable STI (at enrollment) (+1)
SE: Main partner has other sex partners (+2)
AG: Under age 25 (+2)

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REFERENCES

HIV and AIDS Uganda Country Progress Report 2013
GOVERNMENT SOURCES FOR HIV/ART PREVALENCE

CONCLUSIONS

Mathematical modeling can provide a useful counterfactual when a clinical trial lacks a control arm. In the case of HPTN 082, we predict a 34% incidence in the absence of PrEP.

Our model uses the HIV risk score derived from the VOICE trial to predict HIV incidence. However, our incidence estimate also strongly depends on the male partner population that the trial participants interact with: specifically the levels of HIV prevalence and viral suppression. It is therefore important to consider the timing of the trial and geographic distribution of the participants in addition to their HIV risk scores.

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HIV RISK SCORE COMPONENTS

MODEL CALIBRATION

We calibrate our model to ensure that the relationship between HIV risk score and HIV risk score matches what is reported from HPTN082 survey data. This allows a confidence in the relationship between risk score and HIV risk.

HIV RISK SCORE COMPONENTS

The relative risk associated with each component of the risk score generator from VOICE trial. Strangely-calibrated posterior from VOICE trial and HPTN 082 overview.

EFFECT OF MALE PARTNERS

VOICE CALIBRATION

We also calibrate the model to that the relationship between sexual activity and risk score matches what is reported from HPTN082 survey data. This allows a confidence in the relationship between sexual activity and risk score.

The partner prevalence must also be adjusted to match newer national survey.

VOICE RISK SCORE COMPONENTS

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Prevalence: 0-30%
62% Surin, SA
26% Johannesburg, SA
12% Kampala, Uganda
Annual incidence: 5%
No effectiveness detected: None

HIV PREVALENCE: 2016

- 49 year old female: 0.028%
- 39 year old female: 0.056%
- 29 year old female: 0.112%
- 19 year old female: 0.224%

Incidence: 0.015%

HIV Incidence: 0.025%

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