Imperial College London

UNAIDS

HPTN MODELLING CENTRE
IMPERIAL COLLEGE • FHCC

JOHNS HOPKINS UNIVERSITY

UNIVERSITY OF TORONTO

PennState

The big picture: Global trends in HIV prevention

The choice of indicators influences who is identified as priority populations for HIV epidemic response: a combined analysis of 15 mathematical models from 10 African countries

Romain Silhol

RD Booton, KM Mitchell, J Stannah, O Stevens, D Dimitrov, A Bershteyn, LF Johnson, SL Kelly, HY Kim, M Maheu-Giroux, R Martin-Hughes, S Mishra, J Stone, J Stover, P Vickerman, S Baral, DP Wilson, JW Imai-Eaton, MC Boily

HIVR4P 2024

HIVR4P 2024

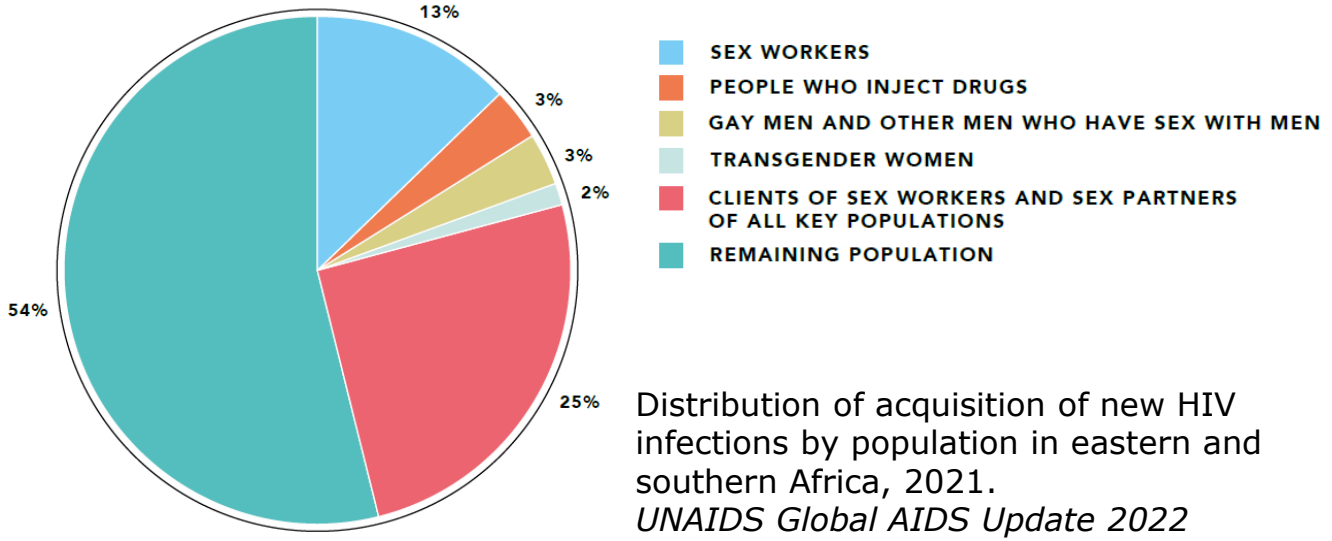
Summary

- We evaluated the differences between indicators measuring the contribution to new HIV infections of unmet prevention and treatment needs among different subgroups from mathematical models in Africa
- The most commonly used indicator only measures HIV acquisitions and underestimates the potential impact of addressing the large treatment needs among men across Africa
- **UNAIDS and future modelling studies should also systematically estimate and report indicators accounting for HIV transmissions in the long term**

Context

- Knowing the contribution of vulnerable population subgroups to new HIV infections due to remaining prevention/treatment gaps in Africa → important to improve HIV prevention programs across Africa
- Estimates of the contributions and the importance of subgroups to new infections vary across studies and settings, **partly due to the various indicators used**

- Most commonly used indicator: fraction of all new infections acquired in one year by each subgroup (e.g., UNAIDS annual estimates)
  - Other indicators focus on transmission



Distribution of acquisition of new HIV infections by population in eastern and southern Africa, 2021.
UNAIDS Global AIDS Update 2022

Objectives

HIVR4P 2024

Conduct a mathematical model comparison study evaluating

1. Contributions of different population subgroups to new infections due to their unmet prevention and treatment needs, using different indicators
2. Consistency in recommendation across indicators

Purpose: making recommendations to UNAIDS and other modelling teams

Study process

HIVR4P 2024

- Identified 4 common HIV indicators in the literature
- Invited modelling teams with an HIV model calibrated to an African setting to provide data in standard spreadsheet:
  - Estimates of the 4 indicators for 7 different population subgroups

Research questions:

Q1. Do all HIV indicators identify the same most important subgroup?

Q2. How different can the different indicators be for the same model and subgroup?

7 subgroups modelled

HIVR4P 2024

Key populations (KP)

- Female sex workers (FSW)
- Clients of female sex workers
- Gay men and other men who have sex with men (MSM)

Non-key populations (non-KP)

- Younger non-KP women
- Older non-KP women
- Younger non-KP men
- Older non-KP men

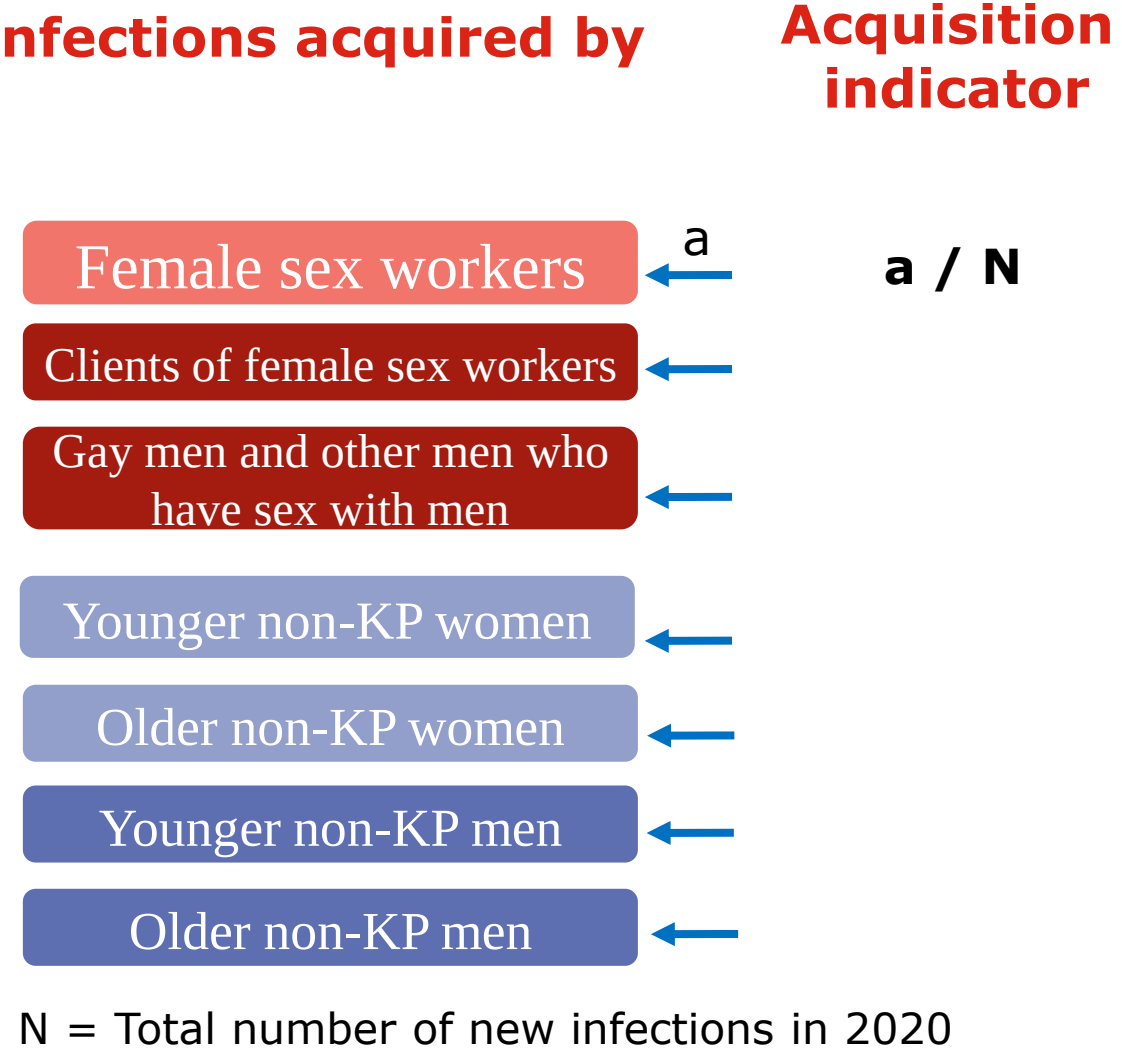
Population aged 15+ years ("Younger" = 15-24 years, "Older" = 25+ years)

The 4 indicators (illustration)

HIVR4P 2024

1. **Acquisition indicator:** fraction of all new infections in 2020 (N) acquired by a specific subgroup

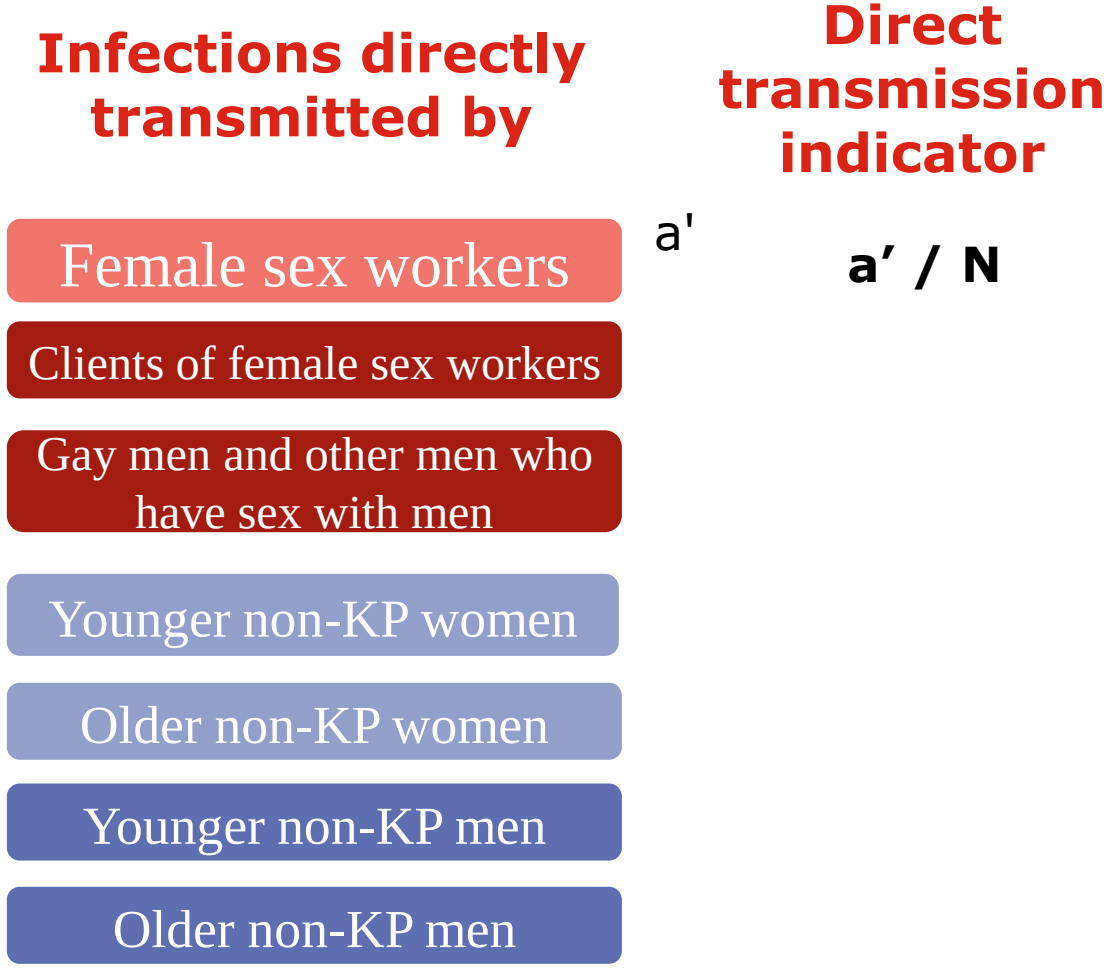
By far the most used indicator (e.g. UNAIDS annual reports)



The 4 indicators (illustration)

HIVR4P 2024

1. ***Acquisition indicator:*** *fraction of all new infections in 2020 (N) acquired by a specific subgroup*
2. **Direct transmission indicator:** fraction of all new infections in 2020 (N) directly transmitted by a specific subgroup



The 4 indicators (illustration)

HIVR4P 2024

1. ***Acquisition indicator:*** *fraction of all new infections in 2020 (N) acquired by a specific subgroup*
2. ***Direct transmission indicator:*** *fraction of all new infections in 2020 (N) directly transmitted by a specific subgroup*
3. **1-year tPAF*:** fraction of new infections directly or indirectly transmitted by a specific subgroup over 2020

Subgroup	1-year tPAF
Female sex workers (FSW)	M_{FSW}/N
Clients of female sex workers	
Gay men and other men who have sex with men	
Younger non-KP women	
Older non-KP women	
Younger non-KP men	
Older non-KP men	

M_{FSW} is calculated by blocking all transmissions from female sex workers: also averts secondary transmissions to their partners' partners

*transmission Population-Attributable Fraction

N = total number of new infections over 2020 if all subgroups can transmit HIV

M_{FSW} = total number of new infections over 2020 attributable to female sex workers

The 4 indicators (illustration)

HIVR4P 2024

1. ***Acquisition indicator:*** *fraction of all new infections in 2020 (N) acquired by a specific subgroup*
2. ***Direct transmission indicator:*** *fraction of all new infections in 2020 (N) directly transmitted by a specific subgroup*
3. ***1-year tPAF:*** *fraction of new infections directly or indirectly transmitted by a specific subgroup over 2020*
4. **10-year tPAF*:** fraction of new infections directly or indirectly transmitted by a specific subgroup over 2020-2029

*transmission Population-Attributable Fraction

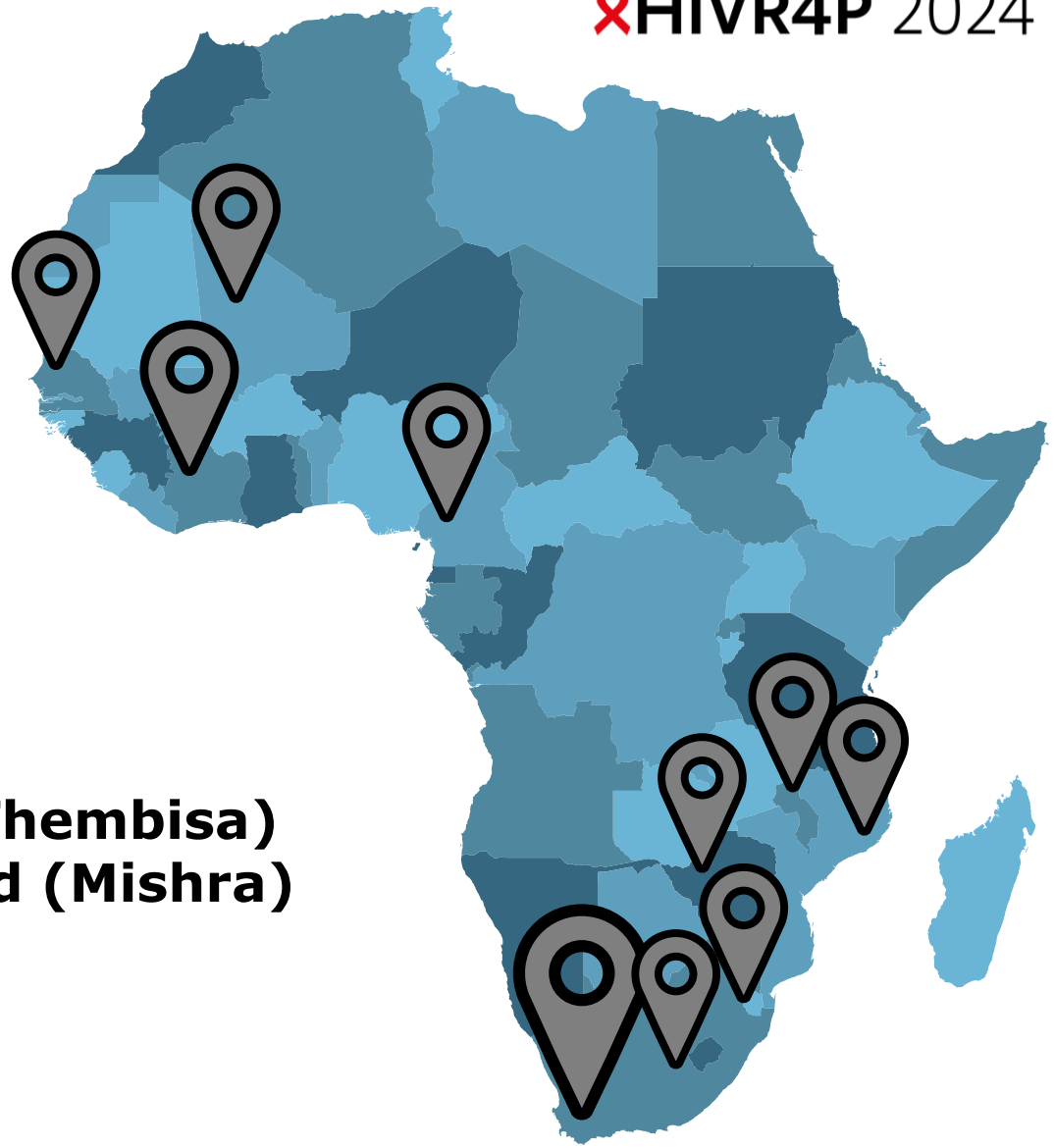
Subgroup	10-year tPAF
Female sex workers (FSW)	M_{FSW}/N
Clients of female sex workers	
Gay men and other men who have sex with men	
Younger non-KP women	
Older non-KP women	
Younger non-KP men	
Older non-KP men	

N = total number of new infections over 2020-2029 if all subgroups can transmit HIV

M_{FSW} = total number of new infections over 2020-2029 attributable to female sex workers

15 mathematical models

HIVR4P 2024



Western and Central Africa (n=5)

- Cameroon (Silhol)
- Côte d'Ivoire (Silhol, Maheu-Giroux)
- Mali (Silhol)
- Senegal (Silhol)

Eastern and Southern Africa (n=10)

- Eswatini (Optima)
- Mozambique (Optima)
- Malawi (Optima)
- South Africa (EMOD, Goals, Optima, Stone, Thembisa)
- South Africa, Lesotho and Eswatini combined (Mishra)
- Zimbabwe (Optima)

10/15 models provided indicator estimates for each of the 7 subgroups

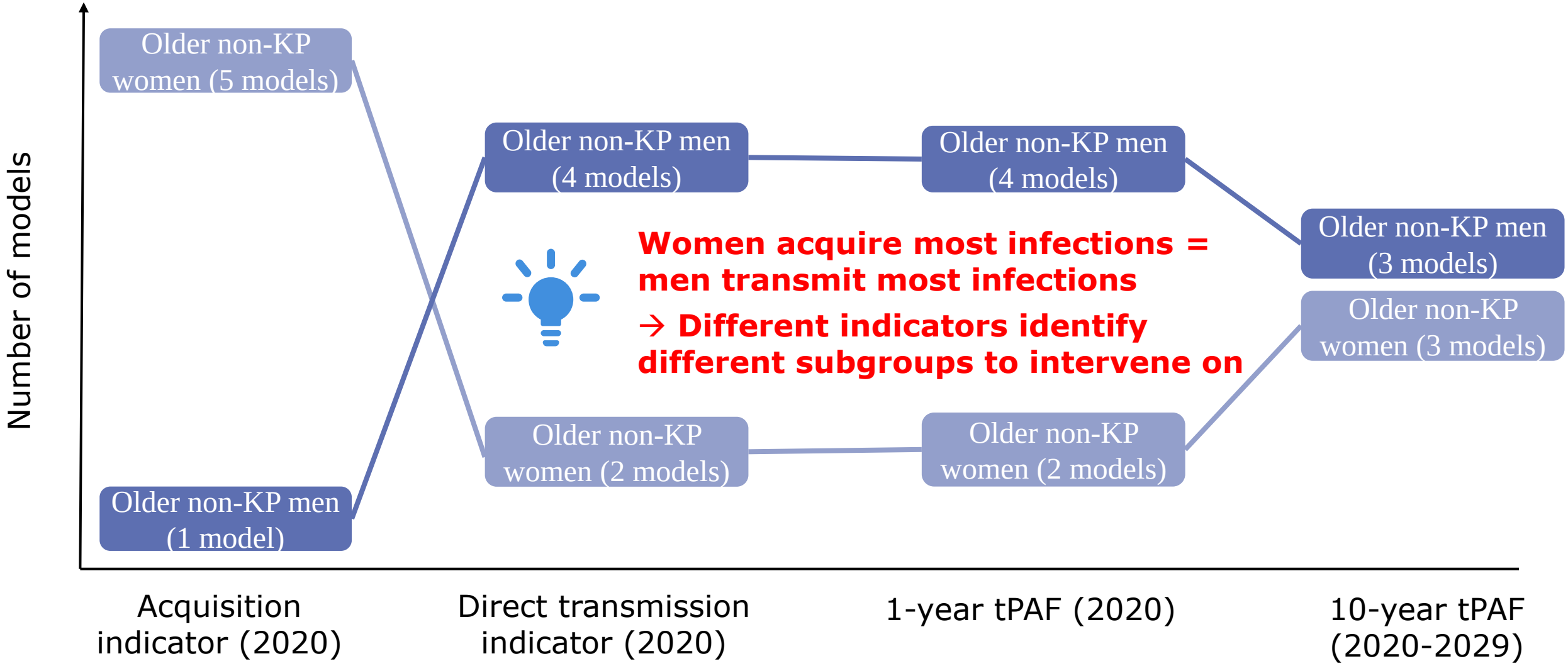
HIVR4P 2024

Q1: Do HIV indicators identify the same most important subgroup?

Which subgroup contributes the most? (Eastern and Southern Africa; 6 models)

HIVR4P 2024

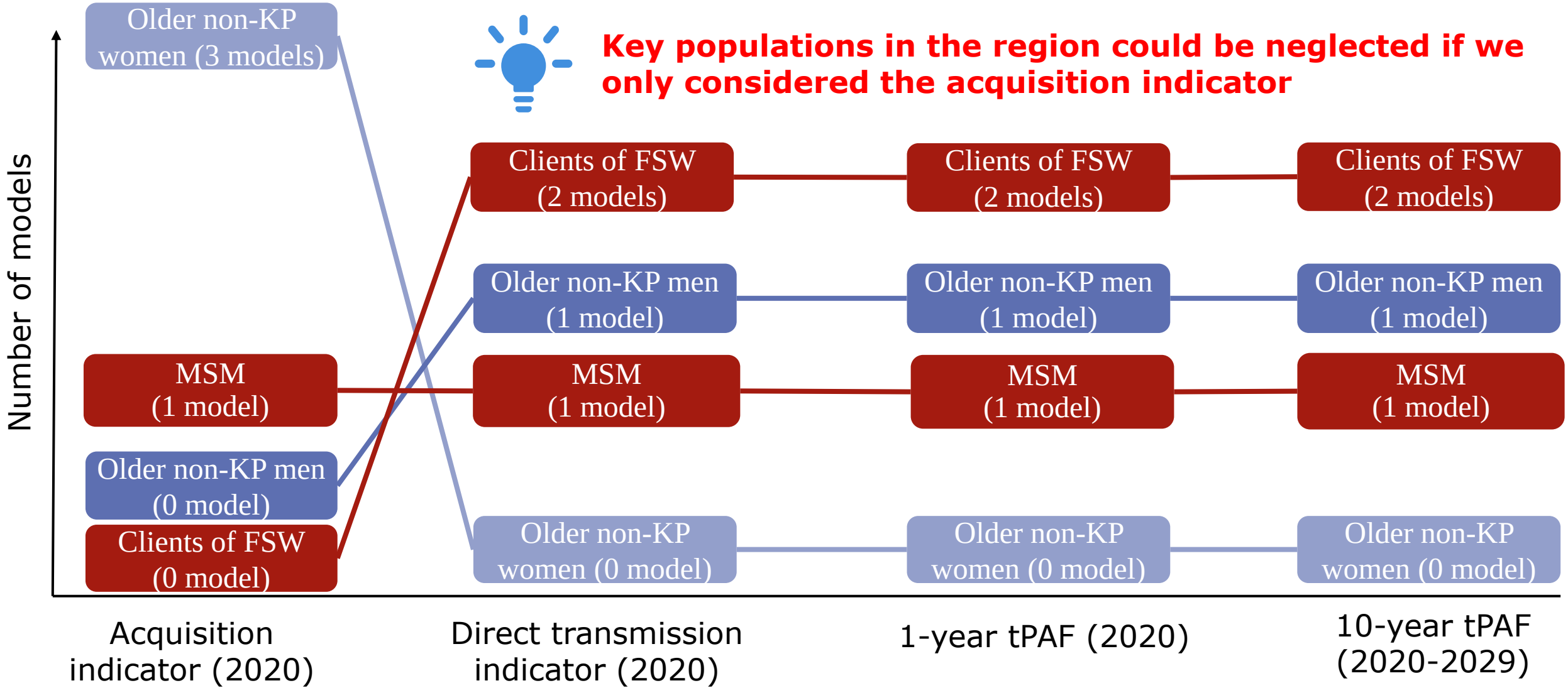
Number of models identifying a specific subgroup as the greatest contributor



Which subgroup contributes the most? (Western and Central Africa; 4 models)

HIVR4P 2024

Number of models identifying a specific subgroup as the greatest contributor



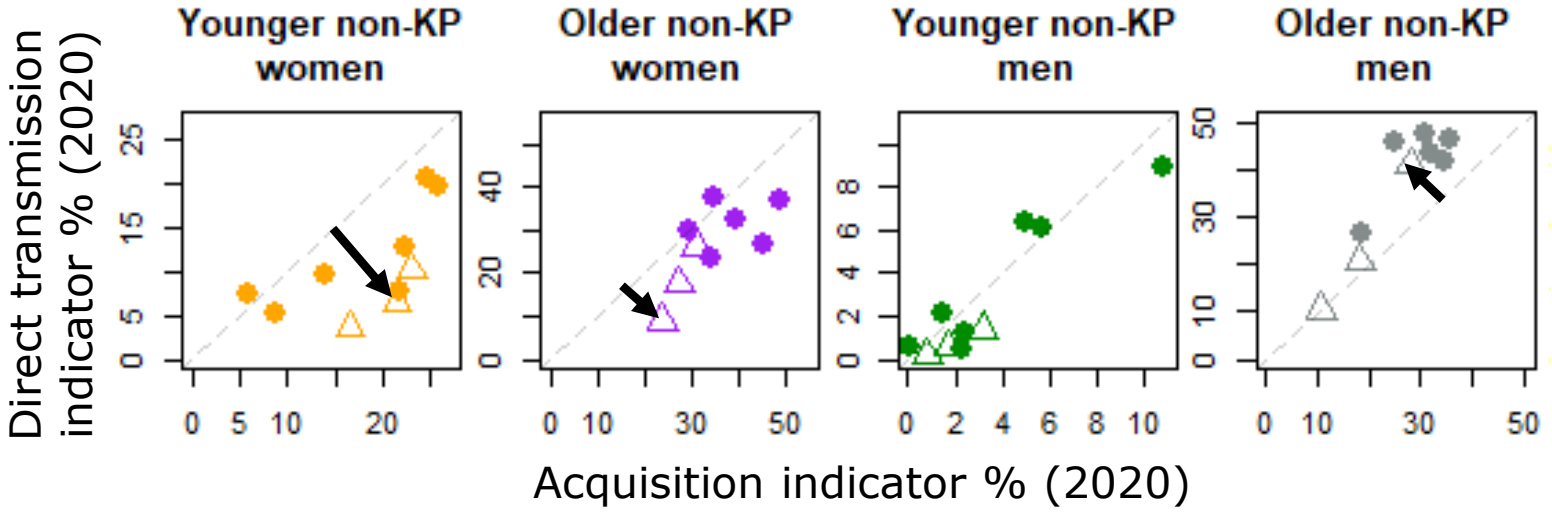
HIVR4P 2024

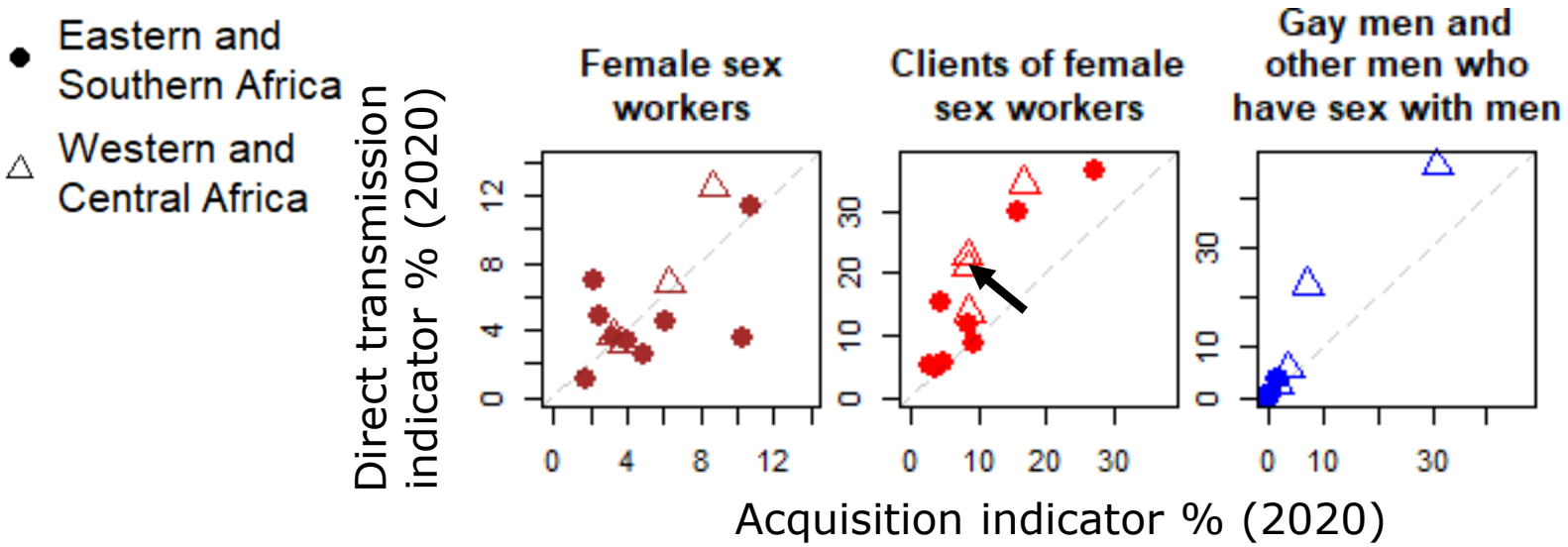
Q2: How different can the indicators be for the same model and subgroup?

Direct transmission vs acquisition indicators

(1 symbol = 1 model)

HIVR4P 2024



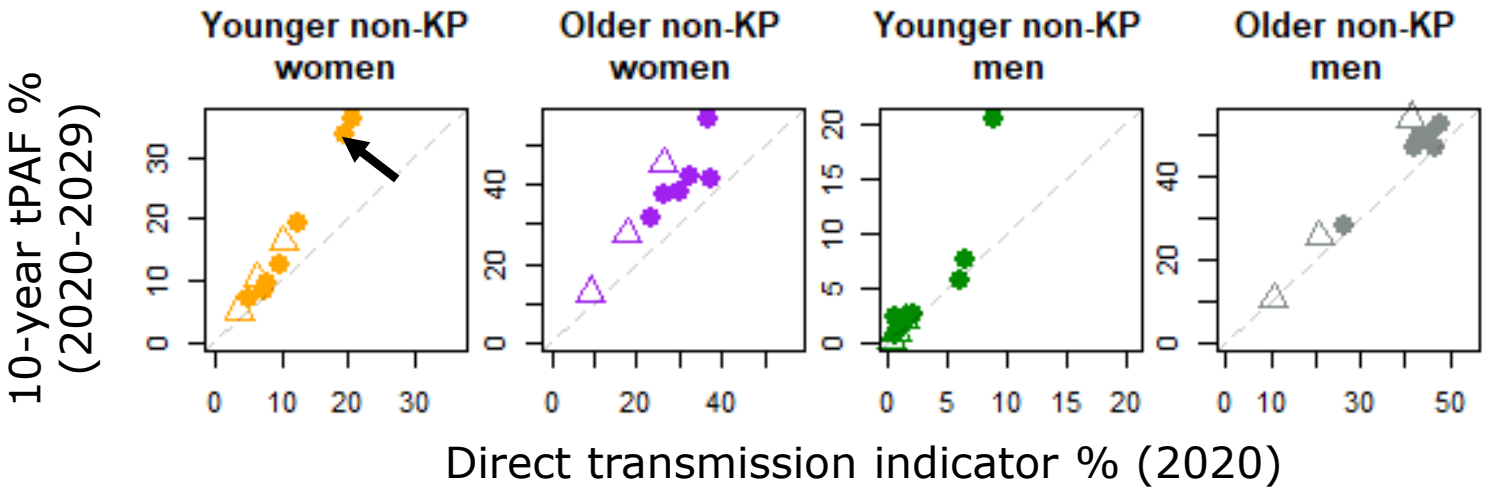


- Younger non-KP women directly transmit less infections than they acquire (up to 3-fold)
- Older non-KP men and clients of FSW always directly transmit more than they acquire (up to 3-fold)
- Largest differences in Western and Central Africa (△)

→ Only using the acquisition indicator could largely underestimate the potential impact of interventions addressing the treatment needs of men PLHIV

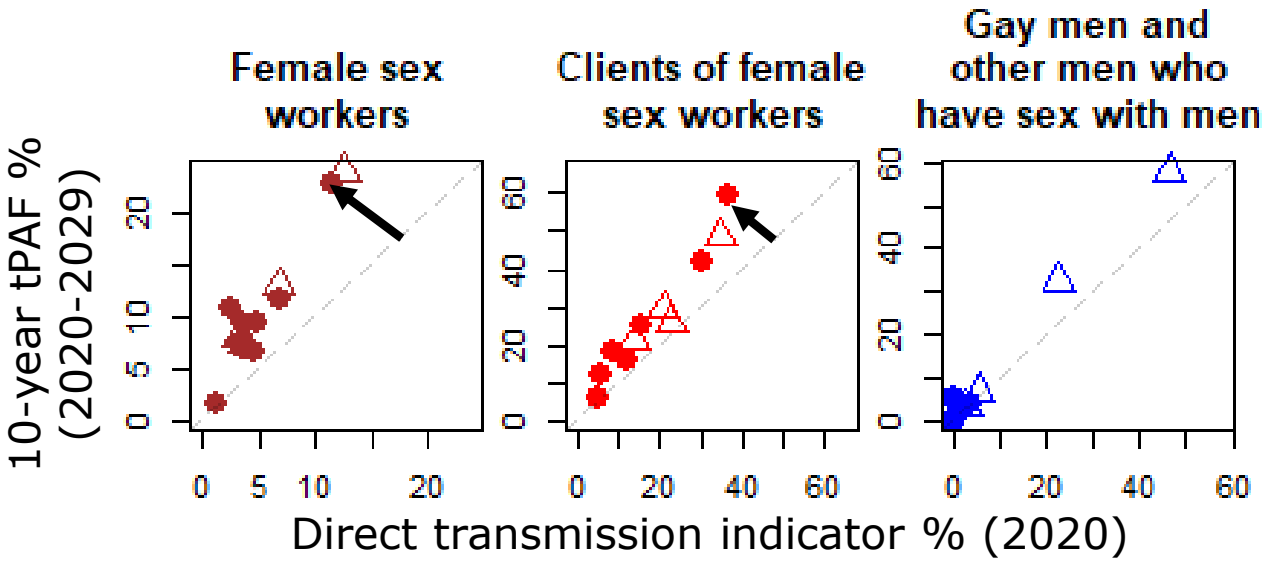
Importance of indirect transmissions

HIVR4P 2024



- Substantial fractions of indirect transmissions (using tPAFs) from younger non-KP women, female sex workers, and their clients

- Eastern and Southern Africa
- △ Western and Central Africa



→ There will be additional long-term benefits of addressing the needs of these vulnerable subgroups (not captured by the direct transmission indicator)

Conclusions

HIVR4P 2024

1. Substantial differences between indicators measuring the contribution of unmet prevention and treatment needs among different subgroups
   - Largest differences in Western and Central Africa
2. The acquisition indicator underestimated the **potential impact of addressing the large treatment needs from male populations across Africa**
3. Direct transmission indicator underestimated the importance of addressing the unmet prevention and treatment needs of vulnerable populations **to reduce all new infections in the long term**
4. UNAIDS and future modelling studies should systematically estimate and report indicators accounting for long-term secondary transmissions (tPAF)

HIVR4P 2024

Thank you!