The effect of point-of-care STI screening during pregnancy on vertical transmission of HIV and adverse pregnancy outcomes in South Africa: a modelling study

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26 September, 2024
World Conference of Epidemiology (WCE), Cape Town, South Africa

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Background

- Sexually transmitted infections (STIs) in pregnancy are associated with increased risk of adverse pregnancy and birth outcomes
- Adverse outcomes include vertical transmission of HIV, stillbirth, preterm delivery (PTD), low birthweight (LBW) and small for gestation age (SGA)
- Treatment of maternal curable STIs may reduce adverse pregnancy and birth outcomes
- In South Africa, syndromic management (SM) in the standard of care for STI management.

SM involves treating symptomatic infections but limited because of undertreatment of asymptomatic STIs and overtreatment of patients with genital symptoms not associated with STI.

Objectives

- To develop a static mathematical model to estimate impact point-of-care (POC) screening and treatment of STIs in pregnant women compared to SM.
- To assess potential impact of POC screening and treatment of the following curable STIs during pregnancy on vertical HIV transmission and adverse pregnancy and birth outcomes:
    1. *Chlamydia trachomatis* [CT]
    2. *Trichomonas vaginalis* [TV]
    3. *Neisseria gonorrhoeae* [NG]

Methods

- We conducted two separate meta-analyses to inform model assumptions regarding the effect of CT, NG and TV on adverse pregnancy/birth outcomes and vertical HIV transmission as follows:-
  - Effects of STIs on vertical transmission of HIV
  - Effects of curable STIs on adverse birth outcomes
- We adopted several assumptions and outputs from the Thembisa model (version 4.5 for 2022)
  - Thembisa is an HIV and demographic model, and used estimates of vertical transmission and births to women living with HIV
- We used data from local studies to inform estimates on:
  - STI prevalence
  - STI point of care screening uptake and treatment
  - Sensitivity of syndromic management of STIs

Methods (2)

- Uncertainty analysis performed for each of the key parameters of interest
- One-way sensitivity analysis conducted to assess the influence of the model parameter on the outcomes of interest
- Multivariable sensitivity analysis with 1000 parameter combinations drawn from sampling distributions
- Compared our model results with trial data from:
  - Rakai trial from Uganda (Wawer, et al. *Lancet*, 1999)
  - The WANTAIM trial from Papua New Guinea (Riddell, et al. *Lancet Glob Health*, 2024)
  - Maduo trial from Botswana (Wynn, et al. *BMC Infect Dis*, 2022)

Results: Prevalence of curable STIs in pregnancy

Point of care (POC) screening and treatment in pregnancy is estimated to reduce the prevalence of STIs in pregnancy

- In the absence of POC screening and treatment the estimates of undiagnosed and untreated curable STIs during pregnancy are :
  - 26% in pregnant women living without HIV
  - 35% in pregnant women living with HIV
- Overall, untreated curable STI prevalence by time of delivery is estimated to be 28% with syndromic management

Results: HIV incidence

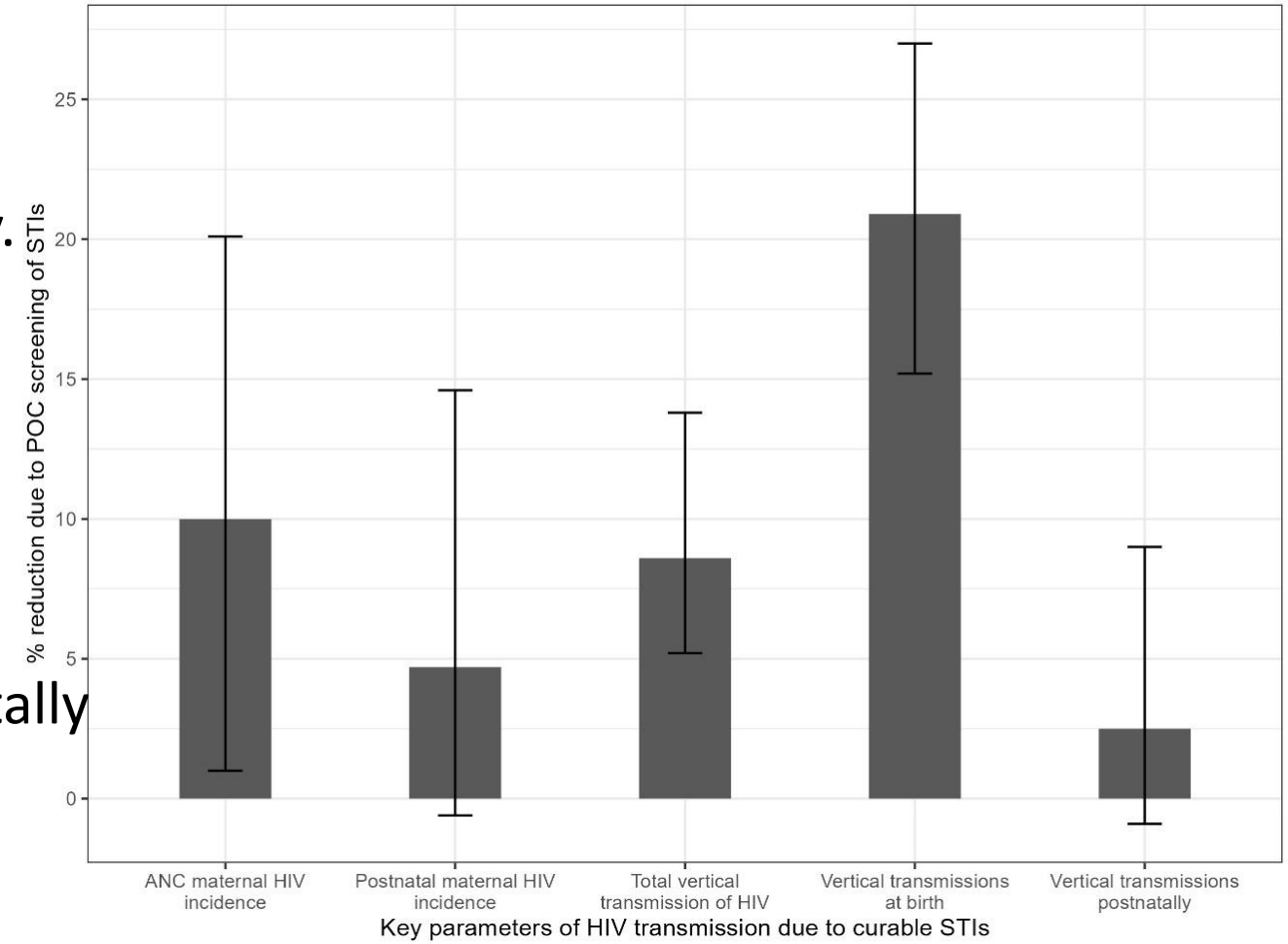
Point of care STI screening & treatment in pregnancy is estimated to reduce maternal HIV incidence and vertical transmissions of HIV

Maternal HIV incidence:

- 10% (95% CI: 1.0-20.1%) reduction in maternal HIV incidence antenatally.
- 4.7% (-0.6 – 14.6%) reduction during the postnatal period.

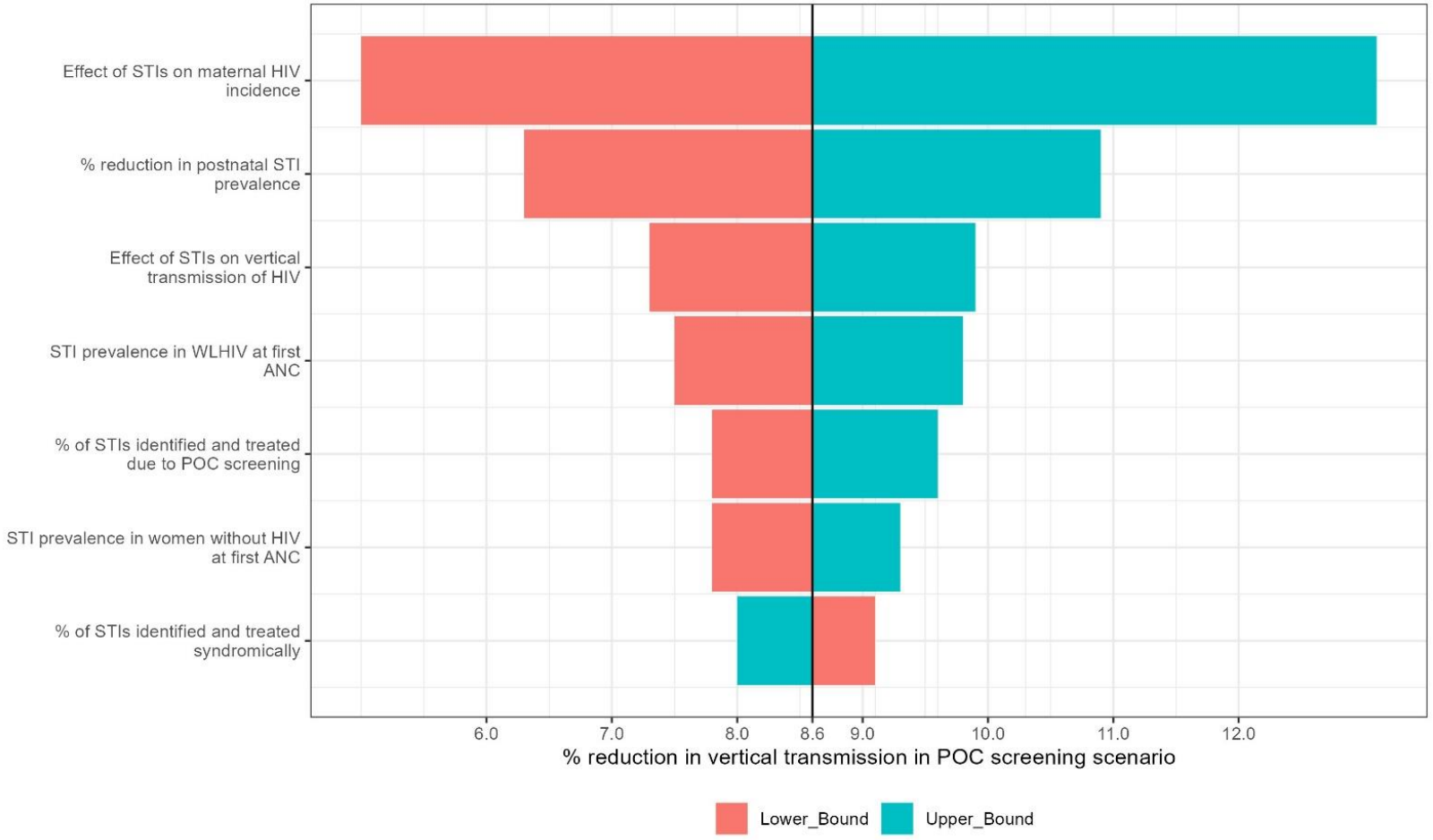
Vertical transmission of HIV:

- Reduce by 21% (15.2 – 27.0%) at birth
- Reduce by 2.5% (-0.09 – 9.0%) postnatally
- Vertical HIV transmission risk reduced by: 8.6% (5.2-13.8%)



Results: one way sensitivity analysis

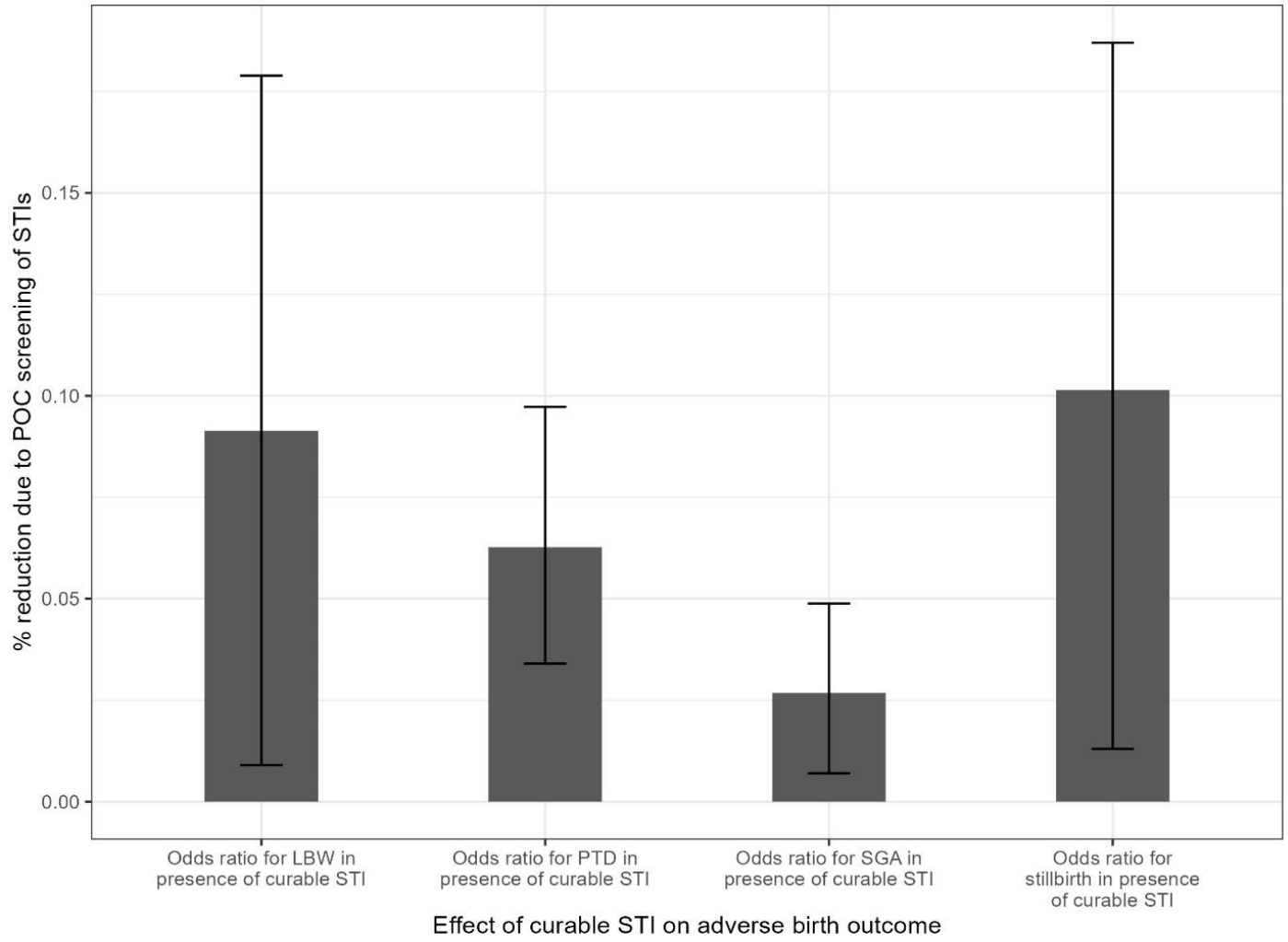
Most of the uncertainty in vertical HIV transmission is attributed to uncertainty in the effect of STIs on maternal incidence of HIV



Results: Adverse birth outcomes

Point of care STI screening and treatment in pregnancy is estimated to reduce adverse birth outcomes:

- 10.1% (95% CI; 1.3-18.7%) reduction in stillbirth
- 6.3% (3.4 – 9.7%) reduction in PTD.
- 2.7% (0.7 – 4.9%) reduction in SGA.
- 9.1% (0.9 – 18.0%) reduction in LBW
- Wide error bars for LBW and stillbirth are due to uncertainty in the effect of curable STIs on occurrence of LBW and stillbirth in the model



Results: Comparison with trial data

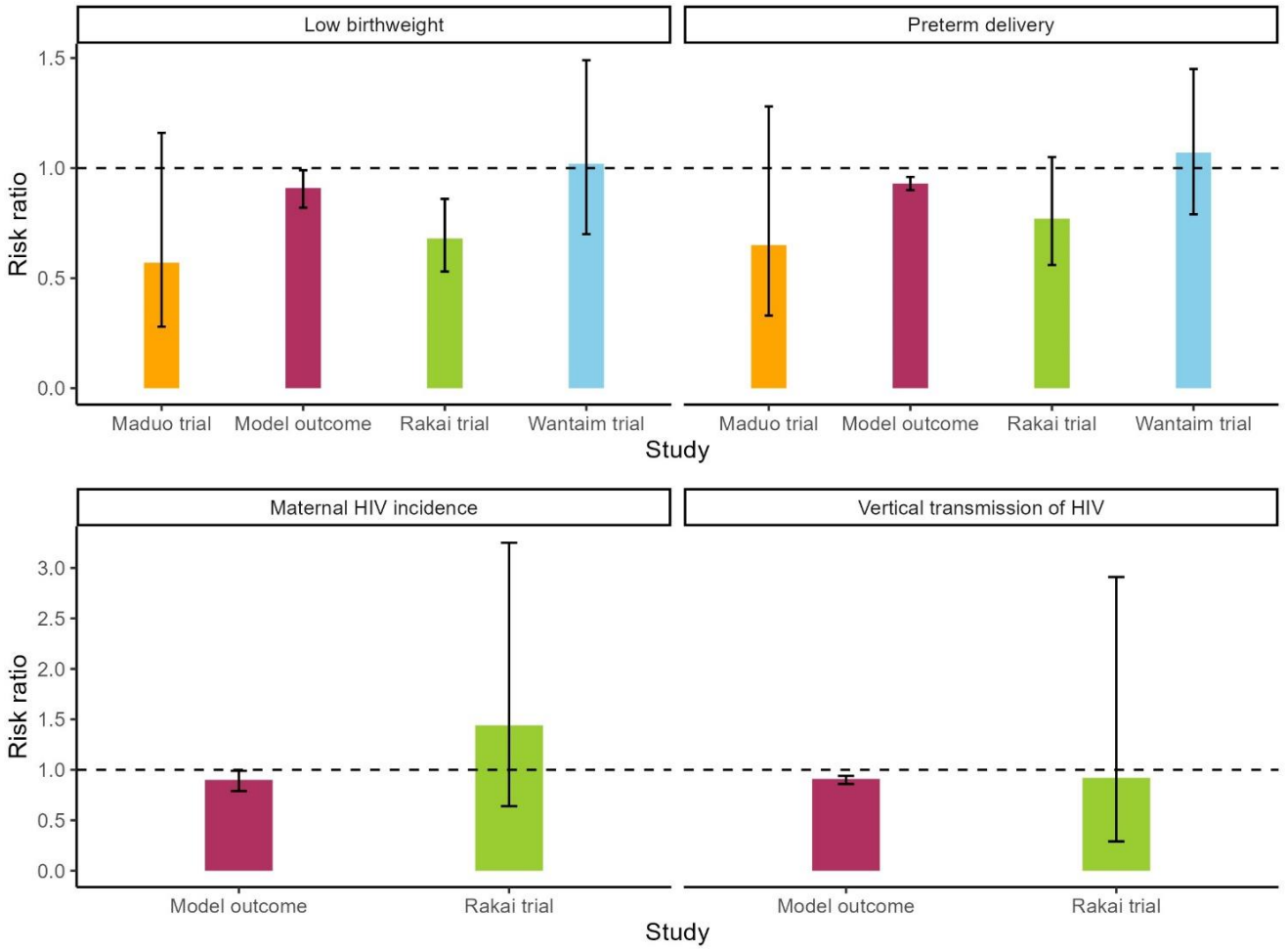
Comparison of the model results and trial data from three randomized trials

Vertical transmission of HIV

- Model outcome with a risk ratio of 0.91
- Rakai trial with a risk ratio of 0.92

- Adverse birth outcomes
  - Model outcome for LBW- risk ratio of 0.91 falls between the outcomes of the 3 trials
    - 0.57 from Maduo trial
    - 0.68 from the Rakai trial
    - 1.02 from the WANTAIM trial
  - Model outcome for PTD - risk ratio of 0.93

    falls between the outcomes of:-
    - 0.65 from the Maduo trial
    - 0.77 from the Rakai trial
    - 1.07 from the WANTAIM trial



Conclusion

- Introduction of point of care STI screening and treatment of curable STIs in South African antenatal care has potential to reduce the following adverse outcomes:
  - Maternal HIV acquisition
  - Vertical HIV transmission
  - Birth outcomes - stillbirths, PTD, LBW and SGA
- Comprehensive maternal healthcare services including screening, treatment and prevention of HIV and curable STIs are needed to contribute towards the elimination of vertical HIV transmission.
- Urgent need to assess cost-effectiveness of POC screening relative to SM for curable STIs

Strengths & limitations

Strengths

- Integration of data from different sources
- Comprehensive review and meta-analysis of effect of STIs on vertical HIV transmission – not previously done

Limitations

- Potential confounding due to assumptions on impact of STIs on vertical HIV transmission and adverse birth outcomes relying on observational data
- We used a static model which does not consider reduction of STIs at population level
- Uncertainty around the extent to which antenatal reductions in STI prevalence can be sustained during postnatal period

Acknowledgements

- Authors
  - Professor Landon Myer
  - A/Professor Dvora Joseph Davey
  - A/Professor Leigh Johnson
  - Professor Sinead Delany-Moretlwe
  - Dorothy Nyemba

- World Congress of Epidemiology 2024

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