MODELLING THE IMPACT OF DUAL HIV AND HPV VACCINE STRATEGIES AMONG ADOLESCENTS IN A RESOURCE CONSTRAINED SETTING

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OUTLINE OF THE PRESENTATION

1. Conceptual framework
2. Aim
3. Objectives
4. Clinical translation of research
5. Methods
6. Limitations
7. To do list
8. Time frame
9. References
1. Differing adolescent health needs
2. Poor attention to adolescent SRH
3. School SRH platform

1. Adolescent involvement in clinical trials
2. HIV – HPV link
3. Burden of disease
   - HIV
   - HPV
AIM

To *estimate* the impact of HPV and HIV dual vaccination preventative strategies on the disease burden when administered to school-going *adolescents* as part of the *school health programme* envisaged under the PHC reengineering model.
OBJECTIVES

To explore the long term outcomes of HIV and HPV infection and disease following the introduction of the HIV and HPV vaccine in adolescents by comparing it with alternative strategies drawing on the principles of mathematical modelling and economic evaluation. These strategies include:

- HIV vaccine vs. current practices†
- HPV vaccine vs. current practices†
- HIV & HPV vaccines concurrently vs. current practices†
- HIV & HPV vaccines concurrently vs. current successfully implemented programmes [male medical circumcision (MMC)]

† Current practice (in South Africa) refers to the ARV rollout (HIV) and the cervical cancer screening programme (HPV).

To explore the ethical considerations of consent and parental autonomy with dual HIV and HPV vaccine administration in adolescents.
CLINICAL TRANSLATION OF RESEARCH

HIV + HPV

Significant mortality and morbidity

Refute or justify integration into the EPI
First testing of dual immunisation practices
METHODS

• Adolescents: 12 – 18 years old
• Sample size – to be estimated
• Study site – Soweto
• Vaccinations – at different coverage levels
  – HPV: Gardasil
  – HIV: RV144 (31% efficacy)
• Stratification – computational difficulties
• Study comparators – current SA
Model Assumptions

MODEL
• A priori model
• Stochastic
• Age homogenous
• Closed population → Births = Deaths
• Type I survivorship

TRANSMISSION
• Sexually naïve
• Heterosexual HIV transmission
Model Parameters

1. Transmission
   • Life expectancy \( L \)
   • Force of infection \( \lambda \)
   • Recovery \( \sigma \)
   • Vaccinated \( p \)
   • Death rate – All cause \( \mu \) – Disease related \( \alpha \)

2. Sexual behaviour

3. Natural history

4. Interventions
   a. Age at sexual debut
   b. Baseline CD4
   c. Revaccination
   d. Condom use / contraception
   e. No. of partners
   a. Baseline CD4
   b. Impact of ART
   c. Potential coverage levels
   d. Transmission probabilities of STIs
   e. Revaccination?
   f. Effects of temporary immunity
   g. Potential coverage levels
Transmission model with vaccination and temporary immunity

\[
\frac{dS(t)}{dt} = N\mu(1-p) - (\mu + \lambda)S(t) - \alpha R(t)
\]

\[
\frac{dI(t)}{dt} = \lambda S(t) - (\sigma + \mu)I(t)
\]

\[
\frac{dR(t)}{dt} = \sigma I(t) + N\mu p - (\mu + \alpha)R(t)
\]

\[\alpha = 0 \rightarrow \text{SIR with lifelong immunity}\]
\[\alpha > 0 \rightarrow \text{Only temporary immunity after infection and possibility to reinfection}\]
Simulation Outcomes

MATHEMATICAL MODELS
- Numbers of HIV and HPV infections prevented
- Number needed to vaccinate to prevent one infection
- Herd immunity thresholds

COST-EFFECTIVENESS ANALYSIS
- Cost-effectiveness analysis: outcomes in natural units e.g. life years gained
- Cost-utility analysis: outcomes in healthy years e.g. DALY’s
- CHOICE (WHO)
LIMITATIONS

• The models are run based on existing health data parameters which are often incompletely collected and inaccurate.
• The parameters set in the model are determined by the researcher and may not comprehensively establish all factors linked to causation.
• Costs included will be based on the availability of data.
• Assumptions have limitations
• Change in health seeking behaviour
TO DO LIST.....

1. Implementation of dual vaccines with different efficacy
2. Understanding the interaction between the vaccines
3. Improve understanding of both:
   a. Health Economics – Advanced workshop
   b. Disease Modelling - LSHTM
4. Discuss possible use of the Birth-to Twenty data to calculate study parameters
5. Ethical clearance
### TIME FRAME

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**Note:** The diagram shows the timeline for a research project, with key activities and submission dates for each year.
REFERENCES

ACKNOWLEDGEMENTS

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Thank you for your attention

Questions?