African Population and Health Research Center

AGENT-BASED MODELLING (ABM) PREDICTS NUMBER NEEDED TO VACCINATE TO ACHIEVE A 50% REDUCTION IN ZERO-DOSE VACCINATION AMONG UNDER-FIVE CHILDREN IN KENYA BY 2025

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Background - The Gap

- Globally, vaccination is regarded as a cornerstone of public health efforts worldwide, protecting individuals and communities from a range of infectious diseases (WHO,2020)
- Vaccination prevents 2.5 million deaths among under fives annually; this is exacerbated by the fact that one in five(20%) children lacks access to life saving vaccines in SSA (Ozigbu, 2022)
- Zero-dose (ZD) children is a critical objective in global health, and it is at the heart of the Immunization Agenda 2030 (IA2030) strategy.
- Gavi defines zero-dose children as those who lack the first dose of diphtheria-tetanus-pertussis containing vaccine (DTP1) administered 6weeks of birth-KEPI schedule (NVIP, MoH, 2023).

THE GAP

- Coverage for the first dose of diphtheria–tetanus–pertussis (DTP1)-containing vaccine is the global operational indicator used to estimate ZD children.
- In SSA zero dose vaccination -7.7%, one vaccine-3.3%, two vaccines - 3.4%, three vaccines-14.6%, four vaccines- 70.9%, 59.9%- fully immunized.
- WHO goal is to have 90% of the children immunized (Cata-preta, 2021).
- Kenya ZD rate was estimated to be around 7%, indicating that approximately 7 in 100 children under 1 year of age did not receive any vaccinations (KDHS,2022).

CONT'D GAP

- Efforts have been made to improve this rate, but challenges persist in reaching all children with essential vaccines from birth.
- Addressing the prevalence of zero dose vaccination among children under five in Kenya is imperative to mitigate the risk of outbreaks of vaccine-preventable diseases and improve overall public health outcome

MATERIALS & METHODS

- Target population and subgroups: Under-five children in Kenya

  - Setting and location: Focus on LMICs, specifically in Kenya.

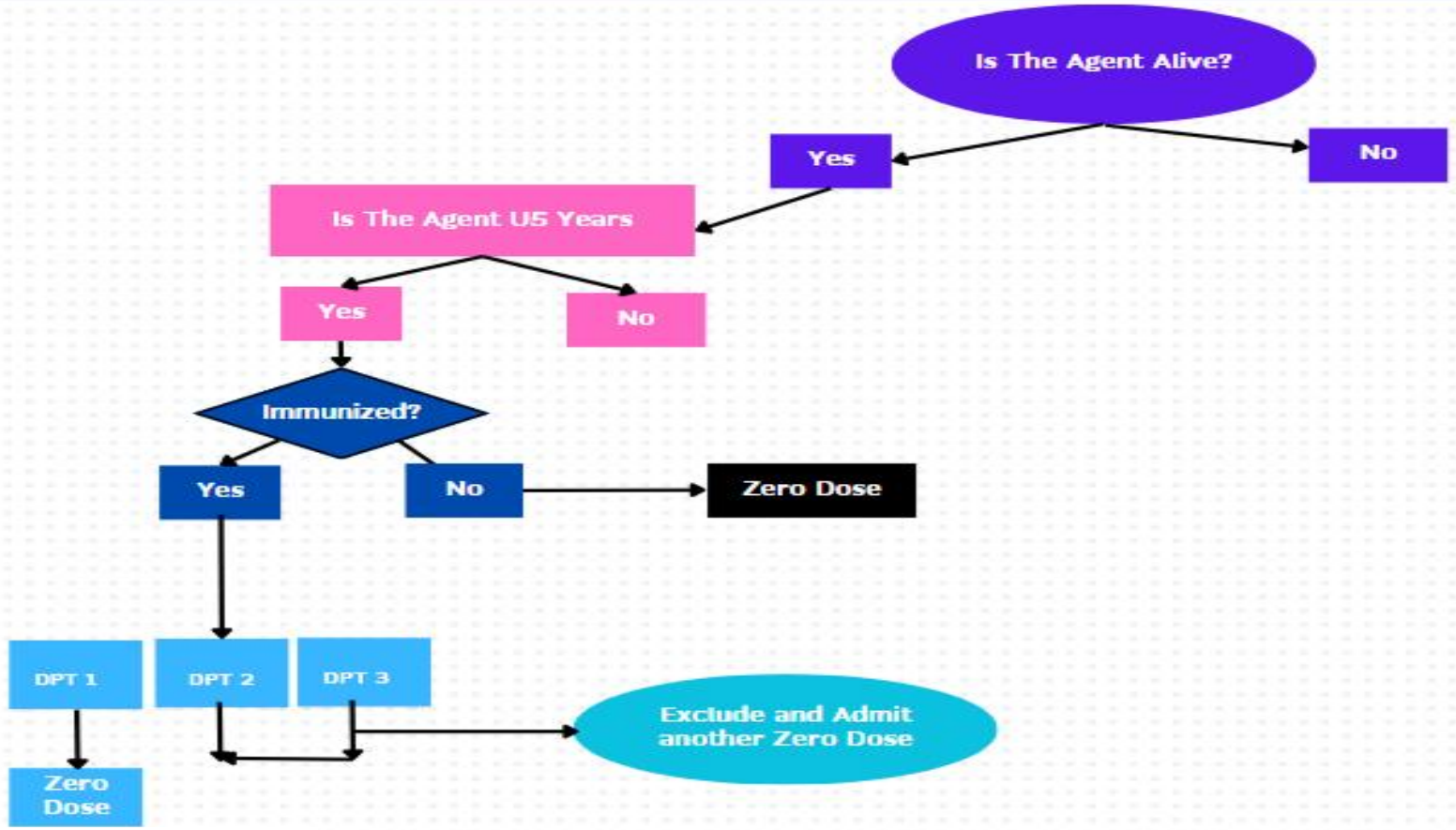
  - Time Horizon: Achieving a 50% reduction in zero dose vaccination rates by 2025.

  - Description of Outcomes: Aim to reduce under-five morbidity and mortality rates through increased vaccination coverage by the year 2025

- Model structure - Starsim - SIS model (Susceptible (S) → Infectious (I) → Susceptible (S))
  - Agent - under five child
  - Interaction - caretakers/mother/guardian/ health worker/
  - Environment - Vaccination

Flowchart

ZERO DOSE VACCINATION



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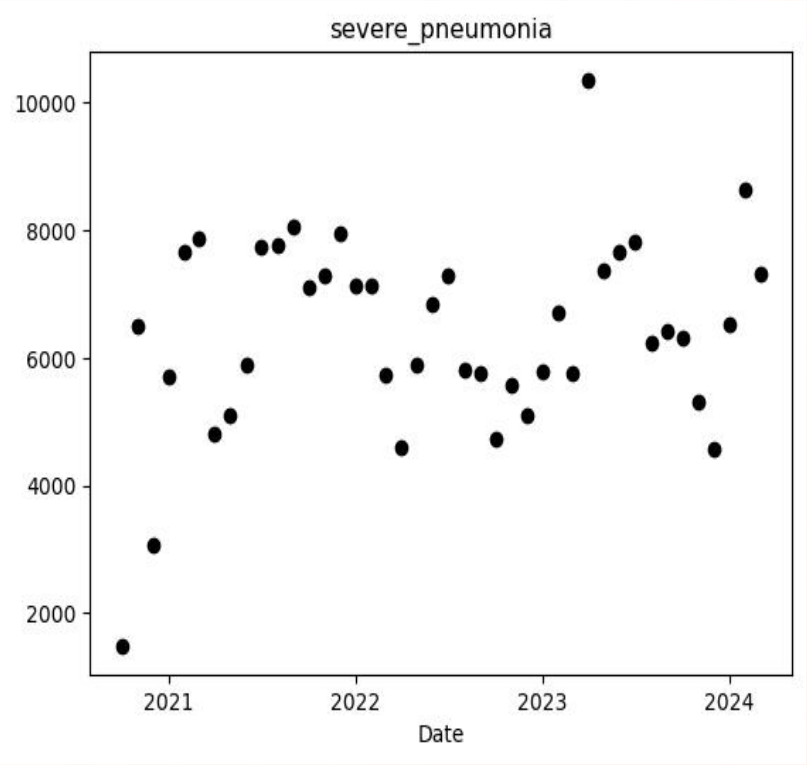
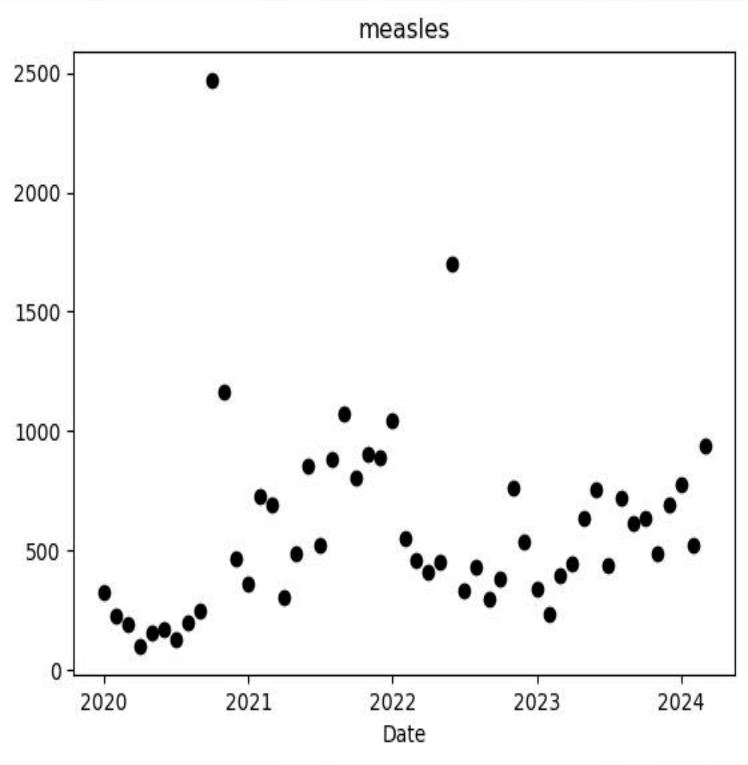
Disease scatter plot (before modelling)

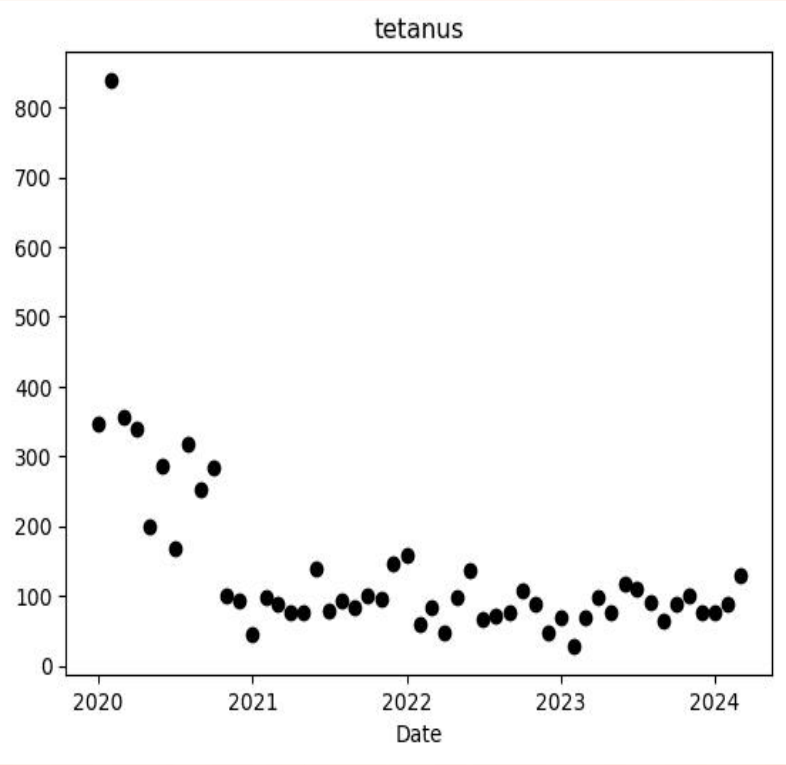
No. of severe pneumonia cases



No. of Measles cases



No. of Tetanus cases



SOURCE KDHIS,2024

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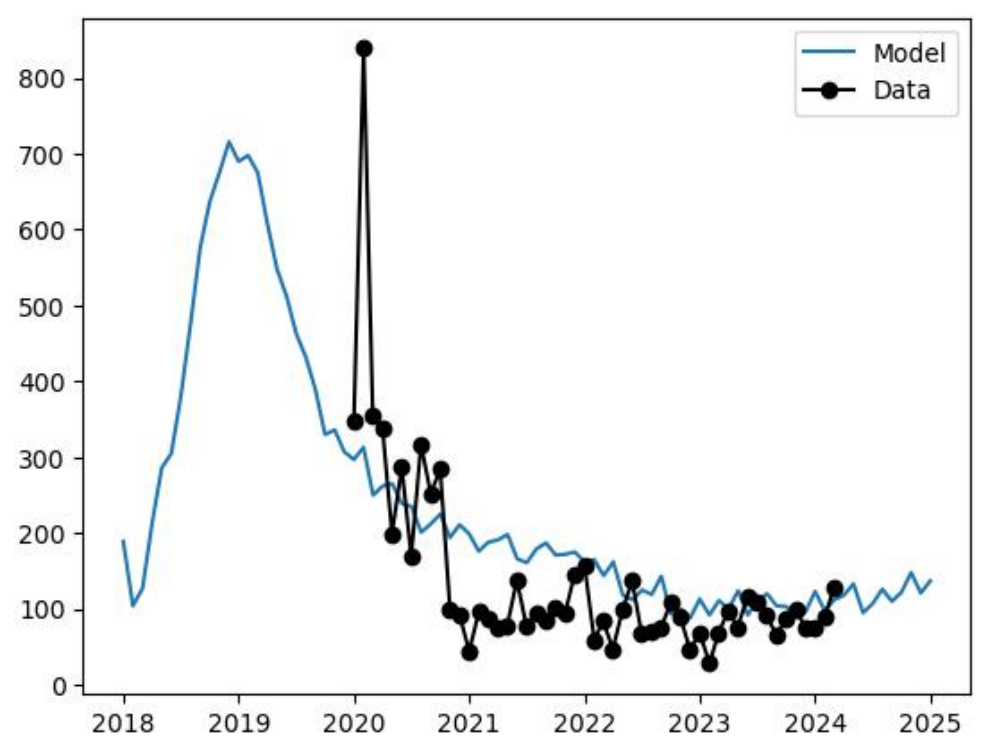
Research question

- How many tetanus cases will be averted if we reduce prevalence of zero dose vaccination by 50% among under-fives by the year 2025?
  - **Globally approx.- 50,000 cases**
  - **Global mortality – 34,684 -**
  - **Tetanus cases – 3338 – 2019 – targeted reduction - 50% = approximate=1670**
  - **Mortality due to tetanus – 2348 – 2019**

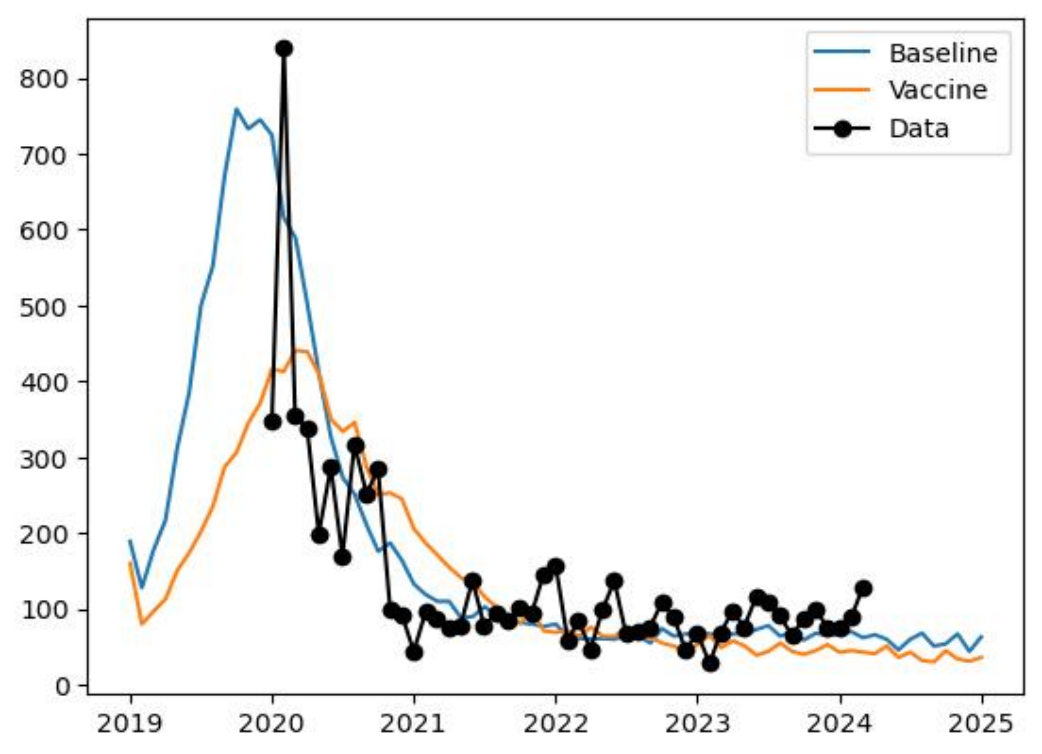
Model Structure: ABM STARSIM WITH SIS MODEL

- Tetanus=Beta=1.3, gamma=3/12, waning=0.055
- Intervention = vaccination= prob=0.25, efficacy=0.9(vaccine to produce immunity)
- Tetanus cases averted by 50% approximate =75 cases/month

Model before calibration



Model after calibration



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Conclusion

- The model demonstrated that halving zero-dose vaccination cases from 3338 to 1670
- Lead to a reduction in tetanus cases from 130 to 65 and susceptibility by 2025.

Limitations

- Time
- Finance

Interventions and comparators

- The project proposed to achieve the 50% reduction in zero dose vaccination rates through introduction of vaccine campaigns.

  - Discuss comparators or control groups used in the study- U5 – Zero dose versus non-zero dose

- Address uncertainties and heterogeneity within the model.

Recommendations

- Increase tetanus caccination-community based
- Develop a tetanus vacanccine with a 10 year potency to reduce chance of one being susceptible to tetanus infection
- Publish manuscript to disseminate the findings.

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THANK YOU

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