Modeling typhoid vaccination in Nepal: TCV impact and booster dose strategy

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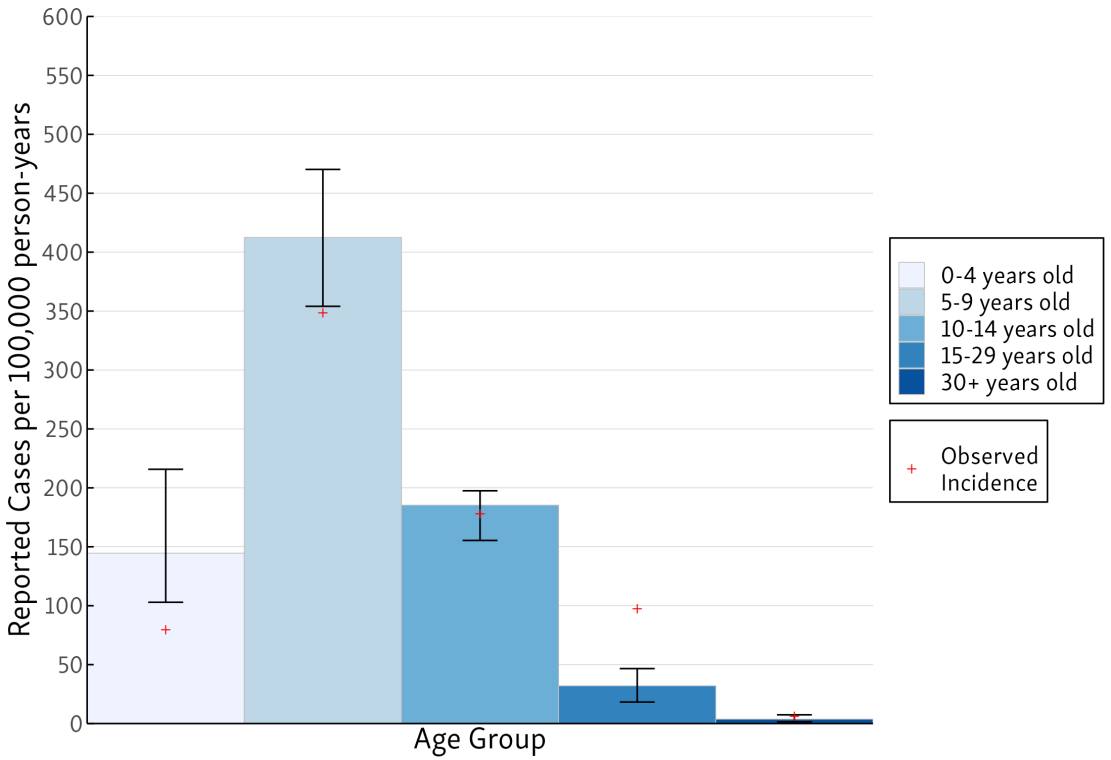
TyVAC Typhoid Vaccine Acceleration Consortium

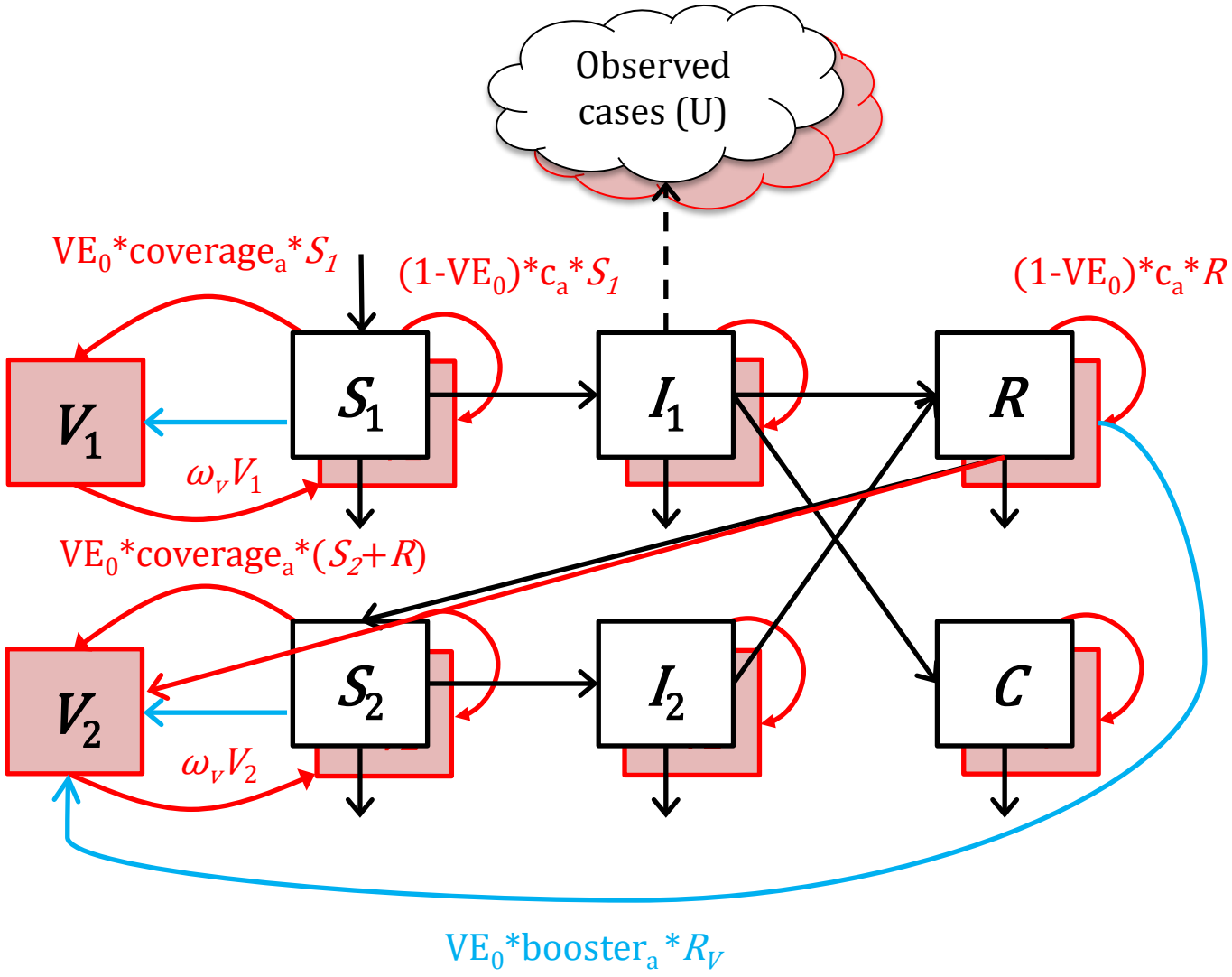
Typhoid vaccination in Nepal

- TCV was introduced into the National Immunization Program of Nepal in April 2012
  - Routine vaccination at 15 months
  - Catch-up campaign to 15 years of age
- Data from TyVAC randomized controlled trial demonstrated high VE (79%) through 2 yrs of follow-up

- Key question: **Will booster doses of TCV be needed to sustain protection among school-aged children?**
  - What is the most cost-effective vaccination strategy?

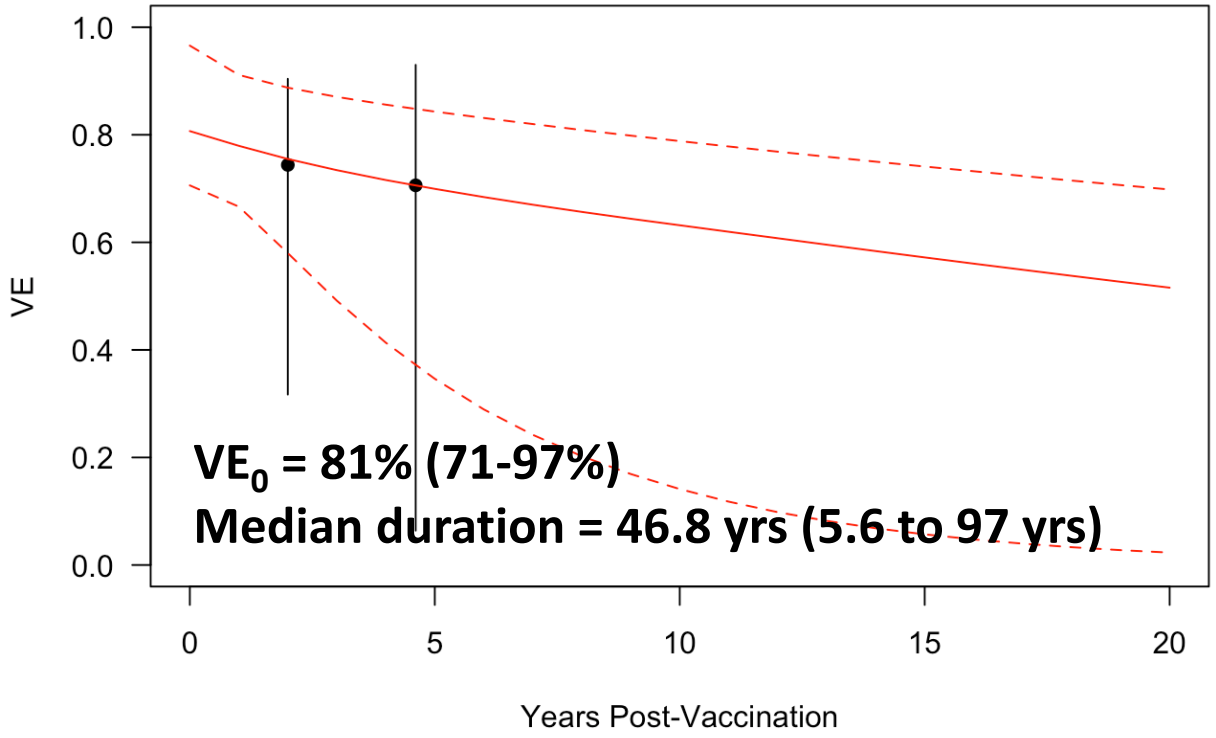
Translating vaccine efficacy into impact



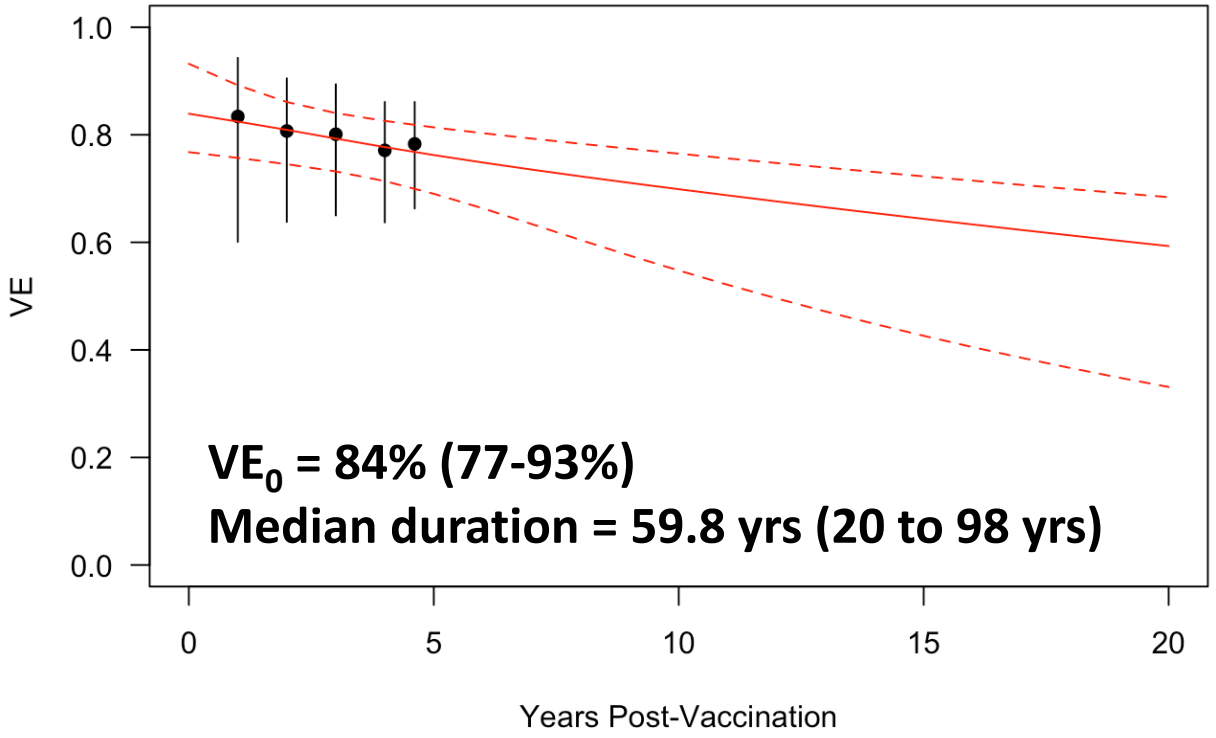


Waning of vaccine effectiveness

Routine vaccination doses (<2 yrs)



Campaign & booster doses (2-15 yrs)



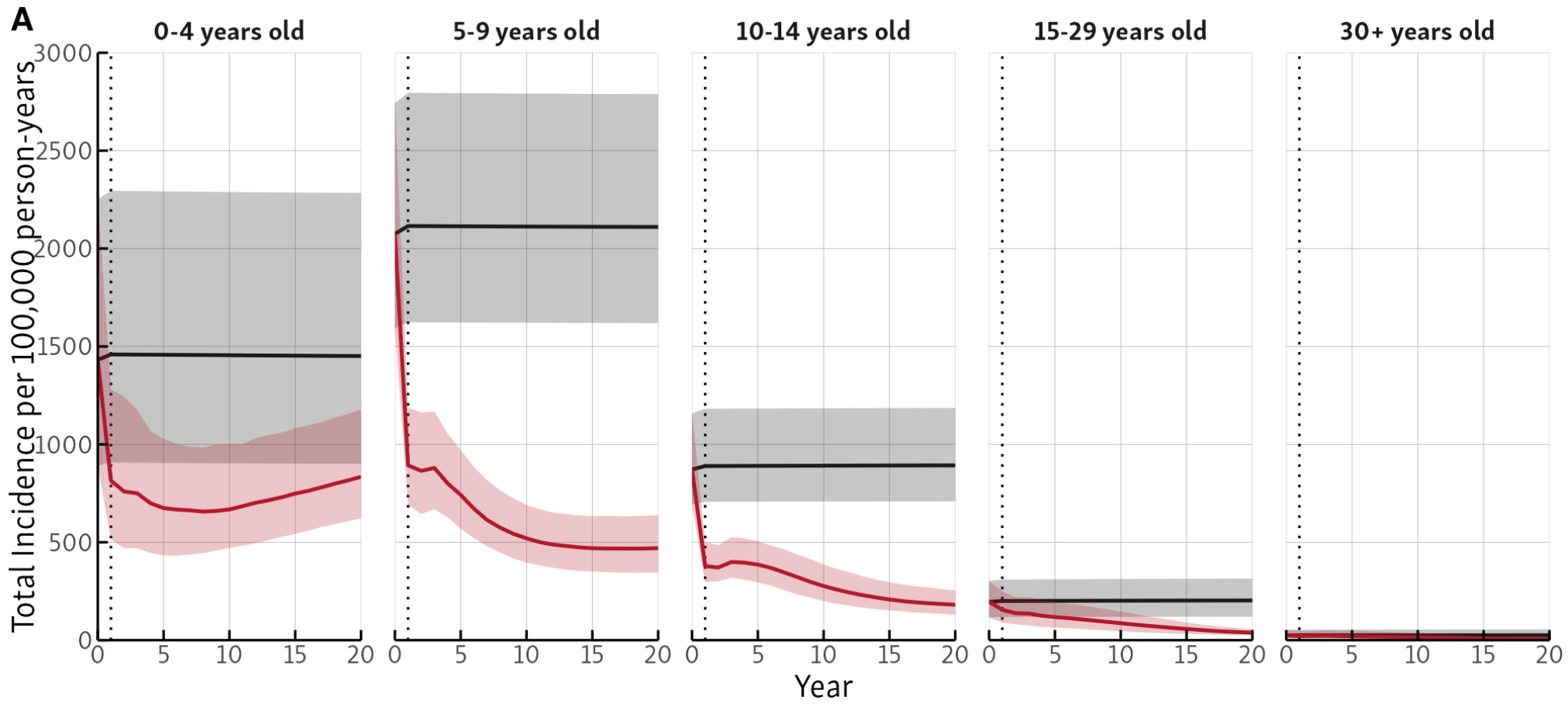
based on data from **Malawi**:
Patel et al (NEJM, 2021 and Lancet, in press)

Vaccination strategies

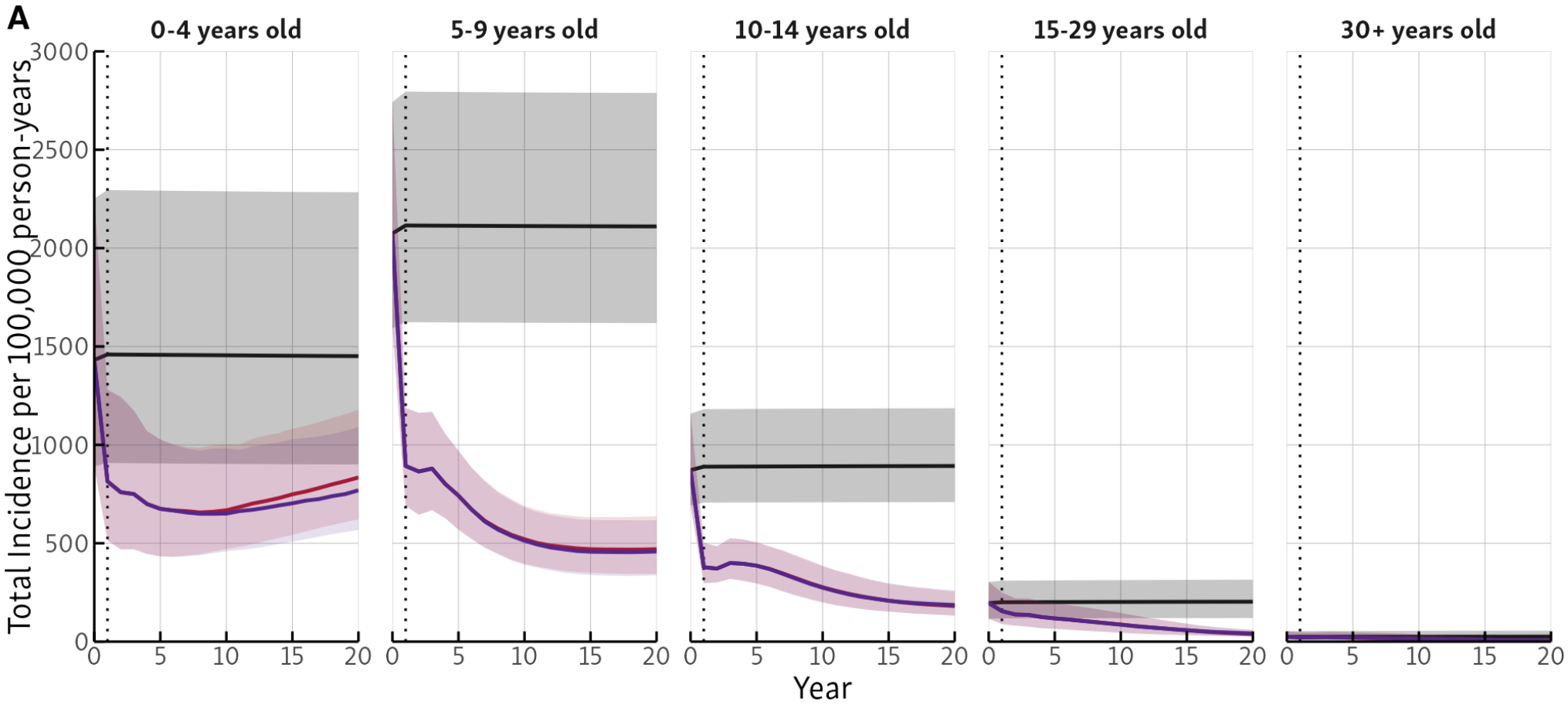
We modeled the following vaccination strategies:

- Routine vaccination at 15m + campaign 15m – 15y **(Base case)**
- Routine 15m + campaign 15m-15y + booster at 5y (in year 5)
- Routine 15m + campaign 15m-15y + booster at 10y (in year 10)
- Routine 15m + campaign 15m-15y + boosters at 5y & 10y (in years 5 & 10)
- No vaccination

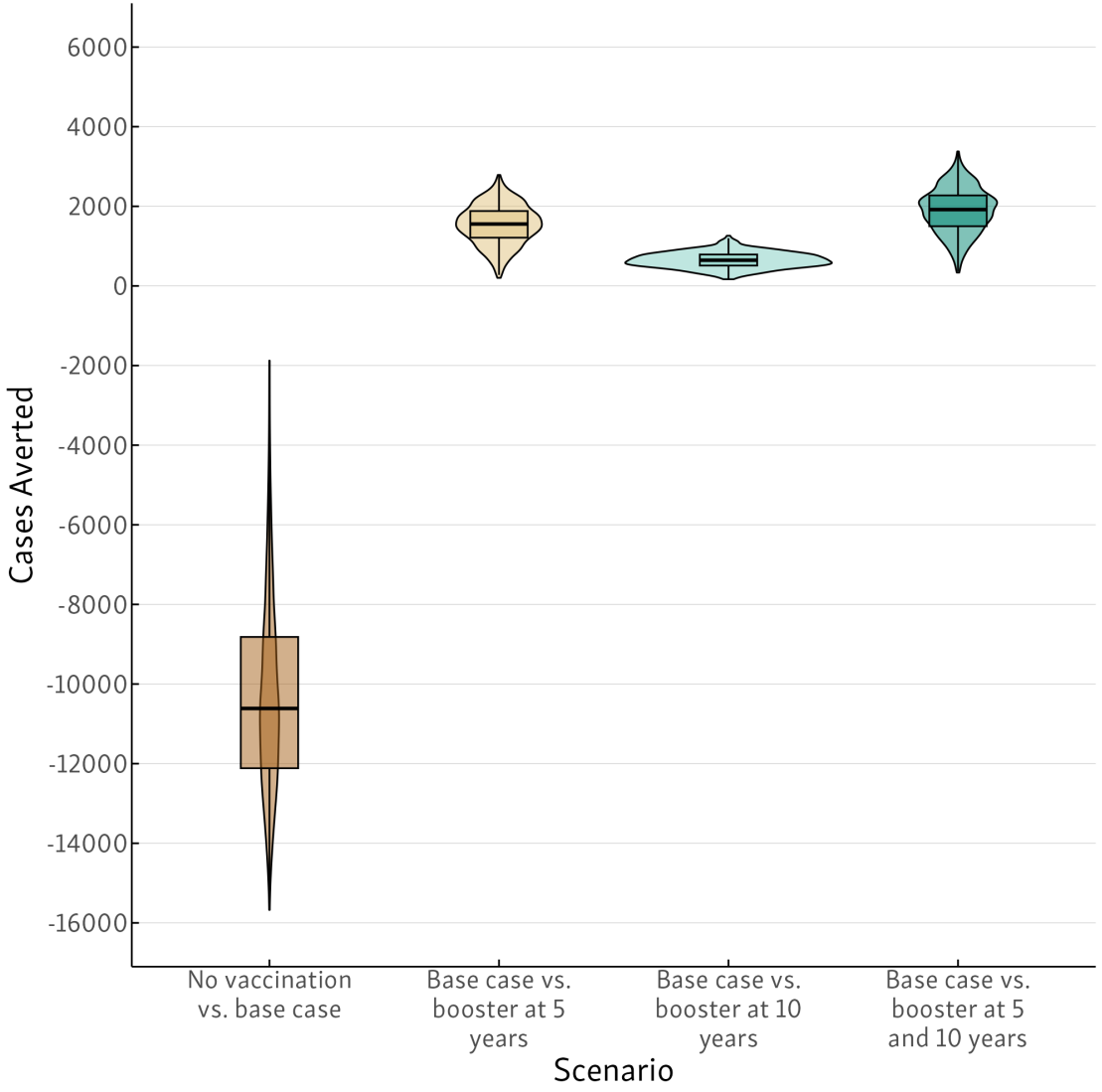
Predicted vaccine impact



Predicted vaccine impact

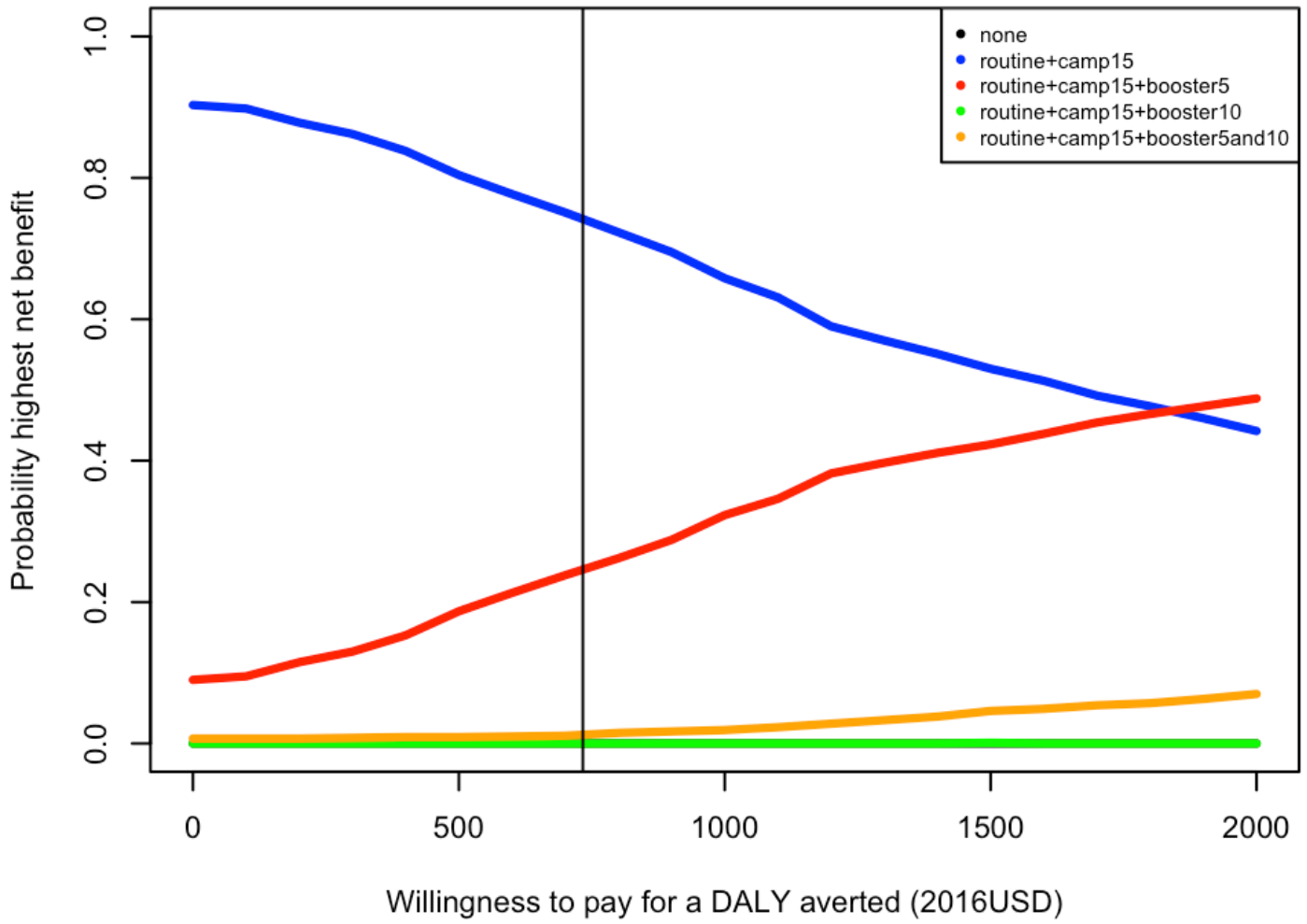


Cases averted



- The **current vaccination strategy** (base case) is predicted to avert ~10,000 cases per 100k population over 20 years
- Including a **booster dose** is predicted to avert an additional 650 to 1,900 cases per 100k

Cost-effectiveness of booster strategies



- The **current vaccination strategy** is preferred (most cost-effective) at a willingness-to-pay (WTP) equal to 1xGDP per capita
- Including a **booster dose at age 5 years** is cost-effective at a WTP threshold of $1300 per DALY averted

Limitations and next steps

- Model was fitted to adjusted typhoid incidence in Kathmandu (STRATAA study)
  - may not be representative of entire country
- Need additional data on the delivery costs and coverage achievable for booster dose strategies
- Update with data from TyVAC-Nepal and TyVOID study on medium-term VE in Kathmandu
  - explore factors underlying differences in waning of VE between settings

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wellcome trust

TyVAC collaborators

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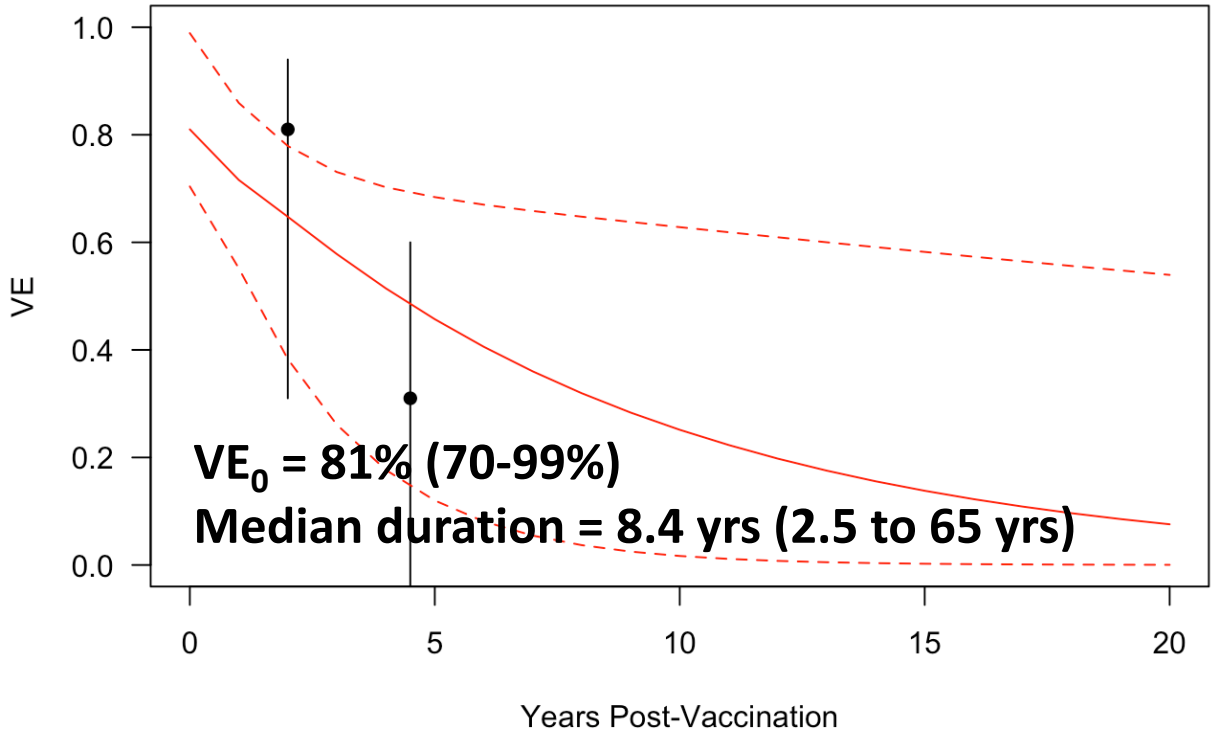
ADDITIONAL SLIDES

Waning of vaccine effectiveness (fast waning)

Routine vaccination doses (<2 yrs)



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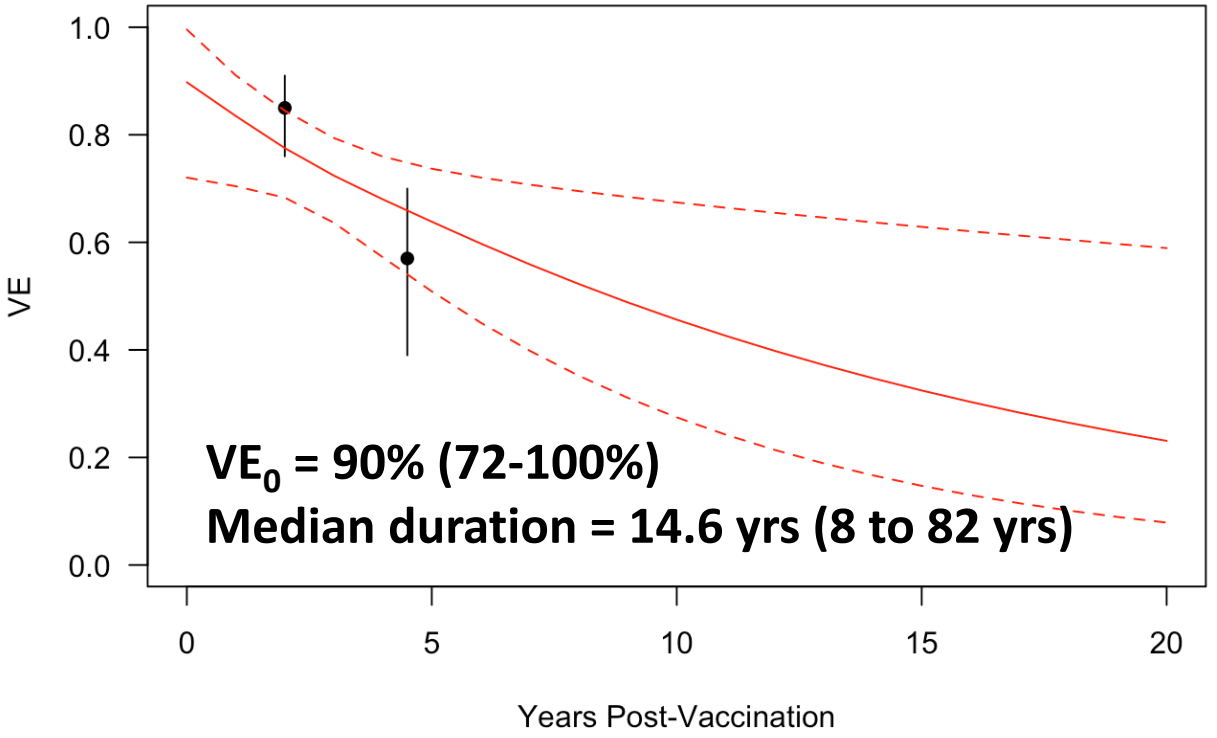


based on data from **Bangladesh**:
Qadri et al (Lancet, 2021) and in prep

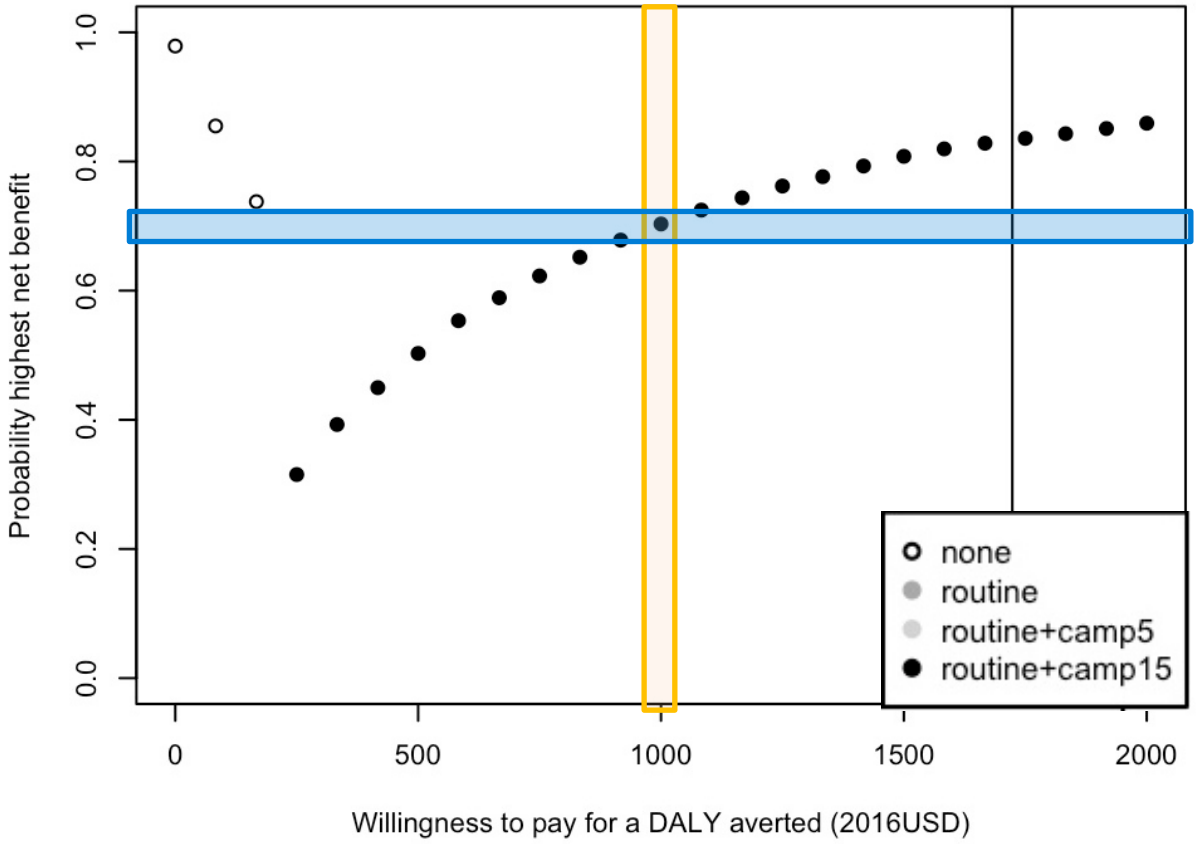
Cost-effectiveness analysis: our approach

- Predict the impact of vaccination on the incidence of typhoid fever using a transmission dynamic model
- Estimate disability-adjusted life-years (DALYs) and treatment costs due to typhoid under each strategy
  - 20-year time horizon
- Estimate the cost of vaccination
- Calculate net monetary benefit:

  $\Delta NB = (DALYs\ averted)*WTP - \Delta Costs$

  (incorporates uncertainty in the model inputs)

Cost-effectiveness acceptability frontier



- Sampled 1,000 times from input parameters (incidence, vaccine efficacy and duration, treatment costs, vaccine delivery costs, CFR, etc)
- Calculated net monetary benefit:
  NB = (DALYs averted)*WTP - ΔCosts
- Examined the proportion of simulations in which the strategy that yielded the highest *average* net benefit was preferred for a given willingness-to-pay value

Bilcke et al (2019) *Lancet ID*