

The estimated cost-effectiveness of a *Shigella* vaccine in children under five in Ethiopia

Katherine L. Rosettie, James Collins, Michelle Park, Abraham D. Flaxman, Ibrahim Khalil, Kelly Compton, Paola Pedroza, Ali H. Mokdad, Marcia R. Weaver

INTRO

- Shigella* is the second leading cause of diarrhea mortality in children under five globally; it was responsible for approximately 8,500,000 disability-adjusted-life-years (DALYs) in 2017.
- Our objectives are to answer the following four questions in Ethiopia: (1) What is the effect of adding a primary *Shigella* vaccine series at 9 and 12 months to the routine immunization schedule; (2) What is the effect of adding a booster dose at 15 months to the primary series?; (3) What is the effect of a booster dose at 18 versus 15 months?; and (4) What is the effect of starting the primary series at 6 months versus 9 months?

METHODS

- We used an open-source microsimulation framework developed at the Institute for Health Metrics and Evaluation called Vivarium.
- We used a time horizon of 15 years (2025-2040) with an initial population of 32,000 simulants ages 0-5 years and an open-cohort structure wherein newborns entered the model each time step (1 day).
- We assumed 50% vaccine efficacy. Cost estimates were based on summary estimates of routine immunizations in low-income countries. We used GBD-reported annual measles and DTP3 vaccines coverage in Ethiopia as a proxy for *Shigella* vaccine coverage.
- We quantified parameter uncertainty for our estimates using the Monte Carlo method whereby we drew 500 values from the distributions of each input parameter.

RESULTS

Incremental cost-effectiveness ratios for 4 vaccine schedules in Ethiopia.

Schedule (months)	DALYs averted in thousands, mean (95% UI)	Incremental cost in thousands, mean (95% UI)	Incremental cost-effectiveness ratio, mean (95% UI)
9, 12	101 (5 – 265)	206,250 (162,211 – 250,986)	7510 (710 – 47610)
9, 12, 15	157 (12 – 400)	-16507 (-99612 – 53,873)	CS (CS – 1510)
9, 12, 18	20 (1 – 102)	-20557 (-30357 to -12264)	CS (CS – CS)
6, 9, 15	62 (-49 – 208)	-44307 (-53797 to -36514)	CS (SW – CS)

DISCUSSION

We estimate that a primary series at 6 and 9 months with a booster 15 months is the most cost-effective *Shigella* vaccine schedule. All three vaccine schedules with booster doses were more cost-effective than the schedule with only two primary doses and would result in a meaningful reduction in the *Shigella* burden in Ethiopia.

If a 3-dose *Shigella* vaccine were implemented in Ethiopia in 2025, up to 320,000 DALYs could be averted by 2040 with an ICER \$720/DALY Averted relative to no vaccine.



Take a picture to learn more

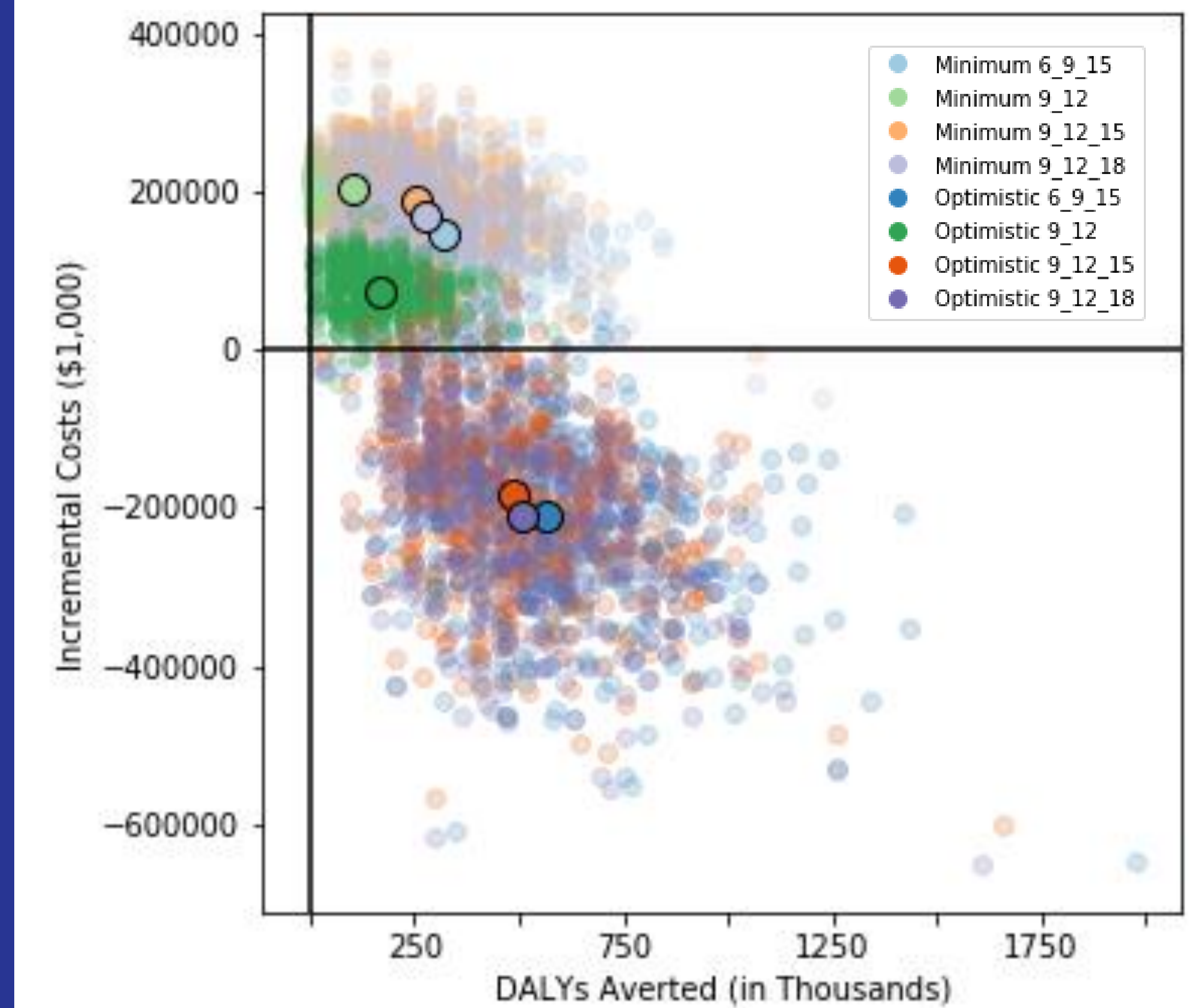


Figure 1. Incremental costs and DALYs averted for 4 vaccine schedules in Ethiopia under two scenarios: minimum and optimistic

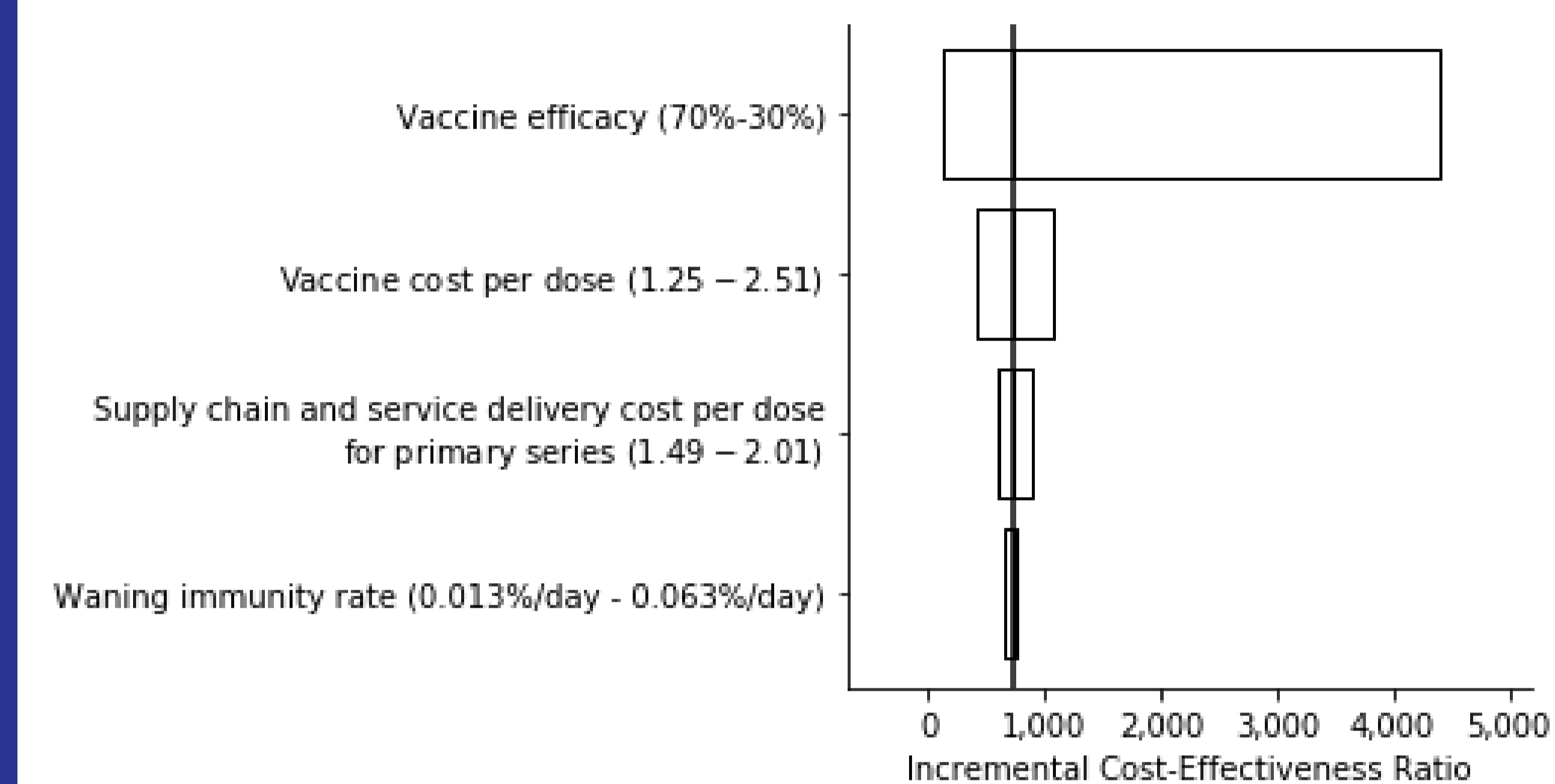


Figure 2. Tornado diagram depicting one-way sensitivity analysis results

Table 1. Overview of key model input parameters.

Input Parameter	Value
Proxy for vaccine dose coverage	
Doses at 6 months	DTP3 coverage from GBD 2016
Doses at 9, 12 months	Estimated from MCV1 and MCV2 coverage from GBD 2017
Doses at 15, 18 months	MCV2 coverage from GBD 2016
Vaccine immunity	
Full immunity duration (months)	24
Vaccine efficacy, % (SE)	50 (0.10)
First dose immunity	70
Second dose immunity	100
Booster/catch-up dose immunity	100
Time after each dose at which immunity is conferred (days)	14
Waning immunity (% decrease/day)	0.0383
Costs	
Unit cost for vaccine (2018 USD/dose)	1.88
Supply chain and service delivery cost (2018 USD/dose)	1.75
Incremental supply chain and service delivery cost for doses added to routine immunization (2018 USD/dose)	0.93