

# Systematic Review of the Incremental Costs of Interventions that Increase Immunization Coverage

## Technical Appendix

### Routine immunization intervention subcategories

We classified the nature of the routine immunization (RI) interventions into the following intervention subtypes:

- Education (Ed) - Interventions involving educating individuals to increase demand for vaccines
- Health system strengthening (Hs) - Interventions that introduced policy and programs or process changes at the health system level to improve immunization coverage. For example, budgeting and monitoring coverage improvement plans with health managers or training health providers and modifying immunization schedule and policies to remove barriers for hard-to-reach populations
- Introduction of RI (Ir) - Interventions that involved the introduction of routine immunization services and reaching populations previously not served by the routine immunization program (e.g., starting routine immunization in Yaoundé, Cameroon)
- reminders (Re) - Interventions utilizing reminder/recall systems using letters, telephone calls, or text messages, including the use of state wide or city wide immunization information systems (IISs) and other electronic registries to identify and recall individuals missing vaccine doses
- screening and referral (SR) - Interventions that screened individuals for prior vaccination or immunity and referred un/under vaccinated for vaccination

For interventions involving multiple components, we classified the intervention based on the main intervention component, for example if an intervention consisted of reminder post card and telephone calls supplemented by home visits for participants not reached, we classified the intervention as a reminder intervention.

### Coverage change estimation

Due to the lack of standardized reporting of coverage data and heterogeneity of underlying study designs, we used a variety of methods to calculate coverage change associated with interventions depending on the reported data. Where possible, we used overall full immunization/up-to-date definitions in calculating coverage change. For example, if a paper reported overall/full immunization/up-to-date coverage change and coverage change for individual vaccines, we used the overall coverage data. We describe, below, the various intervention study designs and how we calculated coverage change for each case.

**Case 1:** Studies without a control group, reporting baseline coverage and final coverage in intervention group (denoted by subscript “m” in Table 1).

*Coverage change = Final intervention coverage – Baseline intervention coverage*

**Case 2:** Studies with a control group reporting coverage data on both study arms (denoted by subscript “n” in Table 1).

*Coverage change = Final intervention coverage – Final control coverage*

**Case 3:** Studies reporting individual coverage changes for multiple antigens or reporting coverage for multiple intervention groups (denoted by subscript “h” in Table 1).

*Coverage change = Average of individual antigen coverage changes or Average of coverage changes across intervention groups*

**Case 4:** Studies with a completely unvaccinated baseline population and reporting on the final number of individuals vaccinated (denoted by subscript “p” in Table 1).

*Coverage change = Final number vaccinated/Total baseline population*

In studies in which the intervention targeted and reached a previously completely unreached/ or unvaccinated population or individuals (denoted by subscript “k” in Table 1), we assumed a baseline coverage of zero. In studies that reported individual antigen baseline coverage, but then reported final overall/full immunization coverage, we averaged the baseline coverages of the individual antigens for the best estimate and reported the range.

For studies that did not report the baseline immunization coverage in the target population and area (denoted by subscript “r” in Table 1), above which the intervention sought improvement, we extracted the information from historic state and local immunization registries or other published sources.

### **Vaccine dose estimation**

Where reported, we extracted the commensurate number of doses delivered corresponding to the coverage change in the intervention. For studies that did not report the number of doses and for which we could not get information from authors, we estimated the number of doses using the coverage outcome definition and coverage change information. For studies targeting multiple vaccines, we used the number of doses for all vaccines and the number of participants attaining full vaccination status. Thus, our methodology potentially underestimates the number of doses for those receiving partial doses.

If a study did not report the number of doses in the up-to-date (UTD) definition, we used the number of doses in the official vaccine schedule of the study location at the time the study was conducted. For example, we used official CDC and State immunization schedules to determine the number of doses for US-based studies. We describe, below, the various cases and how we estimated the number of doses for each case.

**Case 1:** Study coverage information includes the overall/additional number of individuals vaccinated

*Number of doses = number/proportion of individuals vaccinated\*number of doses in the UTD definition*

**Case 2:** Study involved a single dose antigen (e.g. influenza) and study reports the overall/additional number of individuals vaccinated

*Number of doses = number of overall/additional individual vaccinated*

Some studies reported the underlying targeted population but obtained coverage change from a sample of the population. Hence, extrapolating the total number of doses for the entire population based on sample coverage information remains uncertain.