This document explains some of the key logic and assumptions of the CEA. The sections below correspond to the tabs in the workbook. Some tabs are self-explanatory and do not have descriptions here.

CEA Estimate

How we calculate cost per life saved:

- Divide cost per child reached by lives saved per child reached
- In order to estimate lives saved per child reached, we take the sum of the number of deaths averted per child reached for all doses of all vaccines.
- The "deaths averted per child reached" for each vaccine dose is derived from:
    - The efficacy of the vaccine as reported in GW estimates and in the literature.
    - The average fatality rate for diseases prevented by that vaccine (see "Death Rate Estimate" tab for details of how these fatality rates are calculated).
    - The expected percentage point increase in coverage for that vaccine caused by SMS intervention. This in turn is given by:
        - The baseline coverage rate for that vaccine.
        - Effect sizes reported in studies on SMS vaccine reminders (see "Study Results" tab for details).
        - Our overall uncertainty discount for the effectiveness of the intervention (see "Notes of factors not taken into account" tab for details).
- **NB:** The rotavirus, PCV, and rubella vaccines are scheduled to be rolled out in India over the next couple years, but as of now they are not standardly administered throughout the country. For this reason, we have created two sets of cost-effectiveness estimates, one that includes these vaccines and one that does not (e.g., D8 vs. D9).

Costs per YLD and DALY averted

The costs per YLD averted and DALY averted follow similar logic, except that instead of taking average fatality rates as inputs, these estimates use the YLDs and DALYs caused by each disease (see "Morbidity" tab for details of how these are calculated).

Death Rate Estimates

Purpose of this tab: GBD estimates only provide fatality rates for particular diseases across the population as a whole. Thus, GBD estimates include the vaccinated population, for which the fatality rates will be lower than the unvaccinated populations we are targeting. To obtain a more accurate estimate, in this tab we attempt to estimate fatality rates for each disease among *unvaccinated* populations only (Column T).

- To do this, for each disease we divide the number of <5 deaths among unvaccinated children (Column M) by the total number of unvaccinated children <5 (Column C).

- To get these two estimates, we first use two calculations in the "GBD Estimates" tab to estimate the number of individuals in each of 8 age-range subgroups of <5 children:
    - We use the total number of <5 deaths and the <5 death rate (both reported in GBD) to get an estimate of the total <5 population (this is done in C2:E18 of the "GBD Estimates" tab).
    - Then, we use this figure for the <5 population size to estimate the population size for each of the 8 age ranges (this is done in C21:C34 of the "GBD Estimates" tab).
- Using the number of individuals in each age range and the baseline vaccination rates, we calculate the number of individuals in the **unvaccinated population (UvP)** (Column C).
- We then use the baseline vaccination rate and the vaccine's efficacy rate to estimate the **vaccinated but vulnerable population (VVP)** (Column G), which is the number of vaccinated individuals who are still vulnerable because the efficacy of the vaccine is less than 100%.
- Using UvP and VVP, we calculate (in several steps, see Columns H-L) the number of deaths in each age group that occur among the unvaccinated population (Column M).
- Note that our final unvaccinated death rate estimate (Column T) excludes the age range of 0-6 weeks, since the first vaccines for which we will be sending reminders are not administered until 6 weeks. Hence our intervention would have no effect on the death rate for children 0-6 weeks.

Morbidity

Most numbers in this tab are taken directly from GBD data. However, we have replaced GBD's DALY estimates with our own, which uses our estimates of YLLs for just the unvaccinated population, rather than GBD's YLL estimates for the population as a whole.

However, we continue to rely on GBD's YLD estimates for the whole population. As a result, our DALY estimates likely underestimate the true number of DALYs attributable to each disease in our target population.

Specific Location Estimates

Purpose of this tab: Estimate cost-effectiveness for SMS vaccine reminders in four Indian states. These are the states where either we have established partnerships to enroll participants or are working to establish such partnerships. Our activities in the foreseeable future will most likely be concentrated primarily in Gujarat and Rajasthan, so we present numbers (in Columns G and N) that isolate combined estimates for these two states.

GBD Estimates

Purpose of this tab: Uses GBD figures on <5 mortality, DALYs, and YLDs to calculate key inputs to the CEA.

Key calculations: Fraction of deaths in each age group caused by each disease (I20:T33)

- This calculation assumes that for each disease, 60% of <5 deaths occur in children <2 (this is the rate for measles).

Study Results

Purpose of this tab: Use existing studies to generate an estimate of how much of the gap in vaccination coverage would be closed by our SMS intervention.

Method: Looks at four RCTs on the effects of SMS reminders on vaccination rates.

- Three of the four studies examined the rates of children receiving 3 vaccinations in a series, comparing groups that received SMS reminders with groups that did not. The fourth study (Haji et al.) looked at a series of only 2 vaccinations and is thus excluded from the final estimate.
- For each study, we calculated the gap in 3rd-vaccination coverage that was closed by the SMS intervention—i.e., the percentage of children who would otherwise not have received the 3rd vaccination who do receive it as a result of the intervention (Column X).
- We then took the weighted average of these effect sizes (X8). This is the "percentage of gap closed" estimate that is used as an input throughout the rest of the model.
    - Note that this estimate is more conservative than if we used the gap closed for the first or second vaccinations in the series.