The DALY Calculation for Contraceptive Injections

1,000 Contraceptive Injections (3-mth) sold in India averts 35 DALY

The sale of 1,000 3-month injections in India averts 35 DALY, or life years lost to disease burden. The health impact for family planning interventions are in part due to averting complications and diseases associated with pregnancy, and in part due to the avoidance of childhood death and disability as a result of inadequate birth spacing.

Where does the 35 DALY figure come from?

One thousand 3-month injections equates to 243 CYP (1000 injections / 4 units per year * 0.97 efficacy rate = 243). The General Fertility rate (GFR) and Crude Birth Rate (CBR) for India tells us that this would have prevented 44 pregnancies, 0.15 maternal deaths and 28 live births.

On average, women that die due to maternal complications are 24 years old and therefore lose approximately 29 years of life. Thus, a total of 4.4 DALY (0.15 deaths * 29 YLL) is averted. In addition intervening would also have averted disability and illness from pregnancy related conditions and complications associated with childbirth. Add up all of this and that equates to 2.9 DALY (years lost to disability). In total we have averted 7.3 DALY from the maternal disease burden in India from the delivery of these 1,000 injections (4.4 YLL + 2.9 YLD).

In addition, adequate birth spacing is estimated to increase child survival rates by between 15-30% depending on country specific or sub-group specific geographical and demographic factors. This relies on a non-linear interaction between a series of inter-dependant variables.

Non-linear models.

A number of PSI interventions rely on what are known as non-linear models to estimate impact. Non-linear simply means that the relationship between inputs (sales), and outputs (DALY averted) is not always constant. For example in one case a doubling of sales may mean a doubling of DALY averted. In another a doubling of sales may result in a threefold rise in DALY averted.

In this model we draw on a systematic review that looks at the correlation between PBI (preceding birth interval in months) and relative risk of death in children aged 0-4 years. This utilizes large sub-regional datasets from Demographic & Health Surveys and generates an incremental shift in child deaths across a population as a result in tiny incremental shift is mean birth interval. The result of a shift of 243 CYP is a reduction of 0.9 deaths in children aged 0-4 years.

---

1 Derived from Disease Control Priorities Project 2 (DCP2), The World Bank Group, 2006; Table 3B: Deaths by Cause, Sex and Age 2001.
3 Rutstein SO. Effects of preceding birth intervals on neonatal, infant and under-five years mortality and nutritional status in developing countries: evidence from the demographic and health surveys. Int J Gynaecol Obstet. 2005 Apr;89 S1:S7-24.
The estimated YLL of a child death is about 31 DALY, and therefore having averted 0.9 deaths in children aged 0-4 years this equates to 27.4 YLL. In total the sale of 1000 3-month injections in India equates to 7.4 DALYs (unintended pregnancies) + 27.4 DALYs (child spacing) = 35 DALY averted.
Details for Number Crunchers

**Protective Benefit**
Protective benefit is calculated by the units needed for one year of protection * % efficacy.
::: 4 3-month injections are required for one year of protection
::: Protective efficacy is 97%
Protective Benefit: 1,000 / 4 injections * 97% efficacy = 243 years of protection (CYP)
243 CYP * general fertility rate (GFR) of 0.181 = 44 unintended pregnancies avoided
243 CYP * crude birth rate (CBR) of 0.113 = 28 live births averted
28 live births averted * maternal mortality ratio (MMR) of 560 deaths per 100,000 live births = 0.15 maternal deaths averted.

**Years of Life Lost to death (YLL) and to disease (YLD) due to complications of unintended pregnancies:**
This is the maternal mortality rate (MMR) * years or years of life lost (YLL) per death.
::: MMR in India is 560 out of every 100,000 live births (0.0056)
::: Years of life lost are calculated based on average age of death from maternal complications of (24.4 years), discounting by 3% the future years until the age of 81.5 (DALY / DCP convention) totaling to 28.55 years
Maternal YLL: 28 live births * 0.0056 maternal mortality * 28.55 YLL per = 4.4 YLL
In addition the YLD due to pregnancy complication and maternal disease / conditions = 2.9YLD

**YLL for children due to birth spacing:**
The estimation of the impact of protection from the marginal risk of child death that arises from low birth interval relies on a non-linear sub model that utilizes large demographic surveillance datasets that fuel a correlation function between mean birth interval in each subgroup of the population and the mean likelihood of child death within that same subgroup. Not all child deaths are due to birth interval, but studies have shown that below a certain level – usually around 36 months, the odds ratio for [CMR (OR) - adjusted for confounding variables] begins to rise rapidly, as is shown on the figure on the left below. What the PBI sub model does is estimate the net impact of a unit equivalent of CYP on the overall subgroup distribution of PBI, as in the figure on the right, and from this it reads off the resulting marginal shift in CMR (OR), which itself translates into a number of deaths across the population.

In our example a CYP of 243 translates into a reduction in absolute number of child deaths of 0.9. This in turn, given a median age of death of 1.8 is multiplied by a discounted YLL weight of 31 to give a PBI YLL of 27.4 DALY.

---

4 Average age of death derived from model utilizing multiple DHS datasets (www.measureDHS.org).