Step-by-step: How D-Rev Calculates the Impact of Brilliance

The problem that we are tackling with Brilliance is the fact that over six million babies requiring treatment for severe jaundice each year are not receiving the treatment they need. One of the main reasons for this is a lack of access to affordable devices that provide phototherapy, the standard treatment for severe jaundice. By introducing a low-cost, high-quality phototherapy device to the global market, D-Rev aims to increase the number of babies receiving treatment who otherwise would not have been treated effectively, and thereby, reduce the number of deaths and disabilities due to untreated severe jaundice.

To measure our progress against this goal, we track three indicators: (1) the number of babies treated with Brilliance, (2) the number of babies treated with Brilliance who otherwise would not have received effective treatment, and (3) the number of deaths and disabilities averted through the use of Brilliance. We calculate these numbers on a per-unit basis, using an algorithm based on machine data and assumptions drawn from fieldwork and academic research, and then sum the results to determine our total impact. Below are the step-by-step equations that represent how we tally our estimates.

Indicator 1: Babies treated with Brilliance

Overview

We calculate the number of babies treated by each unit based on total machine time (or "total usage hours") and average time required for treating one baby. We then sum the number of babies treated per unit.

Key assumptions

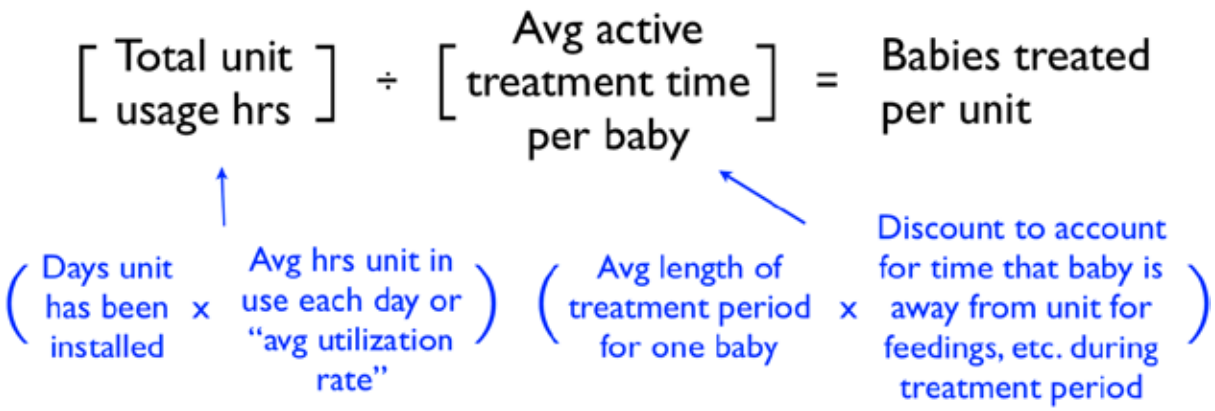
#	Assumption	Current Value	Source of Current Value
(a)	Number of days that unit has been installed	varies, days since installation used as proxy	Brilliance distributor (Phoenix) or hospital
(b)	Average number of hours that Brilliance units are in use each day, every day	5.4 hrs	D-Rev fieldwork (2014)
(c)	Average number of hours that a baby with jaundice is treated with Brilliance (i.e., length of treatment period)	40 hrs	D-Rev fieldwork (2014)
(d)	Discount applied to treatment period length to account for time during phototherapy treatment that a baby is removed from lights to receive basic care (feeding, bath, diaper change, etc.)	75%	D-Rev fieldwork (2014)

Step-by-step

Total usage hours are calculated by multiplying (a), the number of days that the unit has been installed (as indicated by Phoenix or fieldwork) by (b), the average number of hours that the units

are in use every day ("average utilization rate"). To calculate babies treated, we then divide this number by (c), the average treatment time for each baby, discounted by the amount of time that the baby is removed from the lights during the treatment period. When we have actual data collected from the unit (total machine time, or "TMT"), we use those values for the total usage hours of the data collection period, and the average utilization rate it represents to calculate total utilization hours for that unit thereafter. Likewise, when we have received updated information about a more accurate date of first use, we substitute that for the original installation date provided to us.

Equation



Example

For a unit that has been installed at a private, rural Indian hospital for a year, we would estimate that it has treated 65 babies:

(365 days x 5.4 hrs) ÷ (40 hrs x 75%) = 65 babies treated

Indicator 2: Babies treated who otherwise would not have received effective treatment ("babies otherwise")

Overview

We calculate the number of babies treated by each unit who otherwise would not have received effective treatment by multiplying the number of babies treated by the machine by the percentage of hospitals of the type where unit is installed that do not provide effective treatment for jaundice. We then sum the number of "babies otherwise" treated per unit.

Key assumptions

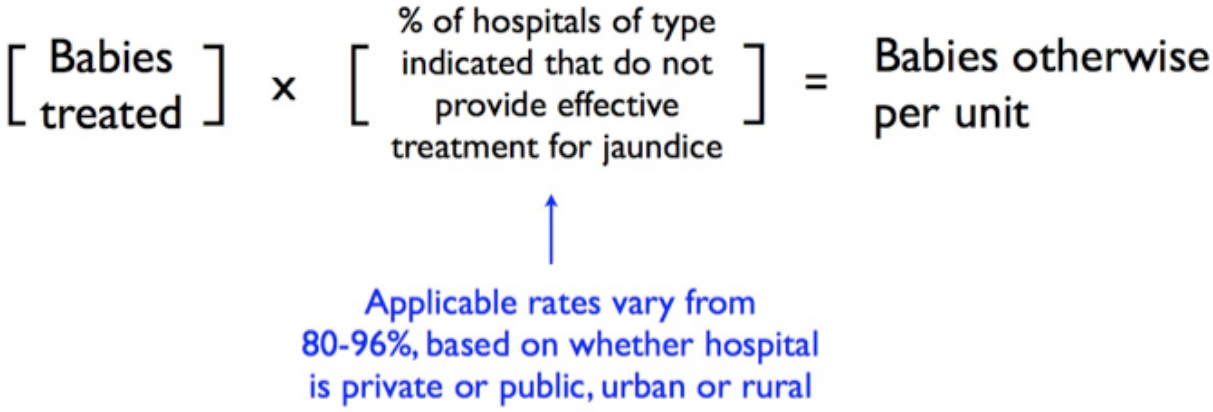
#	Assumption	Current Value	Source of Current Value
(e)	Percentage of public hospitals in lower-middle-income countries that do not provide effective treatment for jaundice	96%	D-Rev fieldwork with Stanford University (2010)

#	Assumption	Current Value	Source of Current Value
(f)	Percentage of private, rural hospitals in lower-middle-income countries that do not provide effective treatment for jaundice	96%	D-Rev fieldwork with Stanford University (2010)
(g)	Percentage of private, urban hospitals in lower-middle-income countries that do not provide effective treatment for jaundice	80%	D-Rev fieldwork with Stanford University (2010)

Step-by-step

To calculate "babies otherwise", we multiply the estimated number of babies treated for each unit by (e), (f), or (g), the ineffective treatment rate associated with the type of hospital where unit is installed. Hospitals are categorized by how they are financed (public/private), and where they are located (urban/rural) in target countries. See chart above for current values used.

Equation



Example

From the example above, we would calculate a total of 62 babies treated who otherwise would not have received effective treatment:

65 x 96% = 62 "babies otherwise" treated

Indicator 3: Deaths and disabilities averted through the use of Brilliance

Overview

We calculate the number of newborns who have avoided death and disabilities from ineffective treatment by multiplying the number of newborns treated who otherwise would not have received effective treatment ("babies otherwise") by the rate at which these babies would have experienced D&D if they hadn't been treated effectively.

Key assumptions

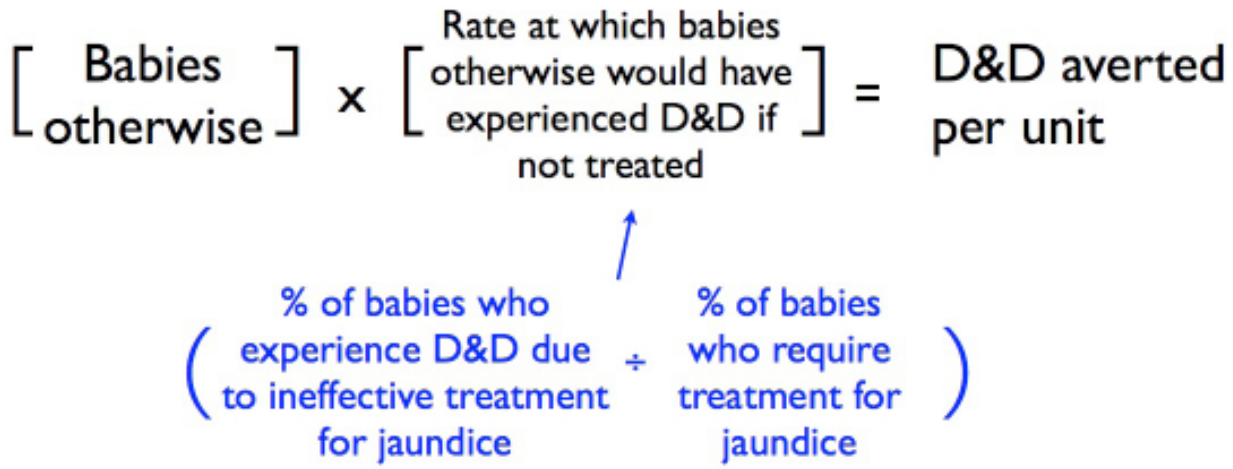
#	Assumption	Current Value(s)	Source of Current Value
(h)	Percentage of all babies who require treatment for jaundice	18%	Bhutani, Vinod K., et al. "Neonatal hyperbilirubinemia and Rhesus disease of the newborn: incidence and impairment estimates for 2010 at regional and global levels." Pediatric research 74.S1 (2013): 86-100.
(i)	Regional burdens of deaths and disabilities (D&D) associated with Rh disease and extreme hyperbilirubinemia (EHB) (per 100,000 births)	70 (East Asia, SE Asia, Pacific); 189 (Latin America); 192 (North Africa, Middle East); 277 (Eastern Europe, Central Asia); 292 (South Asia); 309 (sub-Saharan Africa)[1]	Bhutani, Vinod K., et al. "Neonatal hyperbilirubinemia and Rhesus disease of the newborn: incidence and impairment estimates for 2010 at regional and global levels." Pediatric research 74.S1 (2013): 86-100.
(j)	Effective rate at which babies otherwise would die or experience disability if they weren't treated with Brilliance	0.39% (East Asia, SE Asia, Pacific); 1.05% (Latin America); 1.07% (North Africa, Middle East); 1.54% (Eastern Europe, Central Asia); 1.62% (South Asia); 1.71% (sub-Saharan Africa)	Percentage of all babies who would die or experience disability due to ineffectively treated jaundice (see (i) rates above), divided by the percentage of all babies who require treatment for neonatal jaundice (18%). This gives us the applicable D&D rate for babies receiving treatment, as opposed to the D&D rate for the general population.

[1] See Appendix A for a more in-depth discussion of these regional disease burdens.

Step-by-step

We determine the effective D&D rate, (j), by dividing (i), the percentage of babies who statistically would die or experience disability in that region due to ineffectively treated jaundice, by (h), the percentage of all babies who require treatment for neonatal jaundice. This gives us the effective rate at which babies who require treatment for jaundice would die or experience disability due to ineffectively treated jaundice (instead of the rate at which the general newborn population would die or experience disability in the absence of effective treatment). We then multiply the number of babies treated who otherwise would not have received effective treatment ("babies otherwise") by the effective D&D rate. This tells us statistically how many of the babies otherwise would have died or experienced disability in the absence of effective treatment with Brilliance.

Equation



Example

From the example above, we would calculate a total estimate of 1 death or disability averted:

62 x 1.62% = 1 D&D averted

Appendix A

Summary of findings from most recent comprehensive research on global and regional burdens of mortality and morbidity associated with Rhesus disease (Rh disease) and extreme hyperbilirubinemia (EHB) due to other causes.

Important note: disease burden rates are calculated using the high end of the uncertainty ranges presented. See explanation below.

Description	Globally	High-Income regions	East Asia, SE Asia, Pacific	Latin America, Caribbean	North Africa, Middle East	Eastern Europe, Central Asia	South Asia	Sub-Saharan Africa
Live births in 2010 (in millions)	134.8	11.7	29	9.9	9.7	5.4	37.1	32
Estimate of babies with kernicterus (morbidity) associated with Rh disease and EHB due to other causes	95,800	1,193	9,772	5,556	6,035	3,640	35,446	33,530
Geographic burden (%) of morbidity	100%	1.6%	10.2%	5.8%	6.3%	3.8%	37%	35%
Prevalence of morbidity (per 100,000 live births)	71	10	34	56	62	68	96	105
Estimate of neonatal deaths (mortality) associated with Rh disease and EHB due to other causes	187,000	94	10,659	13,090	12,529	11,220	72,930	65,450
Geographic burden (%) of mortality	100%	0.10%	5.7%	7%	6.7%	6%	39%	35%
Prevalence of mortality (per 100,000 live births)	139	1	37	133	130	209	197	204
Prevalence of mortality and morbidity, combined (per 100,000 live births)	210	11	70	189	192	277	292	309

Source: Bhutani, Vinod K., et al. "Neonatal hyperbilirubinemia and Rhesus disease of the newborn: incidence and impairment estimates for 2010 at regional and global levels." Pediatric research 74.S1 (2013): 86-100. All figures relate to 2010 data.

This 2013 study was "the first to provide global estimates of Rh disease and EHB, in addition to the resulting burden, in terms of deaths and impairment." (p. 95) Yet study authors agree that it "vastly underestimates the burden of EHB" (p. 97). To account for this, study author Dr. Vinod Bhutani advised D-Rev to use the values on the high end of the uncertainty ranges to calculate deaths and disabilities averted as a result of the use of Brilliance. We feel confident that this more fairly represents conditions on the ground, especially since:

- Study authors clearly state that data are extremely limited. (p. 95)
- The study excluded cases of <32 wk gestational age and those with infections to avoid double counting with the burden estimates for those conditions. (p. 97)
- Given the lack of population-based risk data, the study had to rely "on estimates of risks from one low-mortality context in Canada... which will be much lower than the reality in many other countries." (p. 97)
- Because "no single replicable test exists to further measure the risks for EHB... [the study authors] sought to estimate burden as conservatively as possible." (p. 98)
- The study's definition of "disability" does not include bilirubin-induced neurologic dysfunction ("BIND") for low-end of the spectrum disability. (p. 87)