

General Guidance for DALYs calculation

VIMC

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Methods overview

Disability-adjusted life years (DALYs) are an absolute measure of health loss; they count how many years of healthy life are lost due to death and non-fatal illness or impairment. They reflect the number of individuals who are ill or die in each age-sex group and location (Murray. et al. 2012). For VIMC's purposes, we have taken the Global Burden of Disease (GBD 2017) outputs, and selected the specific methods and disability weights (Table 1) that can be applied across all models with reference to the most updated methods provided by the Institute of Health Metrics and Evaluation. These disability weights are unchanged from those we provided for the VIMC 2017 full model runs (GBD 2016).

The aim of this guidance is to ensure comparability across all models, specially for aggregation procedures. Also, this will allow us to compare our estimates with the estimates from other research groups.

Basic assumptions on social value choices

1) Life expectancy:

Historical and projected life expectancy estimates are available through *Montagu* for all countries of interest. The modellers should be referencing specific per country life expectancy, as provided in the corresponding demographic data for a particular run version. We use the per country life expectancy as opposed to the world standard life expectancy, as it is a more realistic (conservative) reflection of the impact of vaccination for a particular country instead of an aspirational life expectancy.

2) DALYs allocation:

In order to reflect the impact of the vaccination intervention in the time range we make projections for, the allocation of DALYs should be to the year when the particular infection/disease/death occurred, instead of spreading the DALYs over the life expectancy.

3) Non-age weighting:

Following the most recent GBD approach, DALYs are non-age weighted, reflecting no social preference for the age of individuals.

4) Non-time discounting:

Following the most recent GBD approach, future DALYs are not discounted, reflecting no social preference for the past, present or future times.

Estimation methods

The general equations used to generate the non-discounted, non-age weighted but contry, year, age specific DALYs are given below:

General Equation

DALYs are calculated by disease and are country/year/age specific. However, we acknowledge that the total DALYs provided by the modellers to the VIMC might come from the sum of DALYs from various clinical conditions that are not recorded in the Consortium, following these formulas:

$$DALY = YLL + YLD \quad (Eq\ 1)$$

Equation for YLL

For a particular disease/country/year combination, Years of Life Lost (YLLs) are computed by multiplying the number of deaths M at each age a by a standard life expectancy L at age a for that country c , and year y .

$$YLL_{c,y,a} = M_{c,y,a} * L_{c,y,a} \quad (Eq\ 2)$$

Equation for (YLD)

Years of Life Lived with Disability (YLDs) are computed as the sum of number of new cases N of different condition/sequelae over the average duration d of that condition/sequelae times the disability weight D associated to that condition/sequelae.

$$YLD_{c,y,a} = \sum_{s=1}^n N_{s,c,y,a} * d_s * D_s \quad (Eq\ 3)$$

Where,

M = number of deaths

N = number of cases of a particular condition/sequelae

$L_{c,y,a}$ = life expectancy at the age of death (in years) per country and year

a = age at death or onset (in years)

d = average duration of the case until remission or death (in years)

D = disability weight

c = country

y = year

$s = 1$ to n number of clinical conditions or sequelae per disease

Disability Weights (D)

Where possible, the weights are based on the GBD 2017 update

IHME_GBD_2017_DISABILITY_WEIGHTS_Y2018M11D08.XLSX. Most of the relevant weights for each sequelae of each disease of the VIMC remit have been selected and are shown in Table 1.

NOTE If your disease/condition combination is not part of Table 1, or you use a different set of values, please email montagu-help@imperial.ac.uk.

Table 1: Disability Weights for VIMC diseases

	disease	condition/sequelae	GBD_2017_mean
1	Cholera	Mild diarrheal diseases	0.074
2	Cholera	Moderate diarrheal diseases	0.188
3	Cholera	Severe diarrheal diseases	0.247
6	HepB	Controlled phase of liver cancer due to hepatitis B Generic uncomplicated disease	0.049
7	HepB	Diagnosis and primary therapy phase of liver cancer due to hepatitis B Cancer	0.288
9	HepB	Metastatic phase of liver cancer due to hepatitis B Cancer	0.451
10	HepB	moderate-acute	0.051
11	HepB	severe-acute	0.133
12	HepB	Terminal phase of liver cancer due to hepatitis B Terminal phase, with medication	0.540
13	Hib	Acute H influenzae type B meningitis	0.133
14	Hib	Blindness due to H influenzae type B meningitis	0.187
15	Hib	Borderline intellectual disability due to H influenzae type B meningitis	0.011
16	Hib	Complete hearing loss due to H influenzae type B meningitis	0.215
17	Hib	Complete hearing loss with ringing due to H influenzae type B meningitis	0.316
19	Hib	Mild behavioral problems due to H influenzae type B meningitis	0.045
20	Hib	Mild hearing loss due to H influenzae type B meningitis	0.010
21	Hib	Mild hearing loss with ringing due to H influenzae type B meningitis	0.021
22	Hib	Mild intellectual disability due to H influenzae type B meningitis	0.043
23	Hib	Mild motor impairment due to long term due to H influenzae type B meningitis	0.010
24	Hib	Mild motor plus cognitive impairments due to H influenzae type B meningitis	0.031
25	Hib	Moderate hearing loss due to H influenzae type B meningitis	0.027
26	Hib	Moderate hearing loss with ringing due to H influenzae type B meningitis	0.074
27	Hib	Moderate motor impairment due to H influenzae type B meningitis	0.061
28	Hib	Moderate motor plus cognitive impairments due to H influenzae type B meningitis	0.203
29	Hib	Moderate vision impairment due to H influenza type B meningitis	0.031
32	Hib	Monocular distance vision loss due to H influenzae type B meningitis	0.017
33	Hib	Profound hearing loss due to H influenzae type B meningitis	0.204
34	Hib	Profound hearing loss with ringing due to H influenzae type B meningitis	0.277
35	Hib	Severe hearing loss due to H influenzae type B meningitis	0.158
36	Hib	Severe hearing loss with ringing due to H influenzae type B meningitis	0.261
37	Hib	Severe motor impairment due to H influenzae type B meningitis	0.402
38	Hib	Severe motor plus cognitive impairments due to H influenzae type B meningitis	0.542
39	Hib	Severe vision impairment due to H influenza type B meningitis	0.184
40	HPV	Controlled phase of cervical cancer Generic uncomplicated disease	0.049
41	HPV	Diagnosis and primary therapy phase of cervical cancer Cancer,	0.288
42	HPV	Metastatic phase of cervical cancer Cancer	0.451
43	HPV	Terminal phase of cervical cancer Terminal phase, with medication	0.540
44	JE	Acute encephalitis	0.133
45	JE	Blindness due to encephalitis	0.187
46	JE	Borderline intellectual disability due to encephalitis	0.011
49	JE	Less severe epilepsy	0.263
50	JE	Mild behavioral problems due to encephalitis	0.045
51	JE	Mild intellectual disability due to encephalitis	0.043
52	JE	Mild motor impairment due to long term due to encephalitis	0.010
53	JE	Mild motor plus cognitive impairments due to encephalitis	0.031
54	JE	Moderate motor impairment due to encephalitis	0.061
55	JE	Moderate motor plus cognitive impairments due to encephalitis	0.203
56	JE	Moderate vision impairment due to encephalitis	0.031
57	JE	Monocular distance vision loss due to encephalitis	0.017
59	JE	Seizure-free, treated epilepsy	0.049

	disease	condition/sequelae	GBD_2017_mean
60	JE	Severe epilepsy	0.552
61	JE	Severe motor impairment due to encephalitis	0.402
62	JE	Severe motor plus cognitive impairments due to encephalitis	0.542
63	JE	Severe vision impairment due to encephalitis	0.184
65	Measles	Moderate measles	0.051
66	Measles	Severe measles	0.133
67	MenA	Acute meningococcal meningitis	0.133
68	MenA	Blindness due to meningococcal meningitis	0.187
69	MenA	Borderline intellectual disability due to meningococcal meningitis	0.011
70	MenA	Complete hearing loss due to meningococcal meningitis	0.215
71	MenA	Complete hearing loss with ringing due to meningococcal meningitis	0.316
73	MenA	Mild behavioral problems due to meningococcal meningitis	0.045
74	MenA	Mild hearing loss due to meningococcal meningitis	0.010
75	MenA	Mild hearing loss with ringing due to meningococcal meningitis	0.021
76	MenA	Mild intellectual disability due to meningococcal meningitis	0.043
77	MenA	Mild motor impairment due to long term due to meningococcal meningitis	0.010
78	MenA	Mild motor plus cognitive impairments due to meningococcal meningitis	0.031
79	MenA	Moderate hearing loss due to meningococcal meningitis	0.027
80	MenA	Moderate hearing loss with ringing due to meningococcal meningitis	0.074
81	MenA	Moderate motor impairment due to meningococcal meningitis	0.061
82	MenA	Moderate motor plus cognitive impairments due to meningococcal meningitis	0.203
83	MenA	Moderate vision impairment due to meningococcal meningitis	0.031
86	MenA	Monocular distance vision loss due to meningococcal meningitis	0.017
87	MenA	Profound hearing loss due to meningococcal meningitis	0.204
88	MenA	Profound hearing loss with ringing due to meningococcal meningitis	0.277
89	MenA	Severe hearing loss due to meningococcal meningitis	0.158
90	MenA	Severe hearing loss with ringing due to meningococcal meningitis	0.261
91	MenA	Severe motor impairment due to meningococcal meningitis	0.402
92	MenA	Severe motor plus cognitive impairments due to meningococcal meningitis	0.542
93	MenA	Severe vision impairment due to meningococcal meningitis	0.184
94	Pneumo	Acute pneumococcal meningitis	0.133
95	Pneumo	Blindness due to pneumococcal meningitis	0.187
96	Pneumo	Borderline intellectual disability due to pneumococcal meningitis	0.011
97	Pneumo	Complete hearing loss due to pneumococcal meningitis	0.215
98	Pneumo	Complete hearing loss with ringing due to pneumococcal meningitis	0.316
99	Pneumo	Less severe epilepsy	0.263
100	Pneumo	Mild behavioral problems due to pneumococcal meningitis	0.045
101	Pneumo	Mild hearing loss due to pneumococcal meningitis	0.010
102	Pneumo	Mild hearing loss with ringing due to pneumococcal meningitis	0.021
103	Pneumo	Mild intellectual disability due to pneumococcal meningitis	0.043
104	Pneumo	Mild motor impairment due to long term due to pneumococcal meningitis	0.010
105	Pneumo	Mild motor plus cognitive impairments due to pneumococcal meningitis	0.031
106	Pneumo	Moderate hearing loss due to pneumococcal meningitis	0.027
107	Pneumo	Moderate hearing loss with ringing due to pneumococcal meningitis	0.074
108	Pneumo	Moderate motor impairment due to pneumococcal meningitis	0.061
109	Pneumo	Moderate motor plus cognitive impairments due to pneumococcal meningitis	0.203
110	Pneumo	Moderate vision impairment due to pneumococcal meningitis	0.031
113	Pneumo	Monocular distance vision loss due to pneumococcal meningitis	0.017
114	Pneumo	Profound hearing loss due to pneumococcal meningitis	0.204
115	Pneumo	Profound hearing loss with ringing due to pneumococcal meningitis	0.277
116	Pneumo	Seizure-free, treated epilepsy	0.049
117	Pneumo	Severe epilepsy	0.552

	disease	condition/sequelae	GBD_2017_mean
118	Pneumo	Severe hearing loss due to pneumococcal meningitis	0.158
119	Pneumo	Severe hearing loss with ringing due to pneumococcal meningitis	0.261
120	Pneumo	Severe motor impairment due to pneumococcal meningitis	0.402
121	Pneumo	Severe motor plus cognitive impairments due to pneumococcal meningitis	0.542
122	Pneumo	Severe vision impairment due to pneumococcal meningitis	0.184
124	Rota	Mild diarrheal diseases	0.074
125	Rota	Moderate diarrheal diseases	0.188
126	Rota	Severe diarrheal diseases	0.247
128	Rubella	Hearing loss, complete	0.215
129	Rubella	Hearing loss, complete, with ringing	0.316
130	Rubella	Hearing loss, mild	0.010
131	Rubella	Hearing loss, mild, with ringing	0.021
132	Rubella	Hearing loss, moderate	0.027
133	Rubella	Hearing loss, moderate, with ringing	0.074
136	Rubella	Hearing loss, profound	0.204
137	Rubella	Hearing loss, profound, with ringing	0.277
138	Rubella	Hearing loss, severe	0.158
139	Rubella	Hearing loss, severe, with ringing	0.261
140	Typhoid	Acute typhoid infection	0.051
141	Typhoid	Gastrointestinal bleeding due to typhoid	0.325
142	Typhoid	Intestinal perforation due to typhoid	0.324
143	Typhoid	Severe typhoid fever	0.133
145	YF	Moderate yellow fever	0.051
146	YF	Severe yellow fever	0.133

Note: ¹ Source: IHME_GBD_2017_DISABILITY_WEIGHTS_Y2018M11D08.XLSX

References

Murray CJ et al. Lancet. 2012 Dec 15;380(9859):2197-223. doi: 10.1016/S0140-6736(12)61689-4.

Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2017 (GBD 2017) Disability Weights. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2018.