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:

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

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.

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

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/sequalaes times the disability weight D associated to that condition/sequelae.

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

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
3	HepB	Controlled phase of liver cancer due to hepatitis B Generic uncomplicated disease	0.049
4	HepB	Diagnosis and primary therapy phase of liver cancer due to hepatitis B Cancer	0.288
6	HepB	Metastatic phase of liver cancer due to hepatitis B Cancer	0.451
7	HepB	moderate-acute	0.051
8	HepB	severe-acute	0.133
9	HepB	Terminal phase of liver cancer due to hepatitis B Terminal phase, with medication	0.540
10	Hib	Acute H influenzae type B meningitis	0.133
11	Hib	Blindness due to H influenzae type B meningitis	0.187
12	Hib	Borderline intellectual disability due to H influenzae type B meningitis	0.011
13	Hib	Complete hearing loss due to H influenzae type B meningitis	0.215
14	Hib	Complete hearing loss with ringing due to H influenzae type B meningitis	0.316
16	Hib	Mild behavioral problems due to H influenzae type B meningitis	0.045
17	Hib	Mild hearing loss due to H influenzae type B meningitis	0.010
18	Hib	Mild hearing loss with ringing due to H influenzae type B meningitis	0.021
19	Hib	Mild intellectual disability due to H influenzae type B meningitis	0.043
20	Hib	Mild motor impairment due to long term due to H influenzae type B meningitis	0.010
21	Hib	Mild motor plus cognitive impairments due to H influenzae type B meningitis	0.031
22	Hib	Moderate hearing loss due to H influenzae type B meningitis	0.027
23	Hib	Moderate hearing loss with ringing due to H influenzae type B meningitis	0.074
24	Hib	Moderate motor impairment due to H influenzae type B meningitis	0.061
25	Hib	Moderate motor plus cognitive impairments due to H influenzae type B meningitis	0.203
26	Hib	Moderate vision impairment due to H influenza type B meningitis	0.031
29	Hib	Monocular distance vision loss due to H influenzae type B meningitis	0.017
30	Hib	Profound hearing loss due to H influenzae type B meningitis	0.204
31	Hib	Profound hearing loss with ringing due to H influenzae type B meningitis	0.277
32	Hib	Severe hearing loss due to H influenzae type B meningitis	0.158
33	Hib	Severe hearing loss with ringing due to H influenzae type B meningitis	0.261
34	Hib	Severe motor impairment due to H influenzae type B meningitis	0.402
35	Hib	Severe motor plus cognitive impairments due to H influenzae type B meningitis	0.542
36	Hib	Severe vision impairment due to H influenza type B meningitis	0.184
37	HPV	Controlled phase of cervical cancer Generic uncomplicated disease	0.049
38	HPV	Diagnosis and primary therapy phase of cervical cancer Cancer,	0.288
39	HPV	Metastatic phase of cervical cancer Cancer	0.451
40	HPV	Terminal phase of cervical cancer Terminal phase, with medication	0.540
41	JE	Acute encephalitis	0.133
42	JE	Blindness due to encephalitis	0.187
43	JE	Borderline intellectual disability due to encephalitis	0.011
46	JE	Less severe epilepsy	0.263
47	JE	Mild behavioral problems due to encephalitis	0.045
48	JE	Mild intellectual disability due to encephalitis	0.043
49	JE	Mild motor impairment due to long term due to encephalitis	0.010
50	JE	Mild motor plus cognitive impairments due to encephalitis	0.031
51	JE	Moderate motor impairment due to encephalitis	0.061
52	JE	Moderate motor plus cognitive impairments due to encephalitis	0.203
53	JE	Moderate vision impairment due to encephalitis	0.031
54	JE	Monocular distance vision loss due to encephalitis	0.017
56	JE	Seizure-free, treated epilepsy	0.049
57	JE	Severe epilepsy	0.552
58	JE	Severe motor impairment due to encephalitis	0.402
59	JE	Severe motor plus cognitive impairments due to encephalitis	0.542

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

	disease	condition/sequelae	GBD_2017_mean
118	Pneumo	Severe motor plus cognitive impairments due to pneumococcal meningitis	0.542
119	Pneumo	Severe vision impairment due to pneumococcol meningitis	0.184
121	Rota	Mild diarrheal diseases	0.074
122	Rota	Moderate diarrheal diseases	0.188
123	Rota	Severe diarrheal diseases	0.247
125	Rubella	Hearing loss, complete	0.215
126	Rubella	Hearing loss, complete, with ringing	0.316
127	Rubella	Hearing loss, mild	0.010
128	Rubella	Hearing loss, mild, with ringing	0.021
129	Rubella	Hearing loss, moderate	0.027
130	Rubella	Hearing loss, moderate, with ringing	0.074
133	Rubella	Hearing loss, profound	0.204
134	Rubella	Hearing loss, profound, with ringing	0.277
135	Rubella	Hearing loss, severe	0.158
136	Rubella	Hearing loss, severe, with ringing	0.261
138	YF	Moderate yellow fever	0.051
139	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.