

# Validating a Method to Assess Disease Burden From Insurance Claims

Thomas E. Kottke, MD, MSPH; Jason M. Gallagher, MBA; Marcia Lowry, MS; Pawan D. Patel, MD; Sachin Rauri, MS; Juliana O. Tillema, MPA; Jeanette Y. Ziegenfuss, PhD; Nicolaas P. Pronk, PhD, MA; and Susan M. Knudson, MA

In 2008, Berwick, Nolan, and Whittington proposed the Triple Aim as a measure of healthcare system performance.<sup>1</sup> Although valid, feasible, and actionable measures of experience and cost have been developed for health plans, there is not a tool that a health plan can use to assess the health of its own population using its own data. HealthPartners is therefore developing summary measures of health and well-being designed for self-assessment.<sup>2</sup> The organization has concluded that the best way to track the health of its member population is to use the information inherent in its death records and claims data. Although there are a number of ways to describe the current health and disease burden of a population, including health-adjusted life expectancy, quality-adjusted life years, and disability-adjusted life-years (DALYs),<sup>3-5</sup> calculating DALYs best fits HealthPartners' needs. Calculating DALYs also allows HealthPartners to compare its members' experiences with those of Minnesota residents, the entire US population, and other populations in the United States and abroad.<sup>6-8</sup>

Insurance claims tell the organization which conditions its members are experiencing, but they also present a problem: Insurance claims are agnostic about the burden that the associated conditions place on an individual's health and function. It is therefore necessary to assign a weight to each claim that reflects the disease burden. We used the Global Burden of Disease (GBD) as our source of condition weights.<sup>9</sup>

To document whether and the extent to which our method of calculating DALYs is a valid measure of disease burden, as well as the extent to which it provides information that is not available with measures that are more straightforward, we asked the following questions: (1) Are the correlations between DALYs and function and health of the same magnitude as an accepted measure of risk: the number of disease conditions associated with an individual?<sup>10,11</sup> (2) Do the correlations between DALYs and function and health provide information that differs from that of 2 simpler indicators: the number of members who have a particular condition and the healthcare costs associated with a condition? (3) Is simply calculating the function losses or the health losses associated with a disease or condition as useful as our method of calculating DALYs?

## ABSTRACT

**OBJECTIVES:** To validate a method that estimates disease burden as disability-adjusted life-years (DALYs) from insurance claims and death records for the purpose of identifying the conditions that place the greatest burden of disease on an insured population.

**STUDY DESIGN:** Comparison of the DALYs generated from death records and insurance claims with functional status and health status reported by individuals who were insured with one of HealthPartners' commercial products and completed a health assessment in 2011, 2012, or 2013.

**METHODS:** We calculated values of Spearman's  $\rho$ , the rank-order coefficient of correlation, for the correlation of DALYs with self-reported function and self-reported health. We did the same for the number of medical conditions per member and the cost of claims per member.

**RESULTS:** The Spearman's  $\rho$  values for the correlation of DALYs with function were  $-0.241$ ,  $-0.238$ , and  $-0.229$  in 2011, 2012, and 2013, respectively (all  $P < .0001$ ). The respective Spearman's  $\rho$  values for the correlation of DALYs with health were  $-0.197$ ,  $-0.189$ , and  $-0.192$  (all  $P < .0001$ ). These Spearman's  $\rho$  values were similar in magnitude to those for the correlation of the number of medical conditions per member with function ( $-0.212$ ,  $-0.213$ , and  $-0.205$ ) and health ( $-0.199$ ,  $-0.196$ , and  $-0.198$ ) over the 3 years. The Spearman's  $\rho$  values for the correlation of DALYs with function and health were greater than or equal to those for the correlation of cost of claims per member with function ( $-0.144$ ,  $-0.193$ , and  $-0.186$ ) and greater than those for the cost of claims per member with health ( $-0.126$ ,  $-0.150$ , and  $-0.151$ ).

**CONCLUSIONS:** Health plans can use DALYs calculated from their own health insurance claims and death records as a valid and inexpensive method to identify the conditions that place the greatest burden of poor function and ill health on their insured populations.

*Am J Manag Care.* 2019;25(2):e39-e44

## TAKEAWAY POINTS

Based on the correlation of disability-adjusted life-years (DALYs) with self-reported function and self-reported health, we conclude that our method of estimating DALYs by combining mortality data with insurance claims weighted by a condition burden score is valid.

- ▶ Important differences are revealed when population burden from a condition is defined by DALYs rather than by the number of individuals with the condition or the cost of the condition to the health plan.
- ▶ The magnitude of these correlations with self-reported function and health is greater than that of cost of claims.
- ▶ Unlike assessing disease burden by counting the number of conditions per individual, calculating the DALYs attributable to conditions identifies opportunities to improve population health by addressing particularly burdensome conditions.

To the extent that the answer to the first question is yes, we consider our method of calculating DALYs to be valid. To the extent that the answer to the second question is yes, we conclude that our method adds value, and if the answer to the third question is no, we consider that calculating DALYs from insurance claims is useful.

## METHODS

The HealthPartners institutional review board (IRB) agreed that this analysis is quality improvement, not research, and is thus not subject to IRB review.

## Data Source for Member-Reported Function and Health

Self-report is considered a valid way to measure both the average health and the average function of a population.<sup>12,13</sup> It is used as such in both Europe<sup>14</sup> and the United States.<sup>15</sup> Each year, members insured through HealthPartners' commercial (non-government-sponsored) programs are offered the opportunity to complete a health assessment. One question on the assessment relates to the respondent's difficulty in doing daily work because of physical function, 1 relates to the extent to which emotional problems interfere with the respondent's ability to do their daily work, and 1 asks the respondent to describe their health. For each question, the respondent has 5 choices, ranging from "none" to "I could not do my daily work" for physical function, "not at all" to "extremely" for emotional problems, and "poor" to "excellent" for health. We used these 3 questions in the analyses we report here. We excluded data from any member whose name appeared on one of our health plan, research, or related do-not-contact lists. Overall, this applied to 0.2% of our membership.

## Assigning Condition Burden Weights to Insurance Claims

HealthPartners uses the Johns Hopkins ACG [adjusted clinical group] System in its billing process and to organize insurance claims for further analysis. This system groups all claims into 264 expanded diagnostic clusters (EDCs) and further groups the EDCs into 27 more general major expanded diagnostic clusters (MEDCs). To calculate the morbidity component of DALYs, we assigned a GBD Project score<sup>9</sup> to each EDC. To carry out this process, 2 physicians (T.E.K. and P.D.P.)

independently matched a GBD condition to each of the 264 EDCs. The 2 physicians initially agreed on the weighting for 42% of the EDCs and adjudicated an agreement on the weights for the remainder. The crosswalk is available in the [eAppendix](#) (available at [ajmc.com](#)). We then used the ACG System Aggregated Diagnosis Groups (ADGs) output to adjust the weights for the severity associated with each EDC. We assigned the upper limit of the respective GBD weight to any EDC that the ADG output classified as "major" (high severity), and we assigned the lower-limit GBD weight to all other EDCs.

## Calculating DALYs

DALYs are composed of years of life lost (YLLs) due to premature death and years lived with disability due to morbid conditions. Although the choice of age cut point for YLLs is arbitrary (eg, the US Burden of Disease Collaborators used 86.0 years in a recent publication),<sup>16</sup> we chose 75 years because it is the age used by the County Health Rankings.<sup>17</sup> YLLs are feasible and inexpensive for us to calculate because we already have access to death records from the state of Minnesota, patient status at discharge (alive, transferred, or deceased) associated with hospital insurance claims, and HealthPartners' decedent registry. For this analysis, we used the claims of a member only in the year that they completed a health assessment. Because the same condition may have more than 1 EDC attributed to it (eg, a patient treated for coronary heart disease may have claims that track to ischemic heart disease, cardiovascular signs and symptoms, generalized atherosclerosis, and cardiovascular disorders [other], corresponding to EDCs CAR01, CAR03, CAR10, and CAR16), we counted just 1 EDC within each MEDC, the EDC with the largest GBD weight. We used the method described by Kottke et al to calculate the DALYs due to morbidity for members who had claims in more than 1 MEDC.<sup>18</sup> We found that calculating DALYs using the prevalence method<sup>3</sup> best fit the data we had available.

The costs that we used in this analysis do not include pharmacy costs, because they are not accurate due to carve-outs that are covered by other organizations. If we had included them, the costs associated with chronic inflammatory disease treatment (eg, rheumatoid conditions, psoriasis, and inflammatory bowel disease) would have affected the cost rankings of the rheumatologic, skin, and gastrointestinal MEDCs in particular (19.2% of our total pharmacy costs), but they would not have affected the associations between DALYs and function and health.

## Calculating Losses of Function and Health Attributable to Particular MEDCs

As part of the validity testing process, we calculated the loss of function and health attributable to particular MEDCs. To do this, we multiplied the difference between a perfect score for function (ie, 10) and the average score for members with a claim in an MEDC

**TABLE 1.** Demographic Characteristics of the Commercially Insured Members Who Completed a Health Assessment in 2011, 2012, or 2013

Year	2011 n (%)	2012 n (%)	2013 n (%)
Total	72,693 (100)	58,434 (100)	61,723 (100)
Age, years			
18-29	2046 (3)	2285 (4)	3373 (5)
30-39	14,543 (20)	11,748 (20)	13,238 (21)
40-49	17,640 (24)	13,999 (24)	15,089 (24)
50-64	30,967 (43)	25,431 (44)	26,083 (42)
≥65	7497 (10)	4971 (9)	3940 (6)
Sex			
Female	44,710 (62)	36,485 (62)	37,447 (61)
Male	27,983 (38)	21,949 (38)	24,276 (39)
Race/ethnicity			
Non-Hispanic white	64,507 (89)	51,773 (89)	54,333 (88)
Others	8186 (11)	6661 (11)	7390 (12)
Education			
No college or technical school	7569 (10)	5980 (10)	6297 (10)
Completed some college or technical school	21,996 (30)	15,962 (27)	17,280 (28)
Completed college or more	43,124 (59)	36,490 (62)	38,143 (62)
No data on education	4 (<1)	2 (<1)	3 (0)

**TABLE 2.** Mean, Median, and IQR Values for DALYs, Function, Health, MEDCs per Member, and Cost per Member for 2011, 2012, and 2013\*

	2011	2012	2013
DALYs			
Mean	0.385	0.377	0.371
Median	0.359	0.356	0.350
IQR	0.498	0.502	0.502
Function			
Mean	9.26	9.16	9.23
Median	10	10	10
IQR	1	1	1
Health			
Mean	3.78	3.73	3.77
Median	4	4	4
IQR	1	1	1
MEDCs per member			
Mean	4.62	4.57	4.49
Median	4	4	4
IQR	4	4	4
Cost per member			
Mean	\$4541	\$4519	\$4521
Median	\$1241	\$1329	\$1281
IQR	\$3243	\$3299	\$3267

DALY indicates disability-adjusted life-year; IQR, interquartile range; MEDC, major expanded diagnostic cluster.

\*The potential range of DALYs is from 0 (perfect health) to 1 (death). The potential range for function is from 2 to 10. The potential range for health is from 1 to 5. The potential range for MEDCs per member is from 0 to 27.

by the number of people in an MEDC. We also took the difference between a perfect score for self-reported health (ie, 5) and the average score for members with a claim in an MEDC and multiplied that number by the number of people in an MEDC.

### Statistical Analysis

We present the means, medians, and interquartile ranges (IQRs) for the various measures. We used Spearman's  $\rho$ , the rank test of correlation, as the measure of correlation between DALYs and self-reported health and self-reported function. We also calculated Spearman's  $\rho$  values for the correlation of the number of MEDCs attributed to a patient with self-reported health and self-reported function and the correlation of cost per member with self-reported health and self-reported function. We considered  $P < .05$  to be statistically significant. We used Base SAS 9.4 (SAS Institute; Cary, North Carolina) for statistical testing.

## RESULTS

### Population Attributes

The number of individuals who were covered by one of HealthPartners' commercial insurance products and completed a health assessment exceeded 58,000 in each of the years 2011, 2012, and 2013 (Table 1).

Among these members, the largest single age group in all 3 years was 50 to 64 years. Nearly two-thirds of the responding members were women, and nearly 90% were non-Hispanic white. The respondents were highly educated—59% in the 2011 cohort and 62% in the other 2 years had completed college or more.

### Distribution of the Measures

DALYs per member averaged 0.371 to 0.385 over the 3 years. The medians were somewhat lower than the means; the IQRs ranged from 0.498 to 0.502 (Table 2). The mean function scores ranged from 9.16 to 9.26, and all 3 medians were 10 with IQRs of 1. The mean health scores ranged from 3.73 to 3.78; all medians were 4, and all IQRs were 1. The mean number of MEDCs per member varied from 4.49 to 4.62; all medians were 4, as were the IQRs. The mean cost per member varied from \$4519 to \$4541, with medians ranging from \$1241 to \$1329 and IQRs ranging from \$3243 to \$3299.

### Individual-Level Correlations

Calculated at the individual level, the Spearman's  $\rho$  values for the correlation of DALYs with member-reported function ranged from  $-0.229$  to  $-0.241$  for the 3 years (Table 3). The Spearman's  $\rho$  values for the correlation of DALYs with member-reported health were somewhat lower.

## METHODS

**TABLE 3.** Spearman's Coefficients (95% CLs) for the Correlation of Self-reported Physical Plus Emotional Function (combined as "Function") and Self-reported Health With DALYs and Number of MEDCs per Member for 2011, 2012, and 2013

Indicator	2011	2012	2013
<b>DALYs per Member</b>			
Function	-0.241 (-0.247 to -0.234)	-0.238 (-0.246 to -0.231)	-0.229 (-0.237 to -0.222)
Health	-0.197 (-0.204 to -0.190)	-0.189 (-0.197 to -0.181)	-0.192 (-0.199 to -0.184)
<b>Number of MEDCs per Member</b>			
Function	-0.212 (-0.219 to -0.205)	-0.213 (-0.221 to -0.206)	-0.205 (-0.213 to -0.198)
Health	-0.199 (-0.206 to -0.192)	-0.196 (-0.204 to -0.188)	-0.198 (-0.205 to -0.190)

CL indicates confidence limit; DALY, disability-adjusted life-year; MEDC, major expanded diagnostic cluster.

The Spearman's  $\rho$  values for the correlation of the number of MEDCs per member with self-reported function were similar to those for the correlation of DALYs with self-reported function. Likewise, the Spearman's  $\rho$  values for the correlation of MEDCs per member with self-reported health were not materially different from the Spearman's  $\rho$  values for the correlation of DALYs with self-reported health.

The Spearman's  $\rho$  values for the correlation of the cost of medical care (not including pharmacy claims) with self-reported function, ranging from -0.144 to -0.193, were not as strong as the  $\rho$  values for the correlation of DALYs with self-reported function. The same was true for the correlation between cost of medical care and self-reported health (-0.126 to -0.151).

### Association of Losses of Function and Health Attributable to an MEDC With Counts of Members in an MEDC

Based on self-reported function, the correlations between the function or health lost by the members with a claim in a particular MEDC and simply the number of members with a claim in the same MEDC are nearly perfect. Spearman's  $\rho$  values ranged from 0.981 to 0.985 (Table 4). The same is true for the correlations based on self-reported health and the number of members with a claim in a particular MEDC; the Spearman's  $\rho$  values ranged from 0.994 to 0.996 for the 3 years.

### Impact of the Ranking Method on MEDC Rank

When the MEDCs are ranked by the DALYs, the number of individuals, and the cost of claims associated with an MEDC, important differences emerge (Table 5). For example, the musculoskeletal MEDC remains ranked first in DALYs and cost and ranked second in number of members with a claim in the MEDC in all 3 years. By contrast, the psychosocial MEDC is ranked 2nd by DALYs but just 8th to 10th by number of individuals with the condition and cost of the condition. The administrative MEDC (which includes the EDCs surgical aftercare, transplant status, administrative concerns and nonspecific laboratory tests, and preventive care), although second in cost, is near the bottom in DALYs because most of the

**TABLE 4.** Spearman's Coefficients for the Function Loss and Health Loss Attributable to an MEDC Correlated With the Number of Members With a Claim in an MEDC for 2011, 2012, and 2013<sup>a</sup>

	2011	2012	2013
Correlation of function loss attributable to an MEDC with the number of members with a claim in an MEDC	0.981	0.984	0.985
Correlation of health loss attributable to an MEDC with the number of members with a claim in an MEDC	0.994	0.996	0.995

MEDC indicates major expanded diagnostic cluster.

<sup>a</sup>Function loss attributable to an MEDC is defined as the difference between a perfect function score (in this case, 10) and the mean function score for the members with a claim in the MEDC multiplied by the number of members with a claim in the MEDC. Health loss attributed to an MEDC is calculated in a similar fashion, but in the case of health, a perfect score is 5.

costs attributed to the MEDC are generated by preventive services, to which we do not attribute DALYs. Cardiovascular conditions, ranked 5th by number of individuals with a claim in that MEDC, and malignancies, ranked 5th by cost of claims, ranged from 10th to 14th when ranked by DALYs.

With minor exceptions, the order of the MEDCs was stable over the 3 years when ranked by the number of DALYs attributed to the MEDC. With the exception of the ranks of malignancies and infections, which each varied by 3 levels, and administrative, which moved from the 23rd position in 2011 to 27th in 2013, none of the MEDC ranks differed by more than 2 levels in the 3 years.

## DISCUSSION

In the data set of HealthPartners members who were insured with a commercial product and completed a health assessment in 2011, 2012, or 2013, we found the following regarding our method of calculating DALYs from insurance claims.

The coefficients for the correlation of DALYs with self-reported function and self-reported health were of the same magnitude as the coefficients for the correlation of the number of disease conditions an individual is experiencing with self-reported function and self-reported health. The latter is a validated measure of disease burden.<sup>10,11</sup> We therefore conclude that our method of calculating DALYs is valid given certain limitations. The advantage of using DALYs rather than counts of conditions per individual is that DALYs can be used to identify the conditions that are creating the greatest burden on the population; simply counting conditions per individual cannot do so.

DALYs provide information that is not apparent from simply counting the number of people with a condition or the healthcare costs associated with a condition. Taking the extra step of applying condition weights to insurance claims adds value.

Because the range of GBD condition weights we used to calculate DALYs is far greater than the range of weights that can be generated

by using self-reported function or health as the source of weights, DALYs provide a greater capability to discriminate among conditions.

Using DALYs as our measure of current health allows us to compare the health of our member population with benchmarks that include state and national populations.<sup>6</sup> The method also allows us to benchmark against cities like New York.<sup>8</sup>

### Limitations

There are several limitations to our analysis. The magnitude of the correlations between DALYs and self-reported function and health is probably reduced by the fact that not all individuals have the same propensity to seek medical care. This propensity may vary by disease condition. The magnitude of the correlations is also influenced by the factors by which each individual implicitly assesses their functional capability and health. Self-reported function is based on just 2 questions, 1 for physical function and 1 for emotional function. Even more limited, self-reported health is based on a single question. A more extensive scale might be expected to yield larger correlation coefficients. The fact that the data set is limited to employed individuals and their covered dependents, both of whom tend to be highly educated, and includes neither members insured by Medicare nor Medicaid also limits the generalizability. We are currently collecting function and health data self-reports from stratified random samples of adult members who are insured through both commercial and government programs. When we have adequate numbers, we will be able to repeat this analysis for our entire adult membership. An additional limitation is that because only members who completed a health assessment were included in this analysis, the DALYs due to a death were not included if the individual died without completing a health assessment. This fact would particularly affect the DALYs attributable to cardiovascular conditions and malignancies. Finally, minorities were underrepresented, the age range of the respondents was truncated, and the respondents were predominantly from Minnesota. However, we are not seeking to generalize the findings from the HealthPartners membership to a wider population.

## CONCLUSIONS

The analysis we report here documents that, with limitations, our method of calculating DALYs from insurance claims is valid. In

**TABLE 5.** MEDC Ranking by DALYs, Number of Members, and Cost for 2011, 2012, and 2013

MEDC	2011			2012			2013		
	DALYs	n	Cost	DALYs	n	Cost	DALYs	n	Cost
Musculoskeletal	1	2	1	1	2	1	1	2	1
Psychosocial	2	9	9	2	8	10	2	8	9
Neurologic	3	11	7	3	10	7	3	10	7
General surgery	4	7	4	4	7	4	4	7	4
Respiratory	5	6	8	7	6	8	7	6	10
Female reproductive	6	10	3	6	11	3	6	11	3
Eye	7	3	12	5	3	13	5	3	12
General signs and symptoms	8	12	11	9	12	12	8	12	13
Gastrointestinal/hepatic	9	13	10	8	13	9	9	13	8
Cardiovascular	10	5	6	10	5	6	10	5	6
Malignancies	11	21	5	14	22	5	11	22	5
Endocrine	12	14	15	11	14	15	12	14	15
Genitourinary	13	15	13	12	15	14	14	16	14
Rheumatologic	14	20	18	13	20	19	13	21	18
Skin	15	4	14	15	4	11	15	4	11
Nutrition	16	17	19	16	17	22	16	17	22
Ear, nose, and throat	17	8	16	17	9	16	19	9	16
Renal	18	23	22	18	23	21	17	23	20
Allergy	19	18	20	19	18	18	20	18	19
Hematologic	20	19	23	20	19	23	21	19	23
Infections	21	22	21	21	21	20	18	20	21
Reconstructive	22	24	24	23	24	24	23	24	24
Administrative <sup>a</sup>	23	1	2	24	1	2	27	1	2
Toxic effects and adverse events	24	25	17	22	25	17	22	25	17
Dental	25	26	26	25	26	25	24	26	25
Genetic	26	27	25	26	27	26	25	27	26
Neonatal	27	28	27	27	28	27	26	28	27
Nonusers <sup>b</sup>	28	16	28	28	16	28	28	15	28

DALY indicates disability-adjusted life-year; MEDC, major expanded diagnostic cluster.

<sup>a</sup>The administrative MEDC includes the following EDCs: surgical aftercare, transplant status, administrative concerns and nonspecific laboratory tests, and preventive services.

<sup>b</sup>Nonusers are individuals who did not have an insurance claim in a given year.

addition to being valid, the method we have developed is inexpensive and adds value. It therefore holds promise as a feasible and informative method for organizations that submit or process health insurance claims to use to assess the current health status and the greatest losses to health of the populations they serve. ■

**Author Affiliations:** HealthPartners (TEK, JMG, ML, PDP, SR, JOT, NPP, SMK), Minneapolis, MN; HealthPartners Institute (TEK, JYZ, NPP), Minneapolis, MN.

**Source of Funding:** Analysis was funded solely and entirely by HealthPartners health plan.

**Author Disclosures:** The authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

**Authorship Information:** Concept and design (TEK, JMG, SR, JYZ, NPP); acquisition of data (TEK, JMG, ML, PDP, SR, NPP); analysis and interpretation of data (TEK, JMG, PDP, SR, JOT, JYZ, NPP); drafting of the manuscript (TEK, NPP); critical revision of the manuscript for important intellectual content (TEK, SR,

## METHODS

JOT, JYZ, NPP, SMK); statistical analysis (ML, SR); obtaining funding (TEK, NPP, SMK); administrative, technical, or logistic support (TEK, ML, SR, JOT, NPP, SMK); and supervision (TEK, JMG, PDP, SMK).

**Address Correspondence to:** Thomas E. Kottke, MD, MSPH, HealthPartners, 8170 33rd Ave S, MS 21110X, Minneapolis, MN 55425. Email: Thomas.e.kottke@healthpartners.com.

## REFERENCES

1. Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Aff (Millwood)*. 2008;27(3):759-769. doi: 10.1377/hlthaff.27.3.759.
2. Kottke TE, Gallagher JM, Rauri S, Tillemo JO, Pronk NP, Knudson SM. New summary measures of population health and well-being for implementation by health plans and accountable care organizations. *Prev Chronic Dis*. 2016;13:E89. doi: 10.5888/pcd13.160224.
3. Department of Health Statistics and Information Systems, World Health Organization. WHO methods and data sources for global burden of disease estimates 2000-2011. World Health Organization website. who.int/health-info/statistics/GlobalDALYmethods\_2000\_2011.pdf. Published November 2013. Accessed January 18, 2019.
4. Murray CJ, Atkinson C, Bhalla K, et al; US Burden of Disease Collaborators. The state of US health, 1990-2010: burden of diseases, injuries, and risk factors. *JAMA*. 2013;310(6):591-608. doi: 10.1001/jama.2013.13805.
5. Gold MR, Stevenson D, Fryback DG. HALYS and DALYS and DALYS, oh my: similarities and differences in summary measures of population health. *Annu Rev Public Health*. 2002;23:115-134. doi: 10.1146/annurev.publhealth.23.100901.140513.
6. US health. Institute for Health Metrics and Evaluation website. healthdata.org/us-health. Accessed September 18, 2018.
7. GBD profile: United States. Institute for Health Metrics and Evaluation website. healthdata.org/sites/default/files/files/country\_profiles/GBD/ihme\_gbd\_country\_report\_united\_states.pdf. Accessed January 18, 2019.
8. Perlman S, Driver D. Disability-adjusted life years (DALYs) in New York City. New York City Department of Health and Mental Hygiene website. www1.nyc.gov/assets/doh/downloads/pdf/epi/databrief11.pdf. Published November 2011. Accessed January 18, 2019.
9. Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010 [erratum in *Lancet*. 2013;381(9867):628]. *Lancet*. 2012;380(9859):2129-2143. doi: 10.1016/S0140-6736(12)61680-8.
10. Perkins AJ, Kroenke K, Unützer J, et al. Common comorbidity scales were similar in their ability to predict health care costs and mortality. *J Clin Epidemiol*. 2004;57(10):1040-1048. doi: 10.1016/j.jclinepi.2004.03.002.
11. Charlson ME, Peterson JC, Boutin-Foster C, et al. Changing health behaviors to improve health outcomes after angioplasty: a randomized trial of net present value versus future value risk communication. *Health Educ Res*. 2008;23(5):826-839. doi: 10.1093/her/cym068.
12. Strawbridge WJ, Wallhagen MI. Self-rated health and mortality over three decades: results from a time-dependent covariate analysis. *Res Aging*. 1999;21(3):402-416. doi: 10.1177/0164027599213003.
13. Hoeymans N, Feskens EJ, van den Bos GA, Kromhout D. Measuring functional status: cross-sectional and longitudinal associations between performance and self-report (Zutphen Elderly Study 1990-1993). *J Clin Epidemiol*. 1996;49(10):1103-1110. doi: 10.1016/0895-4356(96)00210-7.
14. Szende A, Williams A, eds. *Measuring Self-Reported Population Health: An International Perspective Based on EQ-5D*. Rotterdam, the Netherlands: EuroQol Group; 2004. euroqol.org/wp-content/uploads/2016/10/Measuring\_Self-Reported\_Population\_Health\_-\_An\_International\_Perspective\_based\_on\_EQ-5D.pdf. Accessed January 18, 2019.
15. 2018 BRFSS questionnaire. CDC website. cdc.gov/brfss/questionnaires/pdf-ques/2018\_BRFSS\_English\_Questionnaire.pdf. Published January 18, 2018. Accessed January 19, 2019.
16. Mokdad AH, Ballesteros K, Echko M, et al; US Burden of Disease Collaborators. The state of US health, 1990-2016: burden of diseases, injuries, and risk factors among US states. *JAMA*. 2018;319(14):1444-1472. doi: 10.1001/jama.2018.0158.
17. Premature death (YPLL). County Health Rankings & Roadmaps website. countyhealthrankings.org/explore-health-rankings/what-and-why-we-rank/health-outcomes/mortality/premature-death/premature-death-ypll. Accessed January 18, 2019.
18. Kottke TE, Faith DA, Jordan CO, Pronk NP, Thomas RJ, Capewell S. The comparative effectiveness of heart disease prevention and treatment strategies. *Am J Prev Med*. 2009;36(1):82-88.e5. doi: 10.1016/j.amepre.2008.09.010.

Visit [ajmc.com/link/3689](https://ajmc.com/link/3689) to download PDF and eAppendix

## eAppendix

EDCs	MEDCs	Expanded Diagnosis Cluster Description	Global Burden of Disease category*	GBD weight mean	low range	high range
ADM02	ADM	Surgical aftercare	open wound: short term, with or without treatment	0.000	0.000	0.000
ADM03	ADM	Transplant status	generic uncomplicated disease: worry and daily medication	0.027	0.017	0.050
ADM05	ADM	Administrative concerns and non-specific laborator	generic uncomplicated disease: worry and daily medication	0.000	0.000	0.000
ADM06	ADM	Preventive care	generic uncomplicated disease: worry and daily medication	0.000	0.000	0.000
ALL01	ALL	Allergic reactions	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
ALL03	ALL	Allergic rhinitis	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
ALL06	ALL	Disorders of the immune system	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
CAR01	CAR	Cardiovascular signs and symptoms	angina pectoris:mild	0.037	0.022	0.058
CAR03	CAR	Ischemic heart disease (excluding acute myocardial	angina pectoris: moderate	0.066	0.043	0.095
CAR04	CAR	Congenital heart disease	disfurgrement level: 3	0.562	0.394	0.725
CAR05	CAR	Congestive heart failure	heart failure: severe	0.186	0.128	0.261
CAR06	CAR	Cardiac valve disorders	heart failure: severe	0.186	0.128	0.261
CAR07	CAR	Cardiomyopathy	heart failure: severe	0.186	0.128	0.261
CAR08	CAR	Heart murmur	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
CAR09	CAR	Cardiac arrhythmia	cardiac conduction disorders and cardiac dysrhythmias	0.145	0.097	0.205
CAR10	CAR	Generalized atherosclerosis	claudication	0.016	0.008	0.028
CAR11	CAR	Disorders of lipid metabolism	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
CAR12	CAR	Acute myocardial infarction	acute myocardial infarction:days 1-2	0.422	0.284	0.566
CAR13	CAR	Cardiac arrest, shock	acute myocardial infarction:days 1-2	0.422	0.284	0.566
CAR14	CAR	Hypertension, w/o major complications	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
CAR15	CAR	Hypertension, with major complications	heart failure: moderate	0.070	0.044	0.102
CAR16	CAR	Cardiovascular disorders, other	angina pectoris:mild	0.037	0.022	0.058
DEN01	DEN	Disorders of mouth	periodontitis	0.008	0.003	0.017
DEN02	DEN	Disorders of teeth	severe tooth loss	0.072	0.048	0.103
DEN03	DEN	Gingivitis	periodontitis	0.008	0.003	0.017
DEN04	DEN	Stomatitis	periodontitis	0.008	0.003	0.017
EAR01	EAR	Otitis media	ear pain	0.018	0.009	0.031
EAR02	EAR	Tinnitus	hearing loss: mild, with ringing	0.038	0.024	0.058
EAR03	EAR	Temporomandibular joint disease	headache:tension type	0.040	0.025	0.062
EAR04	EAR	Foreign body in ears, nose, or throat	ear pain	0.018	0.009	0.031
EAR05	EAR	Deviated nasal septum	disfigurement: level 1	0.013	0.006	0.025
EAR06	EAR	Otitis externa	ear pain	0.018	0.009	0.031
EAR07	EAR	Wax in ear	ear pain	0.018	0.009	0.031
EAR08	EAR	Deafness, hearing loss	hearing loss:complete	0.033	0.020	0.052
EAR09	EAR	Chronic pharyngitis and tonsillitis	infectious disease:acute episode, moderate	0.053	0.033	0.081
EAR10	EAR	Epistaxis	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
EAR11	EAR	Acute upper respiratory tract infection	infectious disease: acute episode mild	0.005	0.002	0.011

<b>EAR12</b>	<b>EAR</b>	ENT disorders, other	ear pain	0.018	0.009	0.031
<b>END02</b>	<b>END</b>	Osteoporosis	disfigurement: level 2	0.072	0.048	0.103
<b>END03</b>	<b>END</b>	Short stature	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>END04</b>	<b>END</b>	Hypothyroidism	iodine-deficiency goitre	0.200	0.134	0.283
<b>END05</b>	<b>END</b>	Other endocrine disorders	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
<b>END06</b>	<b>END</b>	Type 2 diabetes, w/o complication	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
<b>END07</b>	<b>END</b>	Type 2 diabetes, w/ complication	diabetic neuropathy	0.099	0.066	0.145
<b>END08</b>	<b>END</b>	Type 1 diabetes, w/o complication	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>END09</b>	<b>END</b>	Type 1 diabetes, w/ complication	diabetic neuropathy	0.099	0.066	0.145
<b>EYE01</b>	<b>EYE</b>	Ophthalmic signs and symptoms	injury to eyes: short term	0.079	0.050	0.118
<b>EYE02</b>	<b>EYE</b>	Blindness	distance vision blindness	0.195	0.132	0.272
<b>EYE03</b>	<b>EYE</b>	Retinal disorders (excluding diabetic retinopathy)	distance vision blindness	0.195	0.132	0.272
<b>EYE04</b>	<b>EYE</b>	Disorders of the eyelid and lacrimal duct	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>EYE05</b>	<b>EYE</b>	Refractive errors	near vision impairment	0.013	0.006	0.024
<b>EYE06</b>	<b>EYE</b>	Cataract, aphakia	distance vision :severe impairment	0.191	0.129	0.269
<b>EYE07</b>	<b>EYE</b>	Conjunctivitis, keratitis	infectious disease: acute episode mild	0.005	0.002	0.011
<b>EYE08</b>	<b>EYE</b>	Glaucoma	distance vision :severe impairment	0.191	0.129	0.269
<b>EYE09</b>	<b>EYE</b>	Infections of eyelid	infectious disease:acute episode, moderate	0.053	0.033	0.081
<b>EYE10</b>	<b>EYE</b>	Foreign body in eye	injury to eyes: short term	0.079	0.050	0.118
<b>EYE11</b>	<b>EYE</b>	Strabismus, amblyopia	distance vision: moderate impairment	0.033	0.020	0.052
<b>EYE12</b>	<b>EYE</b>	Traumatic injuries of eye	Injury to eyes: short term	0.079	0.050	0.118
<b>EYE13</b>	<b>EYE</b>	Diabetic retinopathy	Distance vision: severe impairment	0.191	0.129	0.269
<b>EYE14</b>	<b>EYE</b>	Eye, other disorders	distance vision: mild impairment	0.004	0.001	0.010
<b>EYE15</b>	<b>EYE</b>	Age-related macular degeneration	Distance vision: blindless	0.195	0.132	0.272
<b>FRE01</b>	<b>FRE</b>	Pregnancy and delivery, uncomplicated	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>FRE02</b>	<b>FRE</b>	Female genital symptoms	urinary incontinence	0.142	0.094	0.204
<b>FRE03</b>	<b>FRE</b>	Endometriosis	Abdominopelvic problems, severe	0.326	0.219	0.451
<b>FRE04</b>	<b>FRE</b>	Pregnancy and delivery with complications	Abdominopelvic problems, severe	0.326	0.219	0.451
<b>FRE05</b>	<b>FRE</b>	Female infertility	infertility: primary	0.011	0.005	0.021
<b>FRE06</b>	<b>FRE</b>	Abnormal pap smear	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>FRE07</b>	<b>FRE</b>	Ovarian cyst	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>FRE08</b>	<b>FRE</b>	Vaginitis, vulvitis, cervicitis	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>FRE09</b>	<b>FRE</b>	Menstrual disorders	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>FRE10</b>	<b>FRE</b>	Contraception	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>FRE11</b>	<b>FRE</b>	Menopausal symptoms	abdominopelvic problems: mild	0.012	0.005	0.023
<b>FRE12</b>	<b>FRE</b>	Utero-vaginal prolapse	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>FRE13</b>	<b>FRE</b>	Female gynecologic conditions, other	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>FRE14</b>	<b>FRE</b>	Pregnancy with termination	Pregnancy and delivery with complications	0.326	0.219	0.451



<b>GAS01</b>	<b>GAS</b>	Gastrointestinal signs and symptoms	diarrhea, mild	0.061	0.036	0.093
<b>GAS02</b>	<b>GAS</b>	Inflammatory bowel disease	crohn's disease or ulcerative colitis	0.225	0.152	0.314
<b>GAS03</b>	<b>GAS</b>	Constipation	abdominopelvic problem: mild	0.012	0.005	0.023
<b>GAS04</b>	<b>GAS</b>	Acute hepatitis	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GAS05</b>	<b>GAS</b>	Chronic liver disease	decompensated cirrhosis of liver	0.194	0.127	0.273
<b>GAS06</b>	<b>GAS</b>	Peptic ulcer disease	gastric bleeding	0.323	0.214	0.461
<b>GAS07</b>	<b>GAS</b>	Gastroenteritis	Diarrhoea, moderate	0.202	0.133	0.299
<b>GAS08</b>	<b>GAS</b>	Gastroesophageal reflux	abdominopelvic problem: mild	0.012	0.005	0.023
<b>GAS09</b>	<b>GAS</b>	Irritable bowel syndrome	diarrhea, mild	0.061	0.036	0.093
<b>GAS10</b>	<b>GAS</b>	Diverticular disease of colon	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GAS11</b>	<b>GAS</b>	Acute pancreatitis	abdominopelvic problem: severe	0.326	0.219	0.451
<b>GAS12</b>	<b>GAS</b>	Chronic pancreatitis	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GAS13</b>	<b>GAS</b>	Lactose intolerance	generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>GAS14</b>	<b>GAS</b>	Gastrointestinal/Hepatic disorders, other	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GSI01</b>	<b>GSI</b>	Nonspecific signs and symptoms	Generic uncomplicated disease: anxiety about diagnosis	0.054	0.033	0.082
<b>GSI02</b>	<b>GSI</b>	Chest pain	Generic uncomplicated disease: anxiety about diagnosis	0.054	0.033	0.082
<b>GSI03</b>	<b>GSI</b>	Fever	infectious disease: acute episode mild	0.005	0.002	0.011
<b>GSI04</b>	<b>GSI</b>	Syncope	Cardiac conduction disorders and dysrhythmias	0.145	0.097	0.205
<b>GSI05</b>	<b>GSI</b>	Nausea, vomiting	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>GSI06</b>	<b>GSI</b>	Debility and undue fatigue	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
<b>GSI07</b>	<b>GSI</b>	Lymphadenopathy	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>GSI08</b>	<b>GSI</b>	Edema	Generic uncomplicated disease: worry and daily medication	0.031	0.017	0.050
<b>GSU01</b>	<b>GSU</b>	Anorectal conditions	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GSU02</b>	<b>GSU</b>	Appendicitis	abdominopelvic problem: severe	0.326	0.219	0.451
<b>GSU03</b>	<b>GSU</b>	Benign and unspecified neoplasm	cancer: diagnosis and primary therapy	0.294	0.199	0.411
<b>GSU04</b>	<b>GSU</b>	Cholelithiasis, cholecystitis	abdominopelvic problem: severe	0.326	0.219	0.451
<b>GSU05</b>	<b>GSU</b>	External abdominal hernias, hydroceles	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GSU06</b>	<b>GSU</b>	Chronic cystic disease of the breast	Disfigurement: level 2	0.072	0.048	0.103
<b>GSU07</b>	<b>GSU</b>	Other breast disorders	Disfigurement: level 2	0.072	0.048	0.103
<b>GSU08</b>	<b>GSU</b>	Varicose veins of lower extremities	Disfigurement: level 2	0.072	0.048	0.103
<b>GSU09</b>	<b>GSU</b>	Nonfungal infections of skin and subcutaneous tiss	infectious disease: mild	0.005	0.002	0.011
<b>GSU10</b>	<b>GSU</b>	Abdominal pain	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>GSU11</b>	<b>GSU</b>	Peripheral vascular disease	claudication	0.016	0.008	0.028
<b>GSU12</b>	<b>GSU</b>	Burns--1st degree	disfigurement: level 1	0.013	0.006	0.025
<b>GSU13</b>	<b>GSU</b>	Aortic aneurysm	angina pectoris:severe	0.167	0.109	0.234
<b>GSU14</b>	<b>GSU</b>	Gastrointestinal obstruction/perforation	Gastric bleeding	0.323	0.214	0.461
<b>GSU15</b>	<b>GSU</b>	Alimentary or excretory surgical openings	Stoma	0.086	0.055	0.131
<b>GTC01</b>	<b>GTC</b>	Chromosomal anomalies	generic uncomplicated disease:anxiety about diagnosis	0.054	0.033	0.082

<b>GTC02</b>	<b>GTC</b>	Inherited metabolic disorders	Generic uncomplicated disease: worry and daily medication	0.031	0.012	0.050
<b>GUR01</b>	<b>GUR</b>	Vesicoureteral reflux	abdominopelvic problem: moderate	0.123	0.083	0.176
<b>GUR02</b>	<b>GUR</b>	Undescended testes	infertility:secondary	0.006	0.002	0.013
<b>GUR03</b>	<b>GUR</b>	Hypospadias, other penile anomalies	infertility:secondary	0.006	0.002	0.013
<b>GUR04</b>	<b>GUR</b>	Prostatic hypertrophy	benign prostatic hypertrophy: symptomatic	0.070	0.046	0.102
<b>GUR05</b>	<b>GUR</b>	Stricture of urethra	abdominopelvic problems: moderate	0.123	0.083	0.176
<b>GUR06</b>	<b>GUR</b>	Urinary symptoms	urinary incontinence	0.142	0.094	0.204
<b>GUR07</b>	<b>GUR</b>	Other male genital disease	impotence	0.019	0.010	0.034
<b>GUR08</b>	<b>GUR</b>	Urinary tract infections	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>GUR09</b>	<b>GUR</b>	Renal calculi	abdominopelvic problem: severe	0.326	0.219	0.451
<b>GUR10</b>	<b>GUR</b>	Prostatitis	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>GUR11</b>	<b>GUR</b>	Incontinence	urinary incontinence	0.142	0.094	0.204
<b>GUR12</b>	<b>GUR</b>	Genito-urinary disorders, other	Urinary incontinence	0.142	0.094	0.204
<b>HEM01</b>	<b>HEM</b>	Hemolytic anemia	Anaemia, severe	0.164	0.112	0.228
<b>HEM02</b>	<b>HEM</b>	Iron deficiency, other deficiency anemias	Anaemia, moderate	0.058	0.038	0.086
<b>HEM03</b>	<b>HEM</b>	Thrombophlebitis	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>HEM04</b>	<b>HEM</b>	Neonatal jaundice	Anaemia, moderate	0.058	0.038	0.086
<b>HEM05</b>	<b>HEM</b>	Aplastic anemia	Anaemia, severe	0.164	0.112	0.228
<b>HEM06</b>	<b>HEM</b>	Deep vein thrombosis	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>HEM07</b>	<b>HEM</b>	Hemophilia, coagulation disorder	Anaemia, moderate	0.058	0.038	0.088
<b>HEM08</b>	<b>HEM</b>	Hematologic disorders, other	Anaemia, moderate	0.058	0.038	0.088
<b>HEM09</b>	<b>HEM</b>	Sickle cell disease	Anaemia, severe	0.164	0.112	0.228
<b>INF01</b>	<b>INF</b>	Tuberculosis infection	tuberculosis: without HIV infection	0.331	0.222	0.450
<b>INF02</b>	<b>INF</b>	Fungal infections	infectious disease: acute episode mild	0.005	0.002	0.011
<b>INF03</b>	<b>INF</b>	Infectious mononucleosis	infectious disease: acute episode mild	0.005	0.002	0.011
<b>INF04</b>	<b>INF</b>	HIV, AIDS	HIV: symptomatic, pre-AIDS	0.221	0.146	0.310
<b>INF05</b>	<b>INF</b>	Sexually transmitted diseases	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>INF06</b>	<b>INF</b>	Viral syndromes	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>INF07</b>	<b>INF</b>	Lyme disease	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>INF08</b>	<b>INF</b>	Septicemia	infectious disease;acute episode, severe	0.210	0.139	0.298
<b>INF09</b>	<b>INF</b>	Infections, other	infectious disease: acute episode mild	0.005	0.002	0.011
<b>MAL01</b>	<b>MAL</b>	Malignant neoplasms of the skin	cancer: diagnosis and primary therapy	0.294	0.199	0.411
<b>MAL02</b>	<b>MAL</b>	Low impact malignant neoplasms	cancer: diagnosis and primary therapy	0.294	0.199	0.411
<b>MAL03</b>	<b>MAL</b>	High impact malignant neoplasms	cancer:metastatic	0.484	0.330	0.643
<b>MAL04</b>	<b>MAL</b>	Malignant neoplasms, breast	cancer:metastatic	0.484	0.330	0.643
<b>MAL05</b>	<b>MAL</b>	Malignant neoplasms, cervix, uterus	cancer: diagnosis and primary therapy	0.294	0.199	0.411
<b>MAL06</b>	<b>MAL</b>	Malignant neoplasms, ovary	cancer: diagnosis and primary therapy	0.294	0.199	0.411
<b>MAL07</b>	<b>MAL</b>	Malignant neoplasms, esophagus	cancer: diagnosis and primary therapy	0.294	0.199	0.411

MAL08	MAL	Malignant neoplasms, kidney	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL09	MAL	Malignant neoplasms, liver and biliary tract	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL10	MAL	Malignant neoplasms, lung	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL11	MAL	Malignant neoplasms, lymphomas	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL12	MAL	Malignant neoplasms, colorectal	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL13	MAL	Malignant neoplasms, pancreas	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL14	MAL	Malignant neoplasms, prostate	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL15	MAL	Malignant neoplasms, stomach	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL16	MAL	Acute leukemia	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MAL18	MAL	Malignant neoplasms, bladder	cancer: diagnosis and primary therapy	0.294	0.199	0.411
MUS01	MUS	Musculoskeletal signs and symptoms	musculoskeletal problems:generalised, severe	0.292	0.197	0.410
MUS02	MUS	Acute sprains and strains	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
MUS03	MUS	Degenerative joint disease	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
MUS04	MUS	Fractures (excluding digits)	treatment	0.087	0.055	0.127
MUS05	MUS	Torticollis	neck pain:acute severe	0.221	0.150	0.305
MUS06	MUS	Kyphoscoliosis	disfigurement: level 2	0.072	0.048	0.103
MUS07	MUS	Congenital hip dislocation	musculoskeletal problems, legs: severe	0.171	0.112	0.240
MUS08	MUS	Fractures and dislocations/digits only	fracture of hand: short term, with or without treatment	0.025	0.013	0.043
MUS09	MUS	Joint disorders, trauma related	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
MUS10	MUS	Fracture of neck of femur (hip)	fracture of neck of femur: short term, with or without treatment	0.192	0.121	0.280
MUS11	MUS	Congenital anomalies of limbs, hands, and feet	motor impairment: severe	0.377	0.251	0.518
MUS12	MUS	Acquired foot deformities	Fracture of foot bones: long term, without treatment	0.033	0.019	0.052
MUS13	MUS	Cervical pain syndromes	neck pain: chronic, severe	0.286	0.197	0.398
MUS14	MUS	Low back pain	low back pain: acute, without leg pain	0.269	0.184	0.373
MUS15	MUS	Bursitis, synovitis, tenosynovitis	dislocations other than shoulder, knee, or hip	0.009	0.004	0.018
MUS16	MUS	Amputation status	Amputation of one leg: long term, with treatment	0.021	0.011	0.035
MUS17	MUS	Musculoskeletal disorders, other	musculoskeletal problems, generalized moderate	0.292	0.197	0.410
NEW01	NEW	Newborn Status, Uncomplicated	generic uncomplicated disease:anxiety about diagnosis	0.031	0.017	0.050
NEW02	NEW	Newborn Status, Complicated	fetal alcohol syndrome: severe	0.177	0.117	0.255
NEW03	NEW	Low Birth Weight	fetal alcohol syndrome: severe	0.177	0.117	0.255
NEW04	NEW	Prematurity	fetal alcohol syndrome: severe	0.177	0.117	0.255
NEW05	NEW	Disorders of Newborn Period	fetal alcohol syndrome: severe	0.177	0.117	0.255
NUR01	NUR	Neurologic signs and symptoms	Generic uncomplicated disease: anxiety about diagnosis	0.054	0.033	0.082
NUR02	NUR	Headaches	headache: migraine	0.433	0.287	0.593
NUR03	NUR	Peripheral neuropathy, neuritis	Motor impairment: moderate	0.076	0.050	0.109
NUR04	NUR	Vertiginous syndromes	Motor impairment: moderate	0.076	0.050	0.109
NUR05	NUR	Cerebrovascular disease	stroke: long-term consequences, severe	0.539	0.363	0.705
NUR06	NUR	Parkinson's disease	Parkinson's disease, moderate	0.263	0.179	0.360

NUR07	NUR	Seizure disorder	epilepsy; untreated	0.420	0.279	0.572
NUR08	NUR	Multiple sclerosis	multiple sclerosis: moderate	0.445	0.303	0.593
NUR09	NUR	Muscular dystrophy	musculoskeletal problems:generalised, severe	0.606	0.421	0.771
NUR10	NUR	Sleep problems	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
NUR11	NUR	Dementia and delirium	Dementia: moderate	0.346	0.233	0.475
NUR12	NUR	Quadriplegia and paraplegia	Spinal cord lesion at neck, treated	0.369	0.243	0.513
NUR15	NUR	Head injury	treatment	0.625	0.444	0.789
NUR16	NUR	Spinal cord injury/disorders	Spinal cord lesion at neck, treated	0.369	0.243	0.513
NUR17	NUR	Paralytic syndromes, other	motor impairment: severe	0.377	0.251	0.518
NUR18	NUR	Cerebral palsy	Motor impairment: severe	0.377	0.251	0.518
NUR19	NUR	Developmental disorder	Intellectual disability: moderate	0.080	0.053	0.114
NUR20	NUR	Central nervous system infections	infectious disease;acute episode, severe	0.210	0.139	0.298
NUR21	NUR	Neurologic disorders, other	dementia:severe	0.438	0.299	0.584
NUR22	NUR	Migraines	headache: migraine	0.433	0.287	0.593
NUR23	NUR	Organic brain syndrome	dementia, severe	0.438	0.299	0.584
NUR24	NUR	Dementia	dementia, moderate	0.346	0.233	0.475
NUR25	NUR	Delirium	dementia, moderate	0.346	0.233	0.475
NUR26	NUR	Autism Spectrum Disorder	Autism	0.259	0.177	0.362
NUT01	NUT	Failure to thrive	fetal alcohol syndrome: severe	0.177	0.117	0.255
NUT02	NUT	Nutritional deficiencies	kwashiorkor	0.055	0.033	0.085
NUT03	NUT	Obesity	Motor impairment: moderate	0.076	0.050	0.109
NUT04	NUT	Nutritional disorders, other	severe wasting	0.127	0.081	0.183
PSY01	PSY	Anxiety, neuroses	Anxiety disorder, moderate	0.149	0.101	0.210
PSY02	PSY	Substance use	Alcohol use disorder moderate	0.388	0.262	0.529
PSY03	PSY	Tobacco use	copd and other chronic respiratory diseases: mild	0.015	0.007	0.028
PSY04	PSY	Behavior problems	Conduct disorder	0.236	0.154	0.337
PSY05	PSY	Attention deficit disorder	attention-deficit hyperactivity disorder	0.049	0.031	0.074
PSY06	PSY	Family and social problems	Conduct disorder	0.236	0.154	0.337
PSY07	PSY	Schizophrenia and affective psychosis	schizophrenia:acute state	0.756	0.571	0.894
PSY08	PSY	Personality disorders	Conduct disorder	0.236	0.154	0.337
PSY09	PSY	Depression	Major depression, moderate episode	0.406	0.276	0.551
PSY10	PSY	Psychologic signs and symptoms	Anxiety disorder, moderate	0.149	0.101	0.210
PSY11	PSY	Psychosocial disorders, other	Conduct disorder	0.236	0.154	0.337
PSY12	PSY	Bipolar disorder	bipolar disorder: residual state	0.035	0.021	0.055
PSY13	PSY	Adjustment disorder	anxiety disorder, moderate	0.149	0.101	0.210
PSY14	PSY	Psychological disorders of childhood	ADHD	0.049	0.031	0.074
PSY15	PSY	Eating disorder	Anorexia nervosa	0.223	0.150	0.310
PSY16	PSY	Impulse control	Conduct disorder	0.236	0.154	0.337

PSY17	PSY	Psych-physiologic and somatoform disorders	anxiety disorder, moderate	0.149	0.101	0.210
PSY18	PSY	Psychosexual	anxiety disorder, moderate	0.149	0.101	0.210
PSY19	PSY	Sleep disorders of nonorganic origin	anxiety disorder, mild	0.030	0.017	0.048
PSY20	PSY	Major depression	major depression, moderate	0.406	0.276	0.551
REC01	REC	Cleft lip and palate	Disfigurement: level 2	0.072	0.048	0.103
REC02	REC	Lacerations	disfigurement: level 1	0.013	0.006	0.025
REC03	REC	Chronic ulcer of the skin	Disfigurement: level 2, with itch or pain	0.187	0.125	0.264
REC04	REC	Burns--2nd and 3rd degree	or neck, or hands or wrist involved, long term, with treatment	0.127	0.086	0.183
REN01	REN	Chronic renal failure	chronic kidney disease (stage IV)	0.105	0.069	0.154
REN02	REN	Fluid/electrolyte disturbances	chronic kidney disease (stage IV)	0.105	0.069	0.154
REN03	REN	Acute renal failure	end stage renal disease: on dialysis	0.573	0.397	0.749
REN04	REN	Nephritis, nephrosis	chronic kidney disease (stage IV)	0.105	0.069	0.154
REN05	REN	Renal disorders, other	Chronic kidney disease (stage IV)	0.105	0.069	0.154
REN06	REN	ESRD	ESRD on dialysis	0.573	0.397	0.749
RES01	RES	Respiratory signs and symptoms	infectious disease: acute episode, mild	0.005	0.002	0.011
RES02	RES	Acute lower respiratory tract infection	infectious disease;acute episode, severe	0.210	0.139	0.298
RES03	RES	Cystic fibrosis	copd and other chronic respiratory diseases: severe	0.383	0.259	0.528
RES04	RES	Emphysema, chronic bronchitis, COPD	copd and other chronic respiratory diseases: severe	0.383	0.259	0.528
RES05	RES	Cough	infectious disease: acute episode, mild	0.005	0.002	0.011
RES06	RES	Sleep apnea	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
RES07	RES	Sinusitis	infectious disease: acute episode, moderate	0.053	0.033	0.081
RES08	RES	Pulmonary embolism	copd and other chronic respiratory diseases: severe	0.383	0.259	0.528
RES09	RES	Tracheostomy	COPD and other chronic respiratory diseases: severe	0.383	0.259	0.528
RES10	RES	Respiratory failure	copd and other chronic respiratory diseases: severe	0.383	0.259	0.528
RES11	RES	Respiratory disorders, other	copd and other chronic respiratory diseases: moderate	0.192	0.129	0.271
RES12	RES	Acute respiratory failure	COPD severe	0.383	0.259	0.528
RES13	RES	Chronic respiratory failure	COPD moderate	0.192	0.129	0.271
RES14	RES	Aspiration and bacterial pneumonias	Infectious disease, acute episode severe	0.210	0.139	0.298
RES98	RES	Asthma, w/o status asthmaticus**	asthma:controlled	0.031	0.017	0.050
RES99	RES	Asthma, with status asthmaticus**	asthma:uncontrolled	0.132	0.087	0.190
RHU01	RHU	Autoimmune and connective tissue diseases	musculoskeletal problems: generalised, severe	0.606	0.421	0.771
RHU02	RHU	Gout	gout:acute	0.293	0.198	0.404
RHU03	RHU	Arthropathy	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
RHU04	RHU	Raynaud's syndrome	musculoskeletal problems: generalised, moderate	0.292	0.197	0.410
RHU05	RHU	Rheumatoid arthritis	musculoskeletal problems:generalised, severe	0.606	0.421	0.771
SKN01	SKN	Contusions and abrasions	dislocations other than shoulder, knee, or hip	0.009	0.004	0.018
SKN02	SKN	Dermatitis and eczema	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
SKN03	SKN	Keloid	Disfigurement: level 1	0.013	0.006	0.025

<b>SKN04</b>	<b>SKN</b>	Acne	disfigurement: level 1	0.013	0.006	0.025
<b>SKN05</b>	<b>SKN</b>	Disorders of sebaceous glands	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN06</b>	<b>SKN</b>	Sebaceous cyst	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN07</b>	<b>SKN</b>	Viral warts and molluscum contagiosum	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN08</b>	<b>SKN</b>	Other inflammatory conditions of skin	herpes zoster	0.061	0.039	0.094
<b>SKN09</b>	<b>SKN</b>	Exanthems	herpes zoster	0.061	0.039	0.094
<b>SKN10</b>	<b>SKN</b>	Skin keratoses	Disfigurement: level 1, with itch or pain	0.029	0.016	0.048
<b>SKN11</b>	<b>SKN</b>	Dermatophytoses	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>SKN12</b>	<b>SKN</b>	Psoriasis	difigurement: level 2 with itch or pain	0.187	0.125	0.264
<b>SKN13</b>	<b>SKN</b>	Disease of hair and hair follicles	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN14</b>	<b>SKN</b>	Pigmented nevus	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN15</b>	<b>SKN</b>	Scabies and pediculosis	infectious disease: acute episode, moderate	0.053	0.033	0.081
<b>SKN16</b>	<b>SKN</b>	Diseases of nail	disfigurement: level 1	0.013	0.006	0.025
<b>SKN17</b>	<b>SKN</b>	Other skin disorders	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN18</b>	<b>SKN</b>	Benign neoplasm of skin and subcutaneous tissues	Disfigurement: level 1	0.013	0.006	0.025
<b>SKN19</b>	<b>SKN</b>	Impetigo	infectious disease: acute episode mild	0.005	0.002	0.011
<b>SKN20</b>	<b>SKN</b>	Dermatologic signs and symptoms	Disfigurement: level 1, with itch or pain	0.029	0.016	0.048
<b>TOX01</b>	<b>TOX</b>	Toxic effects of nonmedicinal agents	Poisoning: short term, with or without treatment	0.171	0.116	0.239
<b>TOX02</b>	<b>TOX</b>	Adverse effects of medicinal agents	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
<b>TOX03</b>	<b>TOX</b>	Adverse events from medical/surgical procedures	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050
<b>TOX04</b>	<b>TOX</b>	Complications of mechanical devices	generic uncomplicated disease:worry and daily medication	0.031	0.017	0.050

\*From:Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. The Lancet 2012;380:2129-43.

To create the cross-walk, two physicians independently matched a GBD description to each EDC. In the case of a mismatch, the two physicians discussed their preferences and agreed on a GBD category

\*\* 'Asthma, w/o status asthmaticus' originally ALL 04 and 'Asthma, with status asthmaticus' originally ALL05 have been reclassified as RES98 a and RES99 for consistency with local diagnosti custom.

We kept the same descriptions, but changed the numbers to RES98 & RES99.