SUPPLEMENTARY FILE

Data sources

Data Sources: National

Country	Source	Country	Source
Argentina	1	Kuwait	21
Australia	2	Latvia	3
Austria	3	Malaysia	22
Belgium	3	Malta	3
Botswana	4	Mexico	23
Brazil	5	Mongolia	24
Chile	6	Mozambique	25
China	7	Nepal	26
Colombia	8	New Zealand	3
Costa Rica	9	Nicaragua	27
Croatia	3	Norway	3
Cuba	10	Panama	28
Cyprus	3	Papua New Guinea*	29, 30, 31
Czechia	3	Paraguay	32
Ecuador*	11, 12, 13	Peru	33
Egypt	14	Philippines*	34, 35, 36
El Salvador	15	Singapore	37
England	3	South Africa	38
Estonia	3	South Korea	3
France	3	Sri Lanka*	39, 40
Guatemala*	16, 17, 18	Thailand*	41, 42
Iran	19	Trinidad and Tobago	43
Iraq	20	Tunisia	44
Ireland	3	United States	45
Japan	3	Uruguay	46

* Also subnational data.

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Data Sources: Subnational

Country	Subnational area	Source
Angola	Dande HDSS	1, 2
Burkina Faso	Nouna HDSS	3
Kenya	Kilifi HDSS	4, 5, 6
Kenya	Kombewa HDSS	7, 8
Tanzania	Korogwe HDSS	9-10
Ethiopia	Kersa HDSS	11
Ethiopia	Kilite-Awlaelo HDSS	12-13
Zambia	SAVVY in four provinces	14-16
Bangladesh	Matlab HDSS	17, 18

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Global Burden of Disease (GBD) region classification

The GBD region classification[1] was changed for two countries in this study: 1) Mongolia from Central Asia to East Asia, because of its proximity to China (the other East Asian country in the database) and because no other Central Asian countries are in this database, and 2) Sri Lanka from Southeast Asia to South Asia, because of its geographic location within South Asia. All European regions were combined because the primary focus is on LMICs, while sub-Saharan African regions were also combined because data were not available for Western Sub-Saharan Africa.

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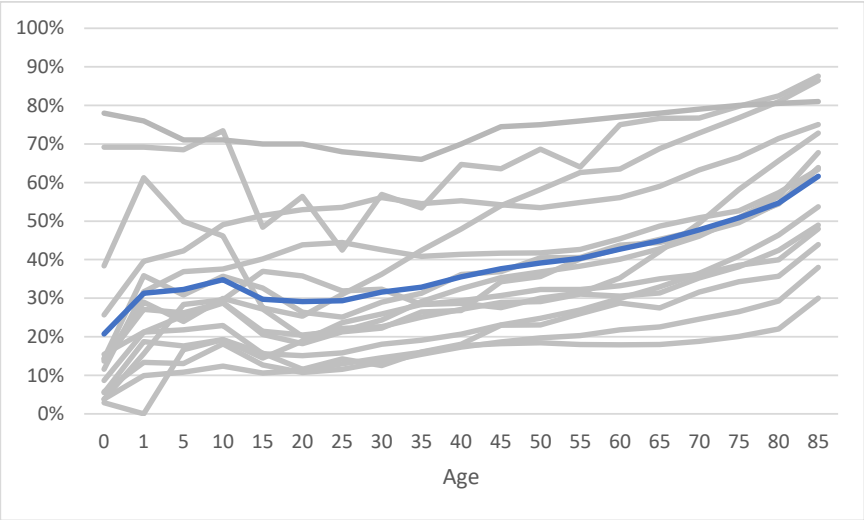
Further description of models

National model

Comparisons of the percentage of home deaths between countries must account for the significant age and cause dependency of this measure otherwise results may be incorrectly interpreted. For the 15 countries in the database where data on place of death by age at death are available, the percentage of deaths occurring at home typically exhibits a strong relationship with age (Figure A.1). Deaths under the age of 1 year are the most likely to occur in a hospital (80%, on average), with about two in three deaths at ages 1-25 years also occurring in hospitals. Beyond age 25 years, the percentage of home deaths increases steadily with increasing age, rising to about two in three deaths at the oldest ages, but with wide variation across countries. In particular, for some countries where death at home is relatively common, there is little gradient in the measure by age.

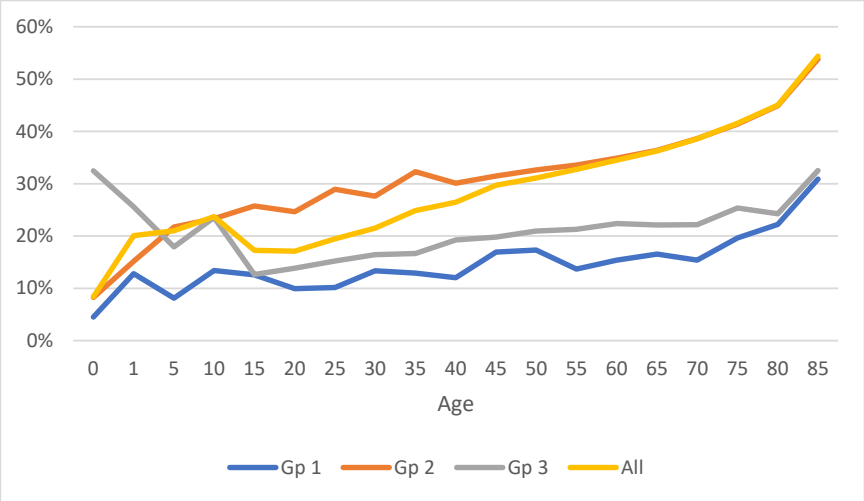
Figure A.1: Age-specific home death percentage, 15 countries (grey) and average (blue)



Note: The average all-age percentage of deaths occurring at home in these countries is 46%. Countries listed in Table 1.

Data on the percentage of home deaths by both age and cause of death were relatively scarce, only available for four countries (all in Latin America). In those countries the home death percentage for Group 2 deaths (non-communicable diseases) increases consistently with age, and beyond age 10 is consistently lower for Group 1 deaths (infectious, nutritional, neonatal and maternal causes). The vast majority of deaths from Group 3 causes (external) occur in hospital, although among infants and young children, one-fifth to one-third die at home (Figure 2). The age pattern of the home death percentage for all deaths, similar to that in Figure 1, is affected by the age-specific proportion of deaths due to each cause group.

Figure A.2: Age- and cause-specific home death percentage, average of four countries



Note: Countries are Colombia, Mexico, Chile and Uruguay. The average all-age percentage of deaths occurring at home in these countries is 40%.

The modelling strategy to estimate the home death percentage therefore needed to standardise this metric by age and cause. This was firstly done by developing a set of regressions to predict a country's age-specific home death percentage that matches its all-age home death percentage and age distribution of deaths. Using the age-specific home death percentage data for the 15 countries shown in Figure A.1, for each age group *x* a regression was conducted as follows:

$$logit(h_x) - logit(h_0) = \beta_0 + \beta_1 Y + \beta_2 Z + \beta_3 I + e$$

where *h* is home death percentage, *x* is age group (1-4 years, 5-9 years … 85+ years), *0* is age group 0 years, *Y* is the percentage of births occurring at home, *Z* is health expenditure (average of last 10 years), *I* is indirectly age-standardised home death percentage (the age distribution of deaths in the population according to the Global Burden of Disease (GBD) Study, multiplied by the average age-specific home death percentage of the 15 countries – this is included to represent the level of home death percentage in a country where the age-specific home death percentage data is not available, i.e. countries outside the 15 included to develop this model), and *e* is an error term.

The model was then used to predict the age-specific home death percentage in all countries in the database by solving h_0 so that the predicted age-specific home death percentages multiplied by the country's GBD age distribution of deaths equals their reported all-age home death percentage:

$$\sum_{x=0}^{85} \dot{h}_x D_x = h_{all}$$

where $\dot{h_x}$ is predicted home death percentage in age group *x*, D_x is the percentage of a country's deaths occurring in age group *x*, and h_{all} is observed home death percentage at all ages.

The age-specific home death percentage in each country in the database was then converted to an age-cause-specific home death percentage by using the age-cause-specific home death data in the four countries with these data. For each age group *x*, logit cause ratios were calculated of

$logit(h_{xc}) - logit(h_{x1})$, where *c* is cause and 1 is cause group 1 of 3 (as above). In each age group for each country in the database, we solved $logit(h_{x1})$ so that the product of the age-cause-specific home death percentage and the percentage of deaths in the age group due to each cause (again from the GBD) equals the age-specific home death percentage:

$$\sum_{c=1}^{3} \sum_{x=0}^{85} \dot{h}_{xc} D_{xc} = \dot{h}_x$$

where $\dot{h}_{xc}$ is the predicted age-cause-specific home death percentage and D_{xc} is the percentage of deaths in the age group due to each cause.

The age-cause-standardised home death percentage for each country in the database could then be calculated using the GBD's age distribution of global deaths as the standard. [1]

After conducting the BMA model described in the main text, the predicted age-cause-standardised home death percentage in each country was converted to a predicted age-specific home death percentage using the same models as those described earlier based on the 15 countries' data, but using the age-cause-standardised home death percentage predicted by the BMA model rather than indirectly age-standardised home death percentage as the predictor, and applying the same procedure to solve for h_0. Next, the logit cause ratios from a previous step were used to convert the age-specific home death percentage to a predicted age-cause-specific home death percentage, and finally to convert to a predicted all-age home death percentage calculated using the GBD's age-cause distribution of deaths in that country. [1]

Subnational model

The subnational model is age-standardised to the GBD age distribution of global deaths below and above age five years, because the percentage of deaths by age are only commonly available for these broad age groups at the subnational level. Cause was unable to be standardised for because no reliable cause of death data are available at the subnational level for most countries. Again, the age-specific home death percentage data for the 15 countries, a regression was conducted as follows:

$$logit(h_5) - logit(h_0) = \beta_0 + \beta_1 Y + \beta_2 Z + \beta_3 J + e$$

Where h_5 is home death percentage at ages five years and above, $h_{0\text{-}4}$ is home death percentage at ages less than five years, *J* is home death percentage indirectly standardised based on ages 0-4 and 5+ years, and *e* is an error term. Again, h_0 is solved so that:

$$\sum_{x=0-4}^{5} \dot{h}_x D_x = h_{all}$$

The age-standardised home death percentage for each country in the database could then be calculated using the GBD's 2019 age distribution of global deaths as the standard. [1]

Once the subnational model had been conducted, the predicted age-standardised home death percentage in each subnational area was converted to a predicted age-specific home death percentage (at ages 0-4 and 5+ years) using similar models to those described above based on the 15 countries' data, but using the age-standardised home death percentage predicted by the subnational model rather than indirectly age-standardised home death percentage as the predictor, and using the same procedure to solve for h_0. The all-age home death percentage could then be calculated in the subnational areas using its percentage of deaths at ages 0-4 and 5+ years, which

can be estimated using the empirical completeness method and an estimate of the under-five mortality rate.[2]

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Covariates used in the models

The covariates used in the models reflect health system, socio-economic and geographic characteristics. In general, it is expected that a stronger health system, higher level of socio-economic development and more urbanised society would mean greater provision of and access to hospitals, and so a lower percentage of deaths occurring at home. The covariates used are:

Health system

- the log of health expenditure per capita from the World Health Organization Global Health Expenditure Database (constant 2017 purchasing power parity per capita), measured for the same year as the place of death data as well as the average over the previous five years and previous 10 years (to reflect long-term rather than short-term spending). It is expected that this covariate would be negatively related with home death percentage, because higher health expenditure should be related with greater access to and provision of hospitals. Preliminary analysis revealed that log of average health expenditure per capita over the previous 10 years has the strongest negative correlation with age-cause-standardised home death percentage. The United States is an outlier, however, because it has an unusually high home death percentage (31% in 2017) despite clearly having the highest health expenditure per capita; hence it was not included in this database.[1]
- the GBD's Universal Health Care (UHC) effective coverage index.[2] The 23 indicators of the UHC index represent health service types of promotion, prevention, treatment, rehabilitation and palliation, and across five population age groups.[2] The indicators include both direct measures of the coverage of health system interventions as well as measures of outcomes. The index weighted the indicators based on their potential health gains according to disability-adjusted life-years.[2] It is also hypothesised that the higher the UHC index of a country, the better the access of the population to hospitals and so the lower the expected home death percentage.
- the percentage of births that occur at home reported by UNICEF, Multiple Indicator Cluster Survey and Demographic and Health Survey data.[3-5] The most recent reported figure was used, as well as the average of the last two reported figures, since in some countries this indicator has reduced substantially in recent years and so a longer-term measurement may more appropriately reflect health system accessibility. This covariate is expected to be positively correlated with home death percentage.

Socio-economic

- the GBD's Socio-Demographic Index (SDI), which is the geometric mean of the fertility rate at ages below 25 years, mean education for ages 15 years and above, and lag distributed income per capita.[6] A higher level of SDI would be expected to be negatively related with home death percentage, which typically is more common among poorer groups in a population.
- the UN's Human Development Index (HDI) education index (as a measure of mean years of schooling) and income index, and the geometric mean of these two indexes.[7] The other component of the HDI, life expectancy at birth, was not used because it a measure of mortality, which is related to the outcome variable. Again, it is hypothesised that these covariates are negatively related with home death percentage.

Geographic

- the percentage of the population living in urban areas as measured by the UN Population Division.[8] Increased urbanisation is expected to be negatively related with home death percentage because home deaths are typically more common in rural areas.
- the region in which the country is located (see Table 1).

BMA involves specification of two types of covariates: those which clearly should be in the model due to no other alternative, and "auxiliary" covariates for which there are multiple possible covariates that could be included.[9] In the modelling, region and urbanisation were used as covariates in every model (for which there are no alternative measures), while the socio-economic and health system variables were treated as auxiliary variables because for each variable the data has an alternative variable which is similar (e.g. SDI and the geometric mean of the HDI income and education indexes).

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Additional tables

Table S1: Estimated and observed all-age home death percentage, low- and middle-income countries, all country-years

Country	Year	Observed	Estimated	Difference	Region
Ecuador	2013	47.5	46.5	-1.0	Andean LA
Ecuador	2014	47.7	45.8	-1.9	Andean LA
Ecuador	2015	47.3	44.5	-2.8	Andean LA
Ecuador	2016	48.7	44.2	-4.5	Andean LA
Ecuador	2017	46.9	43.8	-3.1	Andean LA
Peru	2018	38.9	44.7	+5.8	Andean LA
Peru	2019	36.2	44.2	+8.0	Andean LA
Brazil	2014	19.5	19.0	-0.5	Tropical LA
Brazil	2015	19.7	18.9	-0.8	Tropical LA
Brazil	2016	19.6	18.8	-0.8	Tropical LA
Brazil	2017	19.6	18.7	-0.9	Tropical LA
Brazil	2018	19.5	18.5	-1.0	Tropical LA
Paraguay	2014	31.4	32.8	+1.4	Tropical LA
Paraguay	2015	30.1	31.9	+1.8	Tropical LA
Paraguay	2016	30.5	31.2	+0.7	Tropical LA
Paraguay	2017	29.3	30.4	+1.1	Tropical LA
Paraguay	2018	29.2	29.8	+0.6	Tropical LA
Argentina	2017	22.6	40.2	+17.6	Southern LA
Colombia	2014	25.5	36.0	+10.5	Central LA
Colombia	2015	25.3	35.5	+10.2	Central LA
Colombia	2016	25.0	35.1	+10.1	Central LA
Colombia	2017	26.0	34.8	+8.8	Central LA
Colombia	2018	25.0	34.7	+9.7	Central LA
Costa Rica	2015	35.6	33.3	-2.3	Central LA
Costa Rica	2016	36.2	32.9	-3.3	Central LA
Costa Rica	2017	36.2	32.5	-3.7	Central LA
Costa Rica	2018	37.1	32.4	-4.7	Central LA
El Salvador	2016	48.2	46.3	-1.9	Central LA
Guatemala	2013	64.1	62.2	-1.9	Central LA
Guatemala	2014	63.9	60.9	-3.0	Central LA
Guatemala	2015	63.9	60.2	-3.7	Central LA
Guatemala	2016	64.9	59.5	-5.4	Central LA
Guatemala	2017	65.1	58.9	-6.2	Central LA
Mexico	2013	44.9	34.2	-10.7	Central LA
Mexico	2014	45.1	34.1	-11.0	Central LA
Mexico	2015	45.4	33.8	-11.6	Central LA
Mexico	2016	45.5	33.4	-12.1	Central LA
Mexico	2017	45.8	33.2	-12.6	Central LA
Nicaragua	2015	50.1	55.6	+5.5	Central LA
Nicaragua	2016	50.6	54.3	+3.7	Central LA
Nicaragua	2017	50.1	53.7	+3.6	Central LA

Cuba	2014	40.9	33.9	-7.0	Caribbean
Cuba	2015	41.2	33.1	-8.1	Caribbean
Cuba	2016	40.2	32.7	-7.5	Caribbean
Cuba	2017	39.9	32.2	-7.7	Caribbean
Cuba	2018	39.9	33.4	-6.5	Caribbean
Trinidad and Tobago	2014	29.4	35.1	+5.7	Caribbean
Trinidad and Tobago	2015	28.4	34.5	+6.1	Caribbean
Trinidad and Tobago	2016	29.6	34.3	+4.7	Caribbean
Trinidad and Tobago	2017	29.7	33.9	+4.2	Caribbean
Trinidad and Tobago	2018	29.8	33.6	+3.8	Caribbean
Egypt	2015	72.6	62.1	-10.5	MENA
Egypt	2016	71.0	61.4	-9.6	MENA
Egypt	2017	69.9	60.4	-9.5	MENA
Egypt	2018	67.6	59.6	-8.0	MENA
Egypt	2019	65.8	58.7	-7.1	MENA
Iran	2013	40.8	40.7	-0.1	MENA
Iran	2014	37.4	40.7	+3.3	MENA
Iran	2015	38.9	41.0	+2.1	MENA
Iran	2016	38.4	40.5	+2.1	MENA
Iran	2017	36.6	40.2	+3.6	MENA
Iraq	2019	48.2	51.9	+3.7	MENA
Tunisia	2007	58.9	55.8	-3.1	MENA
Tunisia	2008	58.6	55.1	-3.5	MENA
Tunisia	2009	55.9	54.4	-1.5	MENA
Tunisia	2010	56.3	53.7	-2.6	MENA
Tunisia	2011	57.1	53.0	-4.1	MENA
Nepal	2015	72.0	74.0	+2.0	South Asia
Sri Lanka	2010	46.7	45.4	-1.3	South Asia
Sri Lanka	2011	45.6	45.1	-0.5	South Asia
Sri Lanka	2012	45.2	44.7	-0.5	South Asia
Sri Lanka	2013	45.3	44.1	-1.2	South Asia
Sri Lanka	2014	43.9	43.7	-0.2	South Asia
China	2014	72.1	73.2	+1.1	East Asia
China	2015	72.6	71.9	-0.7	East Asia
China	2016	73.0	70.7	-2.3	East Asia
China	2017	73.9	69.5	-4.4	East Asia
China	2018	73.4	68.4	-5.0	East Asia
Mongolia	2019	60.9	61.0	+0.1	East Asia
Malaysia	2013	48.0	34.8	-13.2	Southeast Asia
Philippines	2014	61.1	67.0	+5.9	Southeast Asia
Philippines	2015	59.1	64.8	+5.7	Southeast Asia
Philippines	2016	56.8	62.6	+5.8	Southeast Asia
Philippines	2017	55.2	59.9	+4.7	Southeast Asia
Philippines	2018	53.2	58.3	+5.1	Southeast Asia
Thailand	2013	50.4	49.9	-0.5	Southeast Asia
Thailand	2014	49.6	49.1	-0.5	Southeast Asia

Thailand	2015	49.5	48.5	-1.0	Southeast Asia
Thailand	2016	49.4	47.7	-1.7	Southeast Asia
Thailand	2017	49.5	47.1	-2.4	Southeast Asia
Mozambique	2007	75.0	78.7	+3.7	SSA
Botswana	2018	47.9	24.6	-23.3	SSA
South Africa	2012	32.8	27.8	-5.0	SSA
South Africa	2013	30.1	27.5	-2.6	SSA
South Africa	2014	30.1	27.2	-2.9	SSA
South Africa	2015	28.5	26.9	-1.6	SSA
South Africa	2016	28.8	26.8	-2.0	SSA
Papua New Guinea	2010	74.9	76.1	+1.2	Oceania

SSA: Sub-Saharan Africa. RMSE: 6.2 percentage points. MAE: 4.6 percentage points.

Table S2: Estimated and observed home death percentage by broad income group and country, 2019

Country	Home death percentage (95% UI)	Estimated deaths*	Income group	Region
Low- and middle-income countries				
China	73.4 (73.4 – 73.4)**	10,653,448	Upper-middle	East Asia
India	53.2 (39.1 – 67.0)	9,391,549	Lower-middle	South Asia
Russian Federation	30.9 (20.3 – 44.3)	1,788,286	Upper-middle	Europe
Indonesia	59.2 (45.6 – 71.8)	1,705,895	Upper-middle	Southeast Asia
Nigeria	75.0 (64.3 – 83.8)	1,593,180	Lower-middle	SSA
Pakistan	61.2 (48.3 – 73.1)	1,499,878	Lower-middle	South Asia
Brazil	19.5 (19.4 – 19.6)**	1,411,016	Upper-middle	Tropical LA
Bangladesh	73.0 (59.3 – 83.4)	849,561	Lower-middle	South Asia
Mexico	45.8 (45.7 – 45.9)**	738,425	Upper-middle	Central LA
Ukraine	52.2 (37.3 – 67.1)	698,663	Lower-middle	Europe
Philippines	53.2 (53.1 – 53.3)**	638,801	Lower-middle	Southeast Asia
Vietnam	59.8 (45.4 – 72.9)	631,818	Lower-middle	Southeast Asia
Democratic Republic of the Congo	75.4 (63.5 – 84.7)	564,091	Low	SSA
Egypt**	65.8 (65.7 – 65.9)**	561,556	Lower-middle	MENA
Ethiopia	91.2 (85.2 – 95.0)	559,997	Low	SSA
South Africa	28.0 (27.9 – 28.1)**	521,802	Upper-middle	SSA
Thailand*	49.5 (49.4 – 49.6)**	497,502	Upper-middle	Southeast Asia
Turkey	42.6 (29.5 – 57.1)	454,742	Upper-middle	MENA
Myanmar	82.3 (72.5 – 89.2)	420,932	Lower-middle	Southeast Asia
Iran	36.6 (36.4 – 36.8)**	391,113	Upper-middle	MENA
Tanzania	74.5 (63.4 – 83.4)	354,351	Lower-middle	SSA
Argentina	22.6 (22.5 – 22.7)**	348,823	Upper-middle	Southern LA
Kenya	71.1 (59.3 – 80.9)	293,888	Lower-middle	SSA
Mozambique	82.0 (72.6 – 88.9)**	264,784	Low	SSA
Afghanistan	85.2 (77.2 – 90.9)	251,418	Low	MENA
Colombia	25.0 (24.8 – 25.2)	246,679	Upper-middle	Central LA
Uganda	66.3 (54.5 – 76.8)	242,798	Low	SSA
Morocco	64.1 (50.5 – 75.9)	228,124	Lower-middle	MENA
Ghana	59.5 (46.7 – 71.4)	208,182	Lower-middle	SSA
Cameroon	63.0 (50.8 – 74.2)	207,271	Lower-middle	SSA
Uzbekistan	44.9 (32.0 – 58.9)	203,599	Lower-middle	Europe
Niger	86.4 (78.2 – 92.0)	202,621	Low	SSA
Sudan	87.2 (79.7 – 92.3)	202,165	Low	MENA
Burkina Faso	65.6 (53.6 – 76.3)	201,814	Low	SSA
Mali	75.0 (64.1 – 83.9)	201,433	Low	SSA
Algeria	44.9 (32.1 – 58.3)	201,111	Lower-middle	MENA
Nepal	72.0 (71.8 – 72.2)**	193,331	Lower-middle	South Asia
Venezuela	49.4 (35.8 – 63.3)	186,929	Upper-middle	Central LA
Angola	67.3 (55.6 – 77.7)	184,934	Lower-middle	SSA

Cote d'Ivoire	61.4 (49.3 – 72.8)	182,433	Lower-middle	SSA
Iraq	48.2 (48.0 – 48.4)**	179,615	Upper-middle	MENA
Malaysia	48.0 (47.8 – 48.2)**	175,876	Upper-middle	Southeast Asia
Yemen	86.5 (79.0 – 91.7)	174,542	Low	MENA
Madagascar	84.1 (75.4 – 90.3)	164,161	Low	SSA
Chad	92.3 (87.2 – 95.6)	156,649	Low	SSA
Peru	36.2 (36.0 – 36.4)**	152,433	Upper-middle	Andean LA
Kazakhstan	38.5 (26.3 – 52.4)	139,467	Upper-middle	Europe
Sri Lanka	43.9 (43.6 – 44.2)**	135,633	Lower-middle	South Asia
Zimbabwe	60.9 (48.5 – 72.5)	126,523	Lower-middle	SSA
Bulgaria	34.5 (22.7 – 49.0)	124,226	Upper-middle	Europe
Zambia	67.0 (55.0 – 77.5)	123,355	Lower-middle	SSA
Belarus	33.7 (22.1 – 48.1)	121,777	Upper-middle	Europe
Serbia	40.4 (27.2 – 55.7)	117,629	Upper-middle	Europe
Malawi	66.8 (54.7 – 77.4)	116,671	Low	SSA
Guinea	82.3 (72.8 – 89.2)	114,265	Low	SSA
Cambodia	72.1 (60.0 – 81.7)	110,851	Lower-middle	Southeast Asia
Cuba	39.9 (39.6 – 40.2)**	105,984	Upper-middle	Caribbean
Haiti	82.2 (72.1 – 89.4)	99,708	Low	Caribbean
Guatemala	65.1 (64.8 – 65.4)	94,821	Upper-middle	Central LA
Benin	60.7 (48.4 – 72.3)	93,065	Lower-middle	SSA
Ecuador	46.9 (46.6 – 47.2)	92,531	Upper-middle	Andean LA
Senegal	64.8 (52.4 – 75.8)	89,909	Lower-middle	SSA
Syria	78.3 (66.8 – 86.7)	84,425	Low	MENA
Burundi	75.6 (64.6 – 84.3)	83,466	Low	SSA
Bolivia	51.1 (37.5 – 64.6)	75,910	Lower-middle	Andean LA
Azerbaijan	41.5 (29.1 – 55.3)	75,129	Upper-middle	Europe
South Sudan	90.7 (84.7 – 94.6)	72,739	Low	SSA
Dominican Republic	34.8 (23.4 – 48.3)	70,545	Upper-middle	Caribbean
Sierra Leone	60.9 (48.8 – 72.1)	70,114	Low	SSA
Papua New Guinea	74.9 (74.6 – 75.2)**	69,785	Lower-middle	Oceania
Rwanda	65.8 (53.3 – 76.6)	68,571	Low	SSA
Central African Republic	86.1 (77.7 – 91.9)	67,755	Low	SSA
Tunisia	57.1 (56.7 – 57.5)**	67,618	Lower-middle	MENA
Togo	69.1 (57.0 – 79.4)	53,555	Low	SSA
Honduras	58.9 (45.6 – 71.0)	52,569	Lower-middle	Central LA
Georgia	45.0 (31.0 – 60.4)	49,418	Upper-middle	Europe
Tajikistan	64.9 (51.6 – 76.3)	48,703	Low	Europe
Laos	76.0 (64.9 – 84.6)	44,457	Lower-middle	Southeast Asia
Eritrea	86.6 (78.6 – 92.1)	43,395	Low	SSA
Moldova	56.3 (41.1 – 70.8)	40,998	Lower-middle	Europe
El Salvador	48.2 (47.7 – 48.7)	40,199	Lower-middle	Central LA
Bosnia and Herzegovina	46.0 (31.8 – 61.5)	37,424	Upper-middle	Europe
Congo	48.7 (36.0 – 61.9)	35,713	Lower-middle	SSA
Kyrgyzstan	61.9 (47.5 – 74.7)	34,676	Lower-middle	Europe
Paraguay	29.2 (28.7 – 29.7)**	34,171	Upper-middle	Tropical LA

Lebanon	41.2 (28.2 – 55.8)	33,858	Upper-middle	MENA
Turkmenistan	37.7 (26.3 – 50.6)	33,620	Upper-middle	Europe
Lesotho	60.3 (47.7 – 72.2)	32,514	Lower-middle	SSA
Jordan	38.2 (26.6 – 51.3)	32,265	Upper-middle	MENA
Libya	44.2 (31.6 – 57.8)	31,660	Upper-middle	MENA
Liberia	77.0 (66.1 – 85.5)	29,750	Low	SSA
Nicaragua	50.1 (49.5 – 50.7)**	29,196	Lower-middle	Central LA
Armenia	43.0 (29.4 – 58.1)	27,978	Upper-middle	Europe
Mongolia	60.9 (60.3 – 61.5)**	24,859	Lower-middle	East Asia
Costa Rica	37.1 (36.5 – 37.7)**	24,416	Upper-middle	Central LA
North Macedonia	43.7 (30.0 – 59.0)	24,047	Upper-middle	Europe
Albania	48.3 (33.5 – 63.9)	22,671	Upper-middle	Europe
Botswana	47.9 (47.2 – 48.6)**	21,172	Upper-middle	SSA
Mauritania	66.1 (53.3 – 77.1)	20,981	Lower-middle	SSA
Jamaica	51.7 (36.9 – 66.4)	19,658	Upper-middle	Caribbean
Namibia	36.6 (25.5 – 49.3)	18,907	Upper-middle	SSA
Guinea-Bissau	79.3 (69.4 – 87.0)	14,816	Low	SSA
The Gambia	76.9 (65.2 – 85.8)	13,505	Low	SSA
Gabon	31.0 (20.6 – 43.6)	11,767	Upper-middle	SSA
Swaziland	44.0 (32.1 – 57.1)	11,566	Lower-middle	SSA
Timor-Leste	79.6 (69.0 – 87.3)	7,756	Lower-middle	Southeast Asia
Equatorial Guinea	37.1 (26.7 – 48.8)	7,618	Upper-middle	SSA
Djibouti	54.0 (41.0 – 66.9)	7,575	Lower-middle	SSA
Fiji	30.1 (16.9 – 47.9)	7,419	Upper-middle	Oceania
Montenegro	35.3 (23.4 – 49.8)	6,794	Upper-middle	Europe
Guyana	60.0 (46.1 – 72.9)	6,684	Upper-middle	Caribbean
Solomon Islands	59.2 (42.5 – 74.9)	6,221	Lower-middle	Oceania
Comoros	71.7 (59.5 – 81.5)	5,007	Lower-middle	SSA
Suriname	42.1 (29.4 – 56.0)	4,371	Upper-middle	Caribbean
Bhutan	54.8 (40.3 – 68.5)	4,252	Lower-middle	South Asia
Cape Verde	55.2 (40.6 – 68.8)	3,501	Lower-middle	SSA
Vanuatu	54.4 (37.0 – 71.2)	2,236	Lower-middle	Oceania
Belize	51.2 (37.9 – 64.5)	1,990	Upper-middle	Caribbean
Maldives	28.7 (18.2 – 42.0)	1,502	Upper-middle	South Asia
Saint Lucia	58.4 (43.0 – 72.5)	1,406	Upper-middle	Caribbean
Samoa	48.2 (30.5 – 66.7)	1,367	Upper-middle	Oceania
Kiribati	48.0 (32.1 – 64.7)	1,151	Lower-middle	Oceania
Sao Tome and Principe	49.6 (36.0 – 63.3)	1,011	Lower-middle	SSA
Federated States of Micronesia	31.6 (18.3 – 48.8)	939	Lower-middle	Oceania
Tonga	42.5 (25.2 – 62.1)	658	Upper-middle	Oceania
Marshall Islands	25.1 (14.0 – 40.6)	422	Upper-middle	Oceania
High-income countries				
United States	30.8 (30.7 – 30.9)**	2,946,456	High	North America
Japan	23.8 (14.5 – 37.0)	1,400,013	High	HIAP
Germany	20.4 (12.6 – 31.7)	959,889	High	Europe

Italy	29.0 (18.5 – 42.9)	642,342	High	Europe
United Kingdom	22.9 (14.3 – 34.9)	621,815	High	Europe
France	23.7 (14.9 – 36.1)	603,278	High	Europe
Spain	27.1 (17.2 – 40.5)	428,577	High	Europe
Poland	33.1 (21.8 – 47.2)	406,277	High	Europe
South Korea	25.8 (16.1 – 39.0)	318,631	High	HIAP
Canada	20.8 (12.9 – 32.0)	288,193	High	North America
Romania	41.9 (28.5 – 57.1)	262,811	High	Europe
Australia	14.8 (14.6 – 15.0)**	170,852	High	HIAP
Netherlands	18.1 (11.1 – 28.5)	157,008	High	Europe
Hungary	31.0 (20.2 – 44.8)	128,868	High	Europe
Greece	30.5 (19.6 – 44.6)	128,669	High	Europe
Portugal	33.3 (21.7 – 47.9)	116,387	High	Europe
Belgium	18.6 (11.3 – 29.2)	114,074	High	Europe
Czechia	26.7 (17.0 – 39.6)	113,803	High	Europe
Chile	49.0 (48.7 – 49.3)**	113,086	High	Southern LA
Sweden	19.5 (12.0 – 30.5)	93,801	High	Europe
Austria	33.0 (32.7 – 33.3)**	82,490	High	Europe
Switzerland	19.6 (11.9 – 30.8)	69,817	High	Europe
Finland	21.2 (13.2 – 32.7)	56,113	High	Europe
Denmark	18.4 (11.3 – 28.8)	55,374	High	Europe
Slovakia	33.5 (22.0 – 47.6)	54,549	High	Europe
Croatia	30.2 (29.8 – 30.6)**	52,311	High	Europe
Israel	23.2 (14.5 – 35.3)	47,925	High	Europe
Norway	21.0 (20.6 – 21.4)**	41,386	High	Europe
Lithuania	30.2 (19.6 – 43.8)	38,501	High	Europe
New Zealand	24.8 (15.3 – 38.0)	34,498	High	HIAP
Uruguay	41.0 (40.5 – 41.5)**	33,847	High	Southern LA
Ireland	25.3 (24.8 – 25.8)**	32,354	High	Europe
United Arab Emirates	21.7 (14.7 – 30.9)	29,113	High	MENA
Latvia	40.4 (39.8 – 41.0)**	27,427	High	Europe
Singapore	23.9 (23.3 – 24.5)**	23,222	High	HIAP
Slovenia	31.2 (20.1 – 45.5)	20,813	High	Europe
Panama	34.9 (34.2 – 35.6)	19,798	High	Central LA
Estonia	30.2 (19.5 – 43.9)	15,889	High	Europe
Oman	27.7 (18.6 – 39.1)	12,374	High	MENA
Trinidad and Tobago	29.8 (28.9 – 30.7)	11,765	High	Caribbean
Mauritius	41.5 (28.2 – 56.5)	10,713	High	Southeast Asia
Kuwait	23.3 (22.4 – 24.2)**	10,013	High	MENA
Cyprus	30.4 (19.7 – 44.2)	8,707	High	Europe
Qatar	17.3 (11.1 – 25.7)	4,421	High	MENA
Bahrain	27.1 (17.8 – 38.9)	4,266	High	MENA
Luxembourg	17.9 (11.0 – 28.2)	4,147	High	Europe
Malta	21.5 (13.3 – 33.2)	3,780	High	Europe
Barbados	47.4 (32.6 – 63.0)	3,093	High	Caribbean
The Bahamas	25.0 (16.1 – 36.6)	2,731	High	Caribbean

Iceland	19.0 (11.7 – 29.6)	2,113	High	Europe
Brunei	25.7 (16.5 – 37.7)	1,880	High	Southeast Asia
Andorra	21.0 (13.0 – 32.2)	620	High	Europe
Antigua and Barbuda	50.6 (35.7 – 65.8)	610	High	Caribbean

* According to GBD, 2019. ** Observed home death percentage for year 2010 or later. LA: Latin America. MENA: Middle East and North Africa. HIAP: High-Income Asia-Pacific. SSA: Sub-Saharan Africa. UI: Uncertainty interval.

Table S3: Subnational model results

Variables	Coefficient	95% confidence interval	
		Lower	Upper
Home birth percentage (current)	0.012**	0.005	0.019
Log health expenditure per capita (average 10 years)	-0.461**	-0.589	-0.333
Urbanisation	-0.012**	-0.017	-0.007
Region (Ref. Andean LA)			
Southern LA	0.570**	0.296	0.844
Tropical LA	-0.715**	-0.981	-0.450
Central LA	-0.084	-0.313	0.144
Caribbean	0.021	-0.310	0.267
MENA	0.230	-0.005	0.465
South Asia	-0.899**	-1.256	-0.541
Southeast Asia	-0.259*	-0.527	0.009
East Asia	0.800**	0.490	1.109
Sub-Saharan Africa	-0.439**	-0.727	-0.151
High-Income Asia-Pacific	-0.012	-0.327	0.302
Europe	-0.005	-0.272	0.262
Oceania	-0.798*	-1.423	-0.172
Constant	3.541**	2.750	4.332

N= 152. *p<0.05 **p<0.01. PPP: Purchasing power parity. RMSE: 6.3 percentage points. MAE: 4.9 percentage points.

Table S4: Estimated and observed all-age home death percentage, subnational areas

Country	Subnational area	Year(s)	Observed	Predicted	Difference
Angola	Dande HDSS	2009-12	48.0	64.3	+16.3
Burkina Faso	Nouna HDSS	2015	64.5	58.8	-5.7
Kenya	Kilifi HDSS	2008-11	57.0	77.8	+20.8
Kenya	Kombewa HDSS	2011-15	62.1	74.8	+12.7
Tanzania	Korogwe HDSS	2006-12	70.0	71.8	+1.8
Ethiopia	Kersa HDSS	2007-13	85.0	93.4	+8.4
Ethiopia	Kilite-Awlaelo HDSS	2010-11	89.0	90.3	+1.3
Zambia	SAVVY in four provinces	2009-10	49.0	61.2	+12.2
Bangladesh	Matlab HDSS	2012	56.1	61.0	+4.9
Subnational areas without national data MAE: 9.3 percentage points					
Ecuador	Azuay	2017	45.3	47.1	+1.8
Ecuador	Bolívar	2017	67.2	58.8	-8.4
Ecuador	Cañar, El Piedrero	2017	58.2	50.6	-7.6
Ecuador	Carchi	2017	62.3	50.1	-12.2
Ecuador	Cotopaxi	2017	64.0	55.8	-8.1
Ecuador	Chimborazo	2017	51.3	53.7	+2.4
Ecuador	El Oro	2017	40.5	38.5	-2.0
Ecuador	Esmeraldas	2017	47.7	50.4	+2.7
Ecuador	Guayas and Galápagos	2017	44.1	36.7	-7.4
Ecuador	Las Golondrinas	2017	62.5	48.2	-14.3
Ecuador	Loja	2017	55.1	46.6	-8.5
Ecuador	Los Ríos	2017	48.2	46.0	-2.2
Ecuador	Manabí	2017	52.5	46.0	-6.5
Ecuador	Morona Santiago	2017	48.7	65.1	+16.4
Ecuador	Napo	2017	61.0	56.5	-4.5
Ecuador	Pastaza	2017	39.4	59.2	+19.8
Ecuador	Pichincha	2017	38.9	41.4	+2.5
Ecuador	Tungurahua	2017	51.5	50.5	-1.0
Ecuador	Zamora Chinchipe	2017	60.8	53.9	-6.9
Ecuador	Sucumbíos	2017	48.0	53.9	+5.9
Ecuador	Orellana	2017	54.0	58.5	+4.5
Ecuador	Santo Domingo de los	2017	39.7	39.9	+0.2
Ecuador	Santa Elena	2017	57.1	44.8	-12.3
Ecuador MAE: 6.9 percentage points.					
Guatemala	Guatemala	2017	42.5	42.9	0.5
Guatemala	El Progreso	2017	68.0	54.8	-13.2
Guatemala	Sacatepéquez	2017	62.5	45.0	-17.5

Guatemala	Chimaltenango	2017	74.3	62.4	-11.9
Guatemala	Escuintla	2017	52.9	53.5	+0.7
Guatemala	Santa Rosa	2017	52.0	58.0	+6.1
Guatemala	Sololá	2017	75.8	65.3	-10.4
Guatemala	Totonicapán	2017	87.4	70.8	-16.6
Guatemala	Quetzaltenango	2017	61.6	58.0	-3.6
Guatemala	Suchitepequez	2017	66.0	58.7	-7.2
Guatemala	Retalhuleu	2017	74.6	56.3	-18.3
Guatemala	San Marcos	2017	80.0	73.4	-6.5
Guatemala	Huehuetenango	2017	74.6	79.0	+4.3
Guatemala	Quiché	2017	78.8	77.3	-1.6
Guatemala	Baja Verapaz	2017	77.7	65.0	-12.7
Guatemala	Alta Verapaz	2017	74.8	71.6	-3.3
Guatemala	Petén	2017	54.7	66.0	+11.3
Guatemala	Izabal	2017	54.7	64.7	+10.0
Guatemala	Zacapa	2017	55.5	60.7	+5.1
Guatemala	Chiquimula	2017	65.0	70.5	+5.5
Guatemala	Jalapa	2017	75.3	53.4	-21.9
Guatemala	Jutiapa	2017	72.3	57.5	-14.8
Guatemala MAE: 9.2 percentage points					
Papua New Guinea	Western	2010	72.0	72.8	+0.8
Papua New Guinea	Gulf	2010	85.0	80.6	-4.4
Papua New Guinea	Central	2010	87.0	74.0	-13.0
Papua New Guinea	National Capital District	2010	55.0	37.0	-18.0
Papua New Guinea	Milne Bay	2010	70.0	70.2	0.2
Papua New Guinea	Oro	2010	71.0	81.2	10.2
Papua New Guinea	Southern Highlands / Hela	2010	86.0	76.7	-9.3
Papua New Guinea	Enga	2010	81.0	80.2	-0.8
Papua New Guinea	Western Highlands / Jiwaka	2010	73.0	75.7	+2.7
Papua New Guinea	Simbu	2010	77.0	75.0	-2.0
Papua New Guinea	Eastern Highlands	2010	74.0	76.7	+2.7
Papua New Guinea	Morobe	2010	73.0	74.4	+1.4
Papua New Guinea	Madang	2010	72.0	81.8	+9.8
Papua New Guinea	East Sepik	2010	78.0	83.8	+5.8
Papua New Guinea	Sandaun	2010	82.0	84.6	+2.6
Papua New Guinea	Manus	2010	67.0	64.5	-2.5
Papua New Guinea	New Ireland	2010	64.0	67.1	+3.1
Papua New Guinea	East New Britain	2010	69.0	65.8	-3.2
Papua New Guinea	West New Britain	2010	62.0	72.6	+10.6

Papua New Guinea	Bougainville	2010	73.0	73.1	+0.1
Papua New Guinea: MAE 5.2 percentage points					
Philippines	National Capital Region	2017	43.7	41.7	-2.1
Philippines	Cordillera Administrative Region	2017	58.1	64.1	+6.0
Philippines	Region I - Ilocos Region	2017	62.3	69.6	+7.3
Philippines	Region II - Cagayan Valley	2017	61.7	73.1	+11.4
Philippines	Region III - Central Luzon	2017	54.7	57.6	+2.9
Philippines	Region IV-A - CALABARZON	2017	55.2	57.0	+1.8
Philippines	Region V - Bicol	2017	62.3	72.5	+10.3
Philippines	Region VI - Western Visayas	2017	52.3	65.3	+13.0
Philippines	Region VII - Central Visayas	2017	60.4	58.7	-1.7
Philippines	Region X - Northern Mindanao	2017	51.3	65.8	+14.5
Philippines	Region XI - Davao	2017	52.0	59.5	+7.6
Philippines	Region XIII - Caraga	2017	57.8	68.9	+11.1
Philippines*: MAE 7.5 percentage points					
Sri Lanka	Western	2014	44.4	39.7	-4.8
Sri Lanka	Central	2014	50.2	48.1	-2.1
Sri Lanka	Southern	2014	53.8	48.2	-5.6
Sri Lanka	Northern	2014	58.3	46.2	-12.1
Sri Lanka	Eastern	2014	60.4	43.6	-16.9
Sri Lanka	North-West	2014	47.1	50.3	+3.2
Sri Lanka	North-Central	2014	39.0	49.9	+11.0
Sri Lanka	Uva	2014	48.1	50.6	+2.6
Sri Lanka	Sabaragamuwa	2014	50.4	50.6	+0.3
Sri Lanka: MAE 6.5 percentage points					
Thailand	Bangkok	2017	31.3	31.9	+0.6
Thailand	Central Region	2017	43.4	45.3	+1.9
Thailand	Northern Region	2017	57.6	49.7	-7.9
Thailand	Northeastern Region	2017	68.1	51.8	-16.3
Thailand	Southern Region	2017	42.1	49.6	+7.5
Thailand: MAE 6.8 percentage points					

HDSS: Health and demographic surveillance system. SAVVY: Sample Vital Registration with Verbal Autopsy (SAVVY). MAE: Mean absolute error.* Some regions of Philippines excluded because of low completeness of death registration.