Supplementary Methods Appendix
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3. References
1. Epidemiological model

1.1 Parameters used in epidemiological model

1.1.1 Flow diagram showing compartments and flows in the epidemiological model (Figure SM1)
### 1.1.2 Table SM1: General model parameters

| Parameter | Description | Value | Reference |
|-----------|-------------|-------|-----------|
| \(d_E\)  | Latent period (E to I<sub>1</sub> and E to I<sub>2</sub>; days) | Gamma distribution (\(\mu=4.0, k=4\)) | (1) |
| \(d_P\)  | Duration of preclinical infectiousness (I<sub>0</sub> to I<sub>1</sub>; days) | Gamma distribution (\(\mu=2.4, k=4\)) | (1) |
| \(d_C\)  | Duration of clinical infectiousness (I<sub>1</sub> to I<sub>C</sub>; days) | Gamma distribution (\(\mu=3.2, k=3.7\)) | (2) |
| \(d_S\)  | Duration of subclinical infectiousness (I<sub>S</sub> to R; days) | Gamma distribution (\(\mu=7.0, k=4.0\)) | Assumed |
| Incubation period (E to I<sub>C</sub>; days) | \(d_E + d_P\); mean 6.4 days | Derived |
| Serial interval (days) | \(d_E + (y_i(d_P + d_C) + (1 - y_i)d_S)/2\); mean approximately 7 days | Derived |
| \(u\)    | Susceptibility to infection on contact | Calculated from \(R_0\) | Derived |
| \(y_i\)  | Probability of clinical symptoms on infection for age group \(i\) | Estimated from case distributions across 6 countries | (3) |
| \(f\)    | Relative infectiousness of subclinical cases | 50% | Assumed |
| \(c_{ij}\) | Number of age-\(j\) individuals contacted by an age-\(i\) individual per day | Country-specific contact matrix | (4) |
| \(N_i\)  | Number of age-\(i\) individuals | Demographic data | (5) |
| \(\Delta t\) | Time step for discrete-time simulation | 0.25 days | |
| Delay from onset to hospitalisation (days) | Gamma distribution (\(\mu=7.0, k=5.0\)) | (6) |
| Duration of hospitalisation in non-ICU bed, severe case (days) | Gamma distribution (\(\mu=14.6, k=5.0\)) | (6) |
| Duration of hospitalisation in non-ICU bed, critical case (before ICU bed; days) | Gamma distribution (\(\mu=6.0, k=5.0\)) | (6) |
| Duration of hospitalisation in ICU bed, critical case (after non-ICU bed; days) | Gamma distribution (\(\mu=9.6, k=5.0\)) | (7-13) |
| Delay from onset to death (days) | Gamma distribution (\(\mu=22, k=10\)) | (14, 15) |
### 1.1.3 Table SM2: Age-specific hospitalisation and fatality risk

| Age group | Case-fatality risk | % of cases hospitalised | % of hospital patients needing ICU |
|-----------|-------------------|-------------------------|----------------------------------|
| 0–9       | 0.00%             | 0.0%                    | 30%                              |
| 1–10      | 0.09%             | 0.8%                    | 30%                              |
| 20–29     | 0.10%             | 0.8%                    | 30%                              |
| 30–39     | 0.12%             | 1.0%                    | 30%                              |
| 40–49     | 0.23%             | 1.9%                    | 30%                              |
| 50–59     | 0.68%             | 5.4%                    | 30%                              |
| 60–69     | 1.87%             | 15.1%                   | 30%                              |
| 70–79     | 4.14%             | 33.3%                   | 30%                              |
| 80+       | 7.68%             | 61.8%                   | 30%                              |

Source: Davies et al (2020) (16)

### 1.2 Scenarios

The epidemiological model uses data from low- and middle-income countries. For each country, the model produces estimates on the number of cases, hospitalisations, number of days in hospital for severe cases (general ward) and critical cases (intensive care unit), and deaths for 57 distinct epidemiological scenarios (2).

For this study, four epidemiological scenarios were chosen out of the set of 57 possible scenarios. Scenario 1 represents an unmitigated epidemic. Scenarios 2–4 scenarios were chosen because they represent a variety of plausible policy options. Descriptions of the scenarios are presented below in Table SM3. Number of cases, days in hospital and deaths per country per scenario can be found in Table SM4.
1.2.1 Table SM3: Scenario descriptions

| Scenario | Description |
|----------|-------------|
| **Scenario 1** | Unmitigated epidemic: no mitigation policies are introduced, and there are no reductions in contacts across any population or setting. |
| **Scenario 2** | The whole population is covered in this intervention scenario. The intervention is triggered by daily incidence reaching 1 per 10,000. The intervention includes self-isolation of symptomatic persons for duration of symptoms, modelled as an additional reduction in contacts among symptomatic people of 75%. The intervention includes distancing measures that reduce contacts at school by 20%, at work by 20%, in other settings by 20%, and in the home setting by 0%. There is no difference in intervention by age. |
| **Scenario 3** | The whole population is covered in this intervention scenario. The intervention is triggered by daily incidence reaching 1 per 10,000. The intervention includes self-isolation of symptomatic persons for duration of symptoms, modelled as an additional reduction in contacts among symptomatic people of 75%. The intervention includes distancing measures that reduce contacts at school by 80%, at work by 80%, in other settings by 80%, and in the home setting by 0%. There is no difference in intervention by age. |
| **Scenario 4** | The intervention is temporary lockdown (30 days) which leads to 100% of the population reducing their contacts through school, home, work and other settings by 100%, 0%, 37.5% and 37.5%, respectively, during Lockdown occurs for the first 30 days. After lockdown is lifted 100% of the population reduces their contacts through school, home, work and other settings by 20%, 0%, 20% and 20%, respectively. |

*For reference, these correspond to Scenarios 1, 4, 22 and 49 in the CovidM epidemiological model, respectively.*
### Table SM4: Expected number of cases, days of hospitalisations (ICU and non-ICU) and deaths per country per scenario per year

| Country               | Scenario | Total Number of Cases per Year | Total Number of ICU bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|-----------------------|----------|--------------------------------|--------------------------------------|------------------------------------------|---------------------------------|
| Afghanistan           | 1        | 12,218,384                     | 1,644,757                            | 3,068,969                                | 102,557                         |
| Afghanistan           | 2        | 9,128,640                      | 1,124,522                            | 2,096,065                                | 69,980                          |
| Afghanistan           | 3        | 5,057,917                      | 659,168                              | 1,228,500                                | 40,911                          |
| Afghanistan           | 4        | 10,687,759                     | 1,379,972                            | 2,571,196                                | 85,767                          |
| Angola                | 1        | 10,568,602                     | 1,337,286                            | 2,495,053                                | 82,997                          |
| Angola                | 2        | 7,951,659                      | 958,471                              | 1,790,227                                | 59,579                          |
| Angola                | 3        | 3,787,000                      | 480,525                              | 904,768                                  | 29,918                          |
| Angola                | 4        | 9,243,636                      | 1,153,109                            | 2,151,984                                | 71,543                          |
| Argentina             | 1        | 16,773,845                     | 7,129,192                            | 13,331,843                               | 443,779                         |
| Argentina             | 2        | 12,167,825                     | 4,923,904                            | 9,183,093                                | 306,425                         |
| Argentina             | 3        | 7,206,744                      | 3,179,287                            | 5,930,435                                | 197,212                         |
| Argentina             | 4        | 14,559,346                     | 6,161,078                            | 11,508,390                               | 383,318                         |
| Burundi               | 1        | 3,825,576                      | 487,746                              | 912,821                                  | 30,294                          |
| Burundi               | 2        | 2,875,192                      | 343,199                              | 643,374                                  | 21,458                          |
| Burundi               | 3        | 1,563,194                      | 192,617                              | 359,761                                  | 11,941                          |
| Burundi               | 4        | 3,360,358                      | 416,410                              | 783,449                                  | 25,959                          |
| Benin                 | 1        | 3,987,008                      | 610,334                              | 1,140,853                                | 37,967                          |
| Benin                 | 2        | 3,027,031                      | 436,071                              | 813,544                                  | 27,099                          |
| Benin                 | 3        | 1,617,554                      | 243,858                              | 455,765                                  | 15,181                          |
| Benin                 | 4        | 3,517,493                      | 523,440                              | 980,738                                  | 32,601                          |
| Burkina Faso          | 1        | 6,855,948                      | 954,395                              | 1,781,199                                | 59,385                          |
| Burkina Faso          | 2        | 5,231,105                      | 692,107                              | 1,290,565                                | 42,965                          |
| Burkina Faso          | 3        | 2,954,321                      | 421,063                              | 787,441                                  | 26,090                          |
| Burkina Faso          | 4        | 6,035,206                      | 826,512                              | 1,546,413                                | 51,440                          |
| Bangladesh            | 1        | 57,227,127                     | 14,236,788                           | 26,575,364                               | 865,269                         |
| Bangladesh            | 2        | 43,270,144                     | 10,038,443                           | 18,753,926                               | 623,995                         |
| Bangladesh            | 3        | 23,696,469                     | 5,910,527                            | 11,038,187                               | 366,351                         |
| Bangladesh            | 4        | 50,407,176                     | 12,324,089                           | 23,001,527                               | 766,395                         |
| Bolivia               | 1        | 3,881,885                      | 929,771                              | 1,734,889                                | 57,656                          |
| Bolivia               | 2        | 2,855,102                      | 614,416                              | 1,146,287                                | 38,054                          |
| Bolivia               | 3        | 1,246,487                      | 279,999                              | 519,997                                  | 17,368                          |
| Bolivia               | 4        | 3,364,052                      | 778,136                              | 1,449,733                                | 48,330                          |
| Brazil                | 1        | 76,815,441                     | 27,418,043                           | 51,183,619                               | 1,705,997                       |
| Brazil                | 2        | 56,285,085                     | 18,283,102                           | 34,199,544                               | 1,139,192                       |
| Brazil                | 3        | 30,752,013                     | 10,628,491                           | 19,851,593                               | 658,619                         |
| Brazil                | 4        | 66,729,482                     | 23,242,139                           | 43,395,705                               | 1,445,675                       |
| Botswana              | 1        | 765,573                        | 159,461                              | 296,629                                  | 9,918                           |
| Botswana              | 2        | 556,036                        | 107,208                              | 199,542                                  | 6,660                           |
| Botswana              | 3        | 305,082                        | 61,841                               | 114,201                                  | 3,789                           |
| Botswana              | 4        | 662,702                        | 134,418                              | 250,999                                  | 8,334                           |
| Central African Republic | 1 | 1,542,576 | 227,256 | 422,653 | 14,108 |
| Central African Republic | 2 | 1,168,851 | 158,952 | 297,691 | 9,900 |
| Central African Republic | 3 | 696,607 | 102,635 | 192,340 | 6,435 |
| Central African Republic | 4 | 1,353,904 | 194,599 | 363,301 | 12,130 |
| Cote d'Ivoire         | 1        | 8,535,012                      | 1,316,578                            | 2,457,106                                | 82,053                          |
| Cote d'Ivoire         | 2        | 6,298,092                      | 916,128                              | 1,708,562                                | 57,156                          |
| Country              | Scenario | Total Number of Cases per Year | Total Number of ICU bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|---------------------|----------|--------------------------------|--------------------------------------|------------------------------------------|--------------------------------|
| Cote d'Ivoire       | 3        | 2,781,975                      | 429,891                              | 803,017                                  | 26,661                          |
| Cote d'Ivoire       | 4        | 7,403,109                      | 1,119,330                            | 2,085,969                                | 69,716                          |
| Cameroon            | 1        | 8,729,175                      | 1,249,335                            | 2,335,084                                | 77,781                          |
| Cameroon            | 2        | 6,604,562                      | 889,631                              | 1,661,757                                | 55,432                          |
| Cameroon            | 3        | 3,552,194                      | 503,336                              | 939,580                                  | 31,265                          |
| Cameroon            | 4        | 7,690,770                      | 1,078,673                            | 2,014,896                                | 67,062                          |
| Congo, Dem. Rep.    | 1        | 28,914,535                     | 4,131,603                            | 7,713,654                                | 257,149                         |
| Congo, Dem. Rep.    | 2        | 21,729,089                     | 2,925,816                            | 5,459,743                                | 181,725                         |
| Congo, Dem. Rep.    | 3        | 10,339,605                     | 1,480,493                            | 2,755,736                                | 91,223                          |
| Congo, Dem. Rep.    | 4        | 25,274,207                     | 3,537,680                            | 6,601,661                                | 219,628                         |
| Congo, Rep.         | 1        | 1,819,210                      | 284,222                              | 531,531                                  | 17,714                          |
| Congo, Rep.         | 2        | 1,380,686                      | 201,095                              | 376,299                                  | 12,564                          |
| Congo, Rep.         | 3        | 828,849                        | 128,924                              | 241,162                                  | 8,085                           |
| Congo, Rep.         | 4        | 1,603,300                      | 245,240                              | 457,934                                  | 15,290                          |
| Colombia            | 1        | 18,341,207                     | 6,156,014                            | 11,493,004                               | 382,745                         |
| Colombia            | 2        | 13,426,478                     | 4,130,466                            | 7,696,118                                | 256,668                         |
| Colombia            | 3        | 7,192,838                      | 2,342,407                            | 4,372,127                                | 144,933                         |
| Colombia            | 4        | 15,964,753                     | 5,231,315                            | 9,754,859                                | 325,054                         |
| Comoros             | 1        | 290,557                        | 47,011                               | 87,853                                   | 2,912                           |
| Comoros             | 2        | 215,335                        | 32,916                               | 61,231                                   | 2,047                           |
| Comoros             | 3        | 114,052                        | 18,551                               | 34,354                                   | 1,129                           |
| Comoros             | 4        | 252,887                        | 40,322                               | 75,626                                   | 2,512                           |
| Cabo Verde          | 1        | 181,545                        | 41,379                               | 77,437                                   | 2,566                           |
| Cabo Verde          | 2        | 128,006                        | 26,548                               | 49,137                                   | 1,638                           |
| Cabo Verde          | 3        | 67,261                         | 14,657                               | 27,550                                   | 905                             |
| Cabo Verde          | 4        | 153,456                        | 33,985                               | 63,203                                   | 2,102                           |
| Costa Rica          | 1        | 1,822,573                      | 652,845                              | 1,218,194                                | 40,619                          |
| Costa Rica          | 2        | 1,326,971                      | 426,627                              | 799,724                                  | 26,659                          |
| Costa Rica          | 3        | 745,696                        | 252,693                              | 470,210                                  | 15,641                          |
| Costa Rica          | 4        | 1,578,679                      | 549,464                              | 1,023,619                                | 34,174                          |
| Dominican Republic  | 1        | 3,807,777                      | 1,127,809                            | 2,105,557                                | 70,140                          |
| Dominican Republic  | 2        | 2,808,435                      | 765,172                              | 1,422,812                                | 47,526                          |
| Dominican Republic  | 3        | 1,562,725                      | 456,253                              | 850,089                                  | 28,343                          |
| Dominican Republic  | 4        | 3,315,475                      | 964,871                              | 1,796,265                                | 59,882                          |
| Algeria             | 1        | 14,034,753                     | 3,466,815                            | 6,462,518                                | 215,453                         |
| Algeria             | 2        | 9,901,970                      | 2,171,944                            | 4,050,559                                | 135,157                         |
| Algeria             | 3        | 5,054,134                      | 1,144,758                            | 2,139,221                                | 70,840                          |
| Algeria             | 4        | 11,937,307                     | 2,835,058                            | 5,295,542                                | 175,989                         |
| Ecuador             | 1        | 6,238,254                      | 1,828,487                            | 3,416,055                                | 113,770                         |
| Ecuador             | 2        | 4,681,266                      | 1,256,087                            | 2,337,136                                | 77,960                          |
| Ecuador             | 3        | 2,586,022                      | 739,506                              | 1,376,652                                | 45,789                          |
| Ecuador             | 4        | 5,480,200                      | 1,567,059                            | 2,923,490                                | 97,214                          |
| Egypt, Arab Rep.    | 1        | 32,689,306                     | 7,149,998                            | 13,352,308                               | 444,818                         |
| Egypt, Arab Rep.    | 2        | 23,251,250                     | 4,594,336                            | 8,576,020                                | 285,393                         |
| Egypt, Arab Rep.    | 3        | 11,840,379                     | 2,461,239                            | 4,607,743                                | 152,674                         |
| Egypt, Arab Rep.    | 4        | 27,975,741                     | 5,946,559                            | 11,123,015                               | 370,198                         |
| Ethiopia            | 1        | 37,424,355                     | 6,123,830                            | 11,438,760                               | 380,821                         |
| Ethiopia            | 2        | 28,272,227                     | 4,318,605                            | 8,066,304                                | 268,718                         |
| Country          | Scenario | Total Number of Cases per Year | Total Number of ICU Bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|------------------|----------|-------------------------------|--------------------------------------|------------------------------------------|-------------------------------|
| Ethiopia         | 3        | 14,996,880                    | 2,457,012                            | 4,593,452                                | 152,671                       |
| Ethiopia         | 4        | 32,804,210                    | 5,277,773                            | 9,861,571                                | 328,540                       |
| Gabon            | 1        | 752,440                       | 127,913                              | 239,231                                  | 7,960                         |
| Gabon            | 2        | 572,426                       | 89,835                               | 168,146                                  | 5,614                         |
| Gabon            | 3        | 347,308                       | 58,095                               | 109,709                                  | 3,636                         |
| Gabon            | 4        | 664,128                       | 110,376                              | 206,162                                  | 6,868                         |
| Ghana            | 1        | 10,378,959                    | 1,826,469                            | 3,406,632                                | 113,608                       |
| Ghana            | 2        | 7,713,894                     | 1,273,479                            | 2,379,059                                | 79,390                        |
| Ghana            | 3        | 3,423,372                     | 602,270                              | 1,120,060                                | 37,244                        |
| Ghana            | 4        | 9,039,576                     | 1,557,544                            | 2,901,100                                | 96,753                        |
| Guinea           | 1        | 4,258,486                     | 700,273                              | 1,311,264                                | 43,627                        |
| Guinea           | 2        | 3,197,000                     | 509,157                              | 950,869                                  | 31,664                        |
| Guinea           | 3        | 1,702,115                     | 304,198                              | 565,934                                  | 18,716                        |
| Guinea           | 4        | 3,718,928                     | 614,331                              | 1,144,140                                | 38,188                        |
| Gambia, The      | 1        | 787,667                       | 120,450                              | 224,342                                  | 7,491                         |
| Gambia, The      | 2        | 592,871                       | 88,337                               | 163,947                                  | 5,443                         |
| Gambia, The      | 3        | 324,942                       | 53,737                               | 101,076                                  | 3,350                         |
| Gambia, The      | 4        | 686,599                       | 104,927                              | 196,707                                  | 6,559                         |
| Guinea-Bissau    | 1        | 646,616                       | 100,306                              | 186,821                                  | 6,208                         |
| Guinea-Bissau    | 2        | 490,671                       | 72,272                               | 135,491                                  | 4,506                         |
| Guinea-Bissau    | 3        | 284,321                       | 45,434                               | 83,769                                   | 2,782                         |
| Equatorial Guinea| 1       | 471,118                       | 62,021                               | 116,074                                  | 3,858                         |
| Equatorial Guinea| 2      | 359,113                       | 44,812                               | 83,462                                   | 2,772                         |
| Equatorial Guinea| 3      | 194,874                       | 25,338                               | 47,842                                   | 1,594                         |
| Equatorial Guinea| 4      | 416,197                       | 53,836                               | 100,579                                  | 3,349                         |
| Guatemala        | 1        | 5,931,816                     | 1,188,378                            | 2,215,139                                | 73,895                        |
| Guatemala        | 2        | 4,445,955                     | 809,411                              | 1,509,951                                | 50,398                        |
| Guatemala        | 3        | 2,471,212                     | 477,648                              | 888,300                                  | 29,576                        |
| Guatemala        | 4        | 5,200,461                     | 1,004,989                            | 1,873,663                                | 62,446                        |
| Honduras         | 1        | 3,368,666                     | 711,832                              | 1,328,439                                | 44,068                        |
| Honduras         | 2        | 2,554,279                     | 498,195                              | 928,829                                  | 30,884                        |
| Honduras         | 3        | 1,508,915                     | 311,766                              | 579,276                                  | 19,368                        |
| Honduras         | 4        | 2,966,095                     | 611,292                              | 1,145,329                                | 38,069                        |
| Haiti            | 1        | 3,844,733                     | 864,008                              | 1,611,689                                | 53,684                        |
| Haiti            | 2        | 2,891,884                     | 602,646                              | 1,127,805                                | 37,539                        |
| Haiti            | 3        | 1,628,745                     | 363,202                              | 678,225                                  | 22,680                        |
| Haiti            | 4        | 3,378,438                     | 746,954                              | 1,392,145                                | 46,507                        |
| India            | 1        | 485,771,554                   | 134,139,960                          | 250,304,013                              | 8,338,438                     |
| India            | 2        | 365,933,322                   | 93,048,830                           | 173,656,182                              | 5,785,607                     |
| India            | 3        | 217,279,232                   | 58,353,362                           | 108,949,367                              | 3,620,179                     |
| India            | 4        | 427,295,821                   | 115,025,841                          | 214,808,062                              | 7,154,678                     |
| Iraq             | 1        | 13,378,016                    | 2,160,706                            | 4,036,577                                | 134,704                       |
| Iraq             | 2        | 10,055,967                    | 1,513,885                            | 2,832,294                                | 94,397                        |
| Iraq             | 3        | 5,444,676                     | 850,809                              | 1,586,861                                | 52,768                        |
| Iraq             | 4        | 11,745,267                    | 1,852,021                            | 3,459,985                                | 115,382                       |
| Country       | Scenario | Total Number of Cases per Year | Total Number of ICU Bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|--------------|----------|--------------------------------|--------------------------------------|------------------------------------------|--------------------------------|
| Jordan       | 1        | 3,230,121                      | 545,182                              | 1,014,537                                | 33,793                         |
| Jordan       | 2        | 2,403,685                      | 360,587                              | 671,528                                  | 22,396                         |
| Jordan       | 3        | 1,441,002                      | 226,241                              | 421,434                                  | 14,020                         |
| Jordan       | 4        | 2,802,082                      | 455,066                              | 851,418                                  | 28,349                         |
| Kenya        | 1        | 17,932,718                     | 3,334,486                            | 6,220,435                                | 207,231                        |
| Kenya        | 2        | 13,972,380                     | 2,685,063                            | 5,015,623                                | 166,727                        |
| Kenya        | 3        | 8,920,887                      | 1,777,161                            | 3,304,638                                | 110,214                        |
| Kenya        | 4        | 15,940,230                     | 3,027,794                            | 5,604,038                                | 188,428                        |
| Cambodia     | 1        | 5,249,630                      | 1,075,358                            | 2,009,207                                | 67,003                         |
| Cambodia     | 2        | 3,735,697                      | 699,366                              | 1,307,952                                | 43,433                         |
| Cambodia     | 3        | 1,491,662                      | 285,706                              | 532,484                                  | 17,650                         |
| Cambodia     | 4        | 4,455,702                      | 883,330                              | 1,665,498                                | 55,017                         |
| Lebanon      | 1        | 2,473,142                      | 849,633                              | 1,578,979                                | 52,778                         |
| Lebanon      | 2        | 1,838,521                      | 596,389                              | 1,111,151                                | 36,992                         |
| Lebanon      | 3        | 1,166,532                      | 410,943                              | 767,150                                  | 25,628                         |
| Lebanon      | 4        | 2,165,968                      | 736,594                              | 1,374,860                                | 45,888                         |
| Liberia      | 1        | 1,679,614                      | 288,953                              | 537,755                                  | 17,919                         |
| Liberia      | 2        | 1,277,408                      | 204,826                              | 383,902                                  | 12,778                         |
| Liberia      | 3        | 740,784                        | 127,259                              | 237,192                                  | 7,905                          |
| Liberia      | 4        | 1,478,591                      | 249,999                              | 464,731                                  | 15,428                         |
| Libya        | 1        | 2,278,127                      | 480,466                              | 897,001                                  | 29,873                         |
| Libya        | 2        | 1,632,675                      | 312,688                              | 585,736                                  | 19,496                         |
| Libya        | 3        | 836,827                        | 167,081                              | 312,036                                  | 10,330                         |
| Libya        | 4        | 1,947,757                      | 401,241                              | 748,906                                  | 24,938                         |
| Sri Lanka    | 1        | 8,020,343                      | 3,408,470                            | 6,355,545                                | 211,681                        |
| Sri Lanka    | 2        | 5,916,153                      | 2,373,553                            | 4,436,367                                | 147,652                        |
| Sri Lanka    | 3        | 3,594,782                      | 1,558,313                            | 2,903,475                                | 96,594                         |
| Sri Lanka    | 4        | 7,016,699                      | 2,945,770                            | 5,508,073                                | 183,972                        |
| Lesotho      | 1        | 696,741                        | 145,159                              | 271,321                                  | 9,017                          |
| Lesotho      | 2        | 508,495                        | 95,194                               | 178,041                                  | 5,963                          |
| Lesotho      | 3        | 229,199                        | 44,272                               | 82,772                                   | 2,796                          |
| Lesotho      | 4        | 600,007                        | 121,391                              | 224,865                                  | 7,490                          |
| Morocco      | 1        | 13,242,617                     | 4,386,424                            | 8,186,000                                | 272,409                        |
| Morocco      | 2        | 9,819,053                      | 3,059,154                            | 5,703,002                                | 190,014                        |
| Morocco      | 3        | 5,899,932                      | 1,973,056                            | 3,680,792                                | 122,031                        |
| Morocco      | 4        | 11,587,125                     | 3,784,741                            | 7,071,203                                | 235,509                        |
| Madagascar   | 1        | 9,150,387                      | 1,448,350                            | 2,707,203                                | 90,126                         |
| Madagascar   | 2        | 6,782,766                      | 1,015,312                            | 1,897,326                                | 63,301                         |
| Madagascar   | 3        | 3,564,207                      | 563,428                              | 1,049,184                                | 35,010                         |
| Madagascar   | 4        | 7,966,525                      | 1,244,624                            | 2,321,257                                | 77,440                         |
| Mexico       | 1        | 46,024,529                     | 13,801,740                           | 25,788,653                               | 858,167                        |
| Mexico       | 2        | 34,417,216                     | 9,459,831                            | 17,652,018                               | 588,526                        |
| Mexico       | 3        | 21,097,466                     | 6,179,136                            | 11,554,983                               | 384,123                        |
| Mexico       | 4        | 40,449,265                     | 11,850,319                           | 22,128,972                               | 737,193                        |
| Mali         | 1        | 6,261,539                      | 750,362                              | 1,399,913                                | 46,770                         |
| Mali         | 2        | 4,479,077                      | 497,582                              | 928,693                                  | 30,937                         |

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| Country    | Scenario | Total Number of Cases per Year | Total Number of ICU bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|------------|----------|--------------------------------|--------------------------------------|------------------------------------------|---------------------------------|
| Mali       | 3        | 2,225,009                       | 265,779                              | 494,222                                  | 16,416                          |
| Mali       | 4        | 5,359,818                       | 623,714                              | 1,164,621                                 | 38,817                          |
| Mozambique | 1        | 10,132,076                      | 1,434,436                            | 2,675,564                                 | 89,192                          |
| Mozambique | 2        | 7,529,591                       | 1,000,297                            | 1,869,917                                 | 62,413                          |
| Mozambique | 3        | 3,939,631                       | 555,318                              | 1,035,086                                 | 34,251                          |
| Mozambique | 4        | 8,820,157                       | 1,230,587                            | 2,293,160                                 | 76,324                          |
| Mauritania | 1        | 1,535,219                       | 254,586                              | 475,933                                  | 15,815                          |
| Mauritania | 2        | 1,165,276                       | 182,692                              | 339,830                                  | 11,333                          |
| Mauritania | 3        | 707,750                         | 121,284                              | 227,135                                  | 7,524                           |
| Mauritania | 4        | 1,353,942                       | 221,412                              | 412,272                                  | 13,723                          |
| Mauritius  | 1        | 486,886                         | 209,370                              | 390,332                                  | 13,048                          |
| Mauritius  | 2        | 351,305                         | 138,424                              | 258,994                                  | 8,630                           |
| Mauritius  | 3        | 214,210                         | 88,073                               | 165,625                                  | 5,463                           |
| Mauritius  | 4        | 422,541                         | 176,489                              | 329,163                                  | 11,016                          |
| Malawi     | 1        | 805,969                         | 113,125                              | 211,467                                  | 7,032                           |
| Malawi     | 2        | 594,975                         | 78,583                               | 146,713                                  | 4,861                           |
| Malawi     | 3        | 271,680                         | 36,561                               | 68,779                                   | 2,297                           |
| Malawi     | 4        | 696,765                         | 95,834                               | 179,066                                  | 5,975                           |
| Niger      | 1        | 7,479,841                       | 911,995                              | 1,704,345                                 | 56,836                          |
| Niger      | 2        | 5,361,960                       | 604,502                              | 1,131,298                                 | 37,571                          |
| Niger      | 3        | 2,656,776                       | 323,439                              | 603,881                                  | 20,052                          |
| Niger      | 4        | 6,407,713                       | 758,281                              | 1,417,828                                 | 45,338                          |
| Nicaragua  | 1        | 67,998,172                      | 10,931,387                           | 20,404,287                                | 679,438                         |
| Nicaragua  | 2        | 51,622,543                      | 7,976,219                            | 14,878,213                                | 495,445                         |
| Nigeria    | 3        | 28,071,653                      | 4,656,256                            | 8,692,205                                 | 289,284                         |
| Nigeria    | 4        | 59,789,002                      | 9,541,920                            | 17,807,959                                | 593,372                         |
| Nicaragua  | 1        | 2,235,573                       | 500,811                              | 937,663                                  | 31,193                          |
| Nicaragua  | 2        | 1,671,928                       | 340,381                              | 632,681                                  | 21,124                          |
| Nicaragua  | 3        | 917,568                         | 190,083                              | 355,496                                  | 11,913                          |
| Nicaragua  | 4        | 1,954,965                       | 422,936                              | 790,201                                  | 26,308                          |
| Nepal      | 1        | 9,915,595                       | 2,499,734                            | 4,665,603                                 | 155,339                         |
| Nepal      | 2        | 7,426,283                       | 1,746,579                            | 3,269,303                                 | 108,874                         |
| Nepal      | 3        | 3,596,042                       | 931,578                              | 1,736,856                                 | 57,693                          |
| Nepal      | 4        | 8,680,619                       | 2,156,185                            | 4,028,306                                 | 134,341                         |
| Pakistan   | 1        | 71,833,291                      | 13,106,615                           | 24,490,691                                | 816,437                         |
| Pakistan   | 2        | 53,017,173                      | 8,893,216                            | 16,571,106                                | 551,824                         |
| Pakistan   | 3        | 29,435,592                      | 5,229,563                            | 9,784,165                                 | 324,960                         |
| Pakistan   | 4        | 62,541,662                      | 10,974,825                           | 20,499,025                                | 682,425                         |
| Peru       | 1        | 11,655,014                      | 3,620,110                            | 6,750,234                                 | 224,803                         |
| Peru       | 2        | 8,460,495                       | 2,403,019                            | 4,479,917                                 | 148,873                         |
| Peru       | 3        | 4,169,861                       | 1,246,737                            | 2,324,155                                 | 77,272                          |
| Peru       | 4        | 10,081,294                      | 3,039,428                            | 5,677,002                                 | 188,946                         |
| Country                | Scenario | Total Number of Cases per Year | Total Number of ICU Bed Days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|-----------------------|----------|--------------------------------|---------------------------------------|------------------------------------------|-------------------------------|
| Paraguay              | 1        | 2,401,205                      | 602,572                               | 1,122,938                                | 37,456                        |
| Paraguay              | 2        | 1,771,743                      | 398,632                               | 744,467                                  | 24,878                        |
| Paraguay              | 3        | 880,974                        | 208,729                               | 389,899                                  | 12,897                        |
| Paraguay              | 4        | 2,085,255                      | 508,237                               | 946,491                                  | 31,507                        |
| West Bank and Gaza    | 1        | 1,594,004                      | 226,571                               | 422,739                                  | 14,105                        |
| West Bank and Gaza    | 2        | 1,189,223                      | 151,666                               | 281,435                                  | 9,407                         |
| West Bank and Gaza    | 3        | 712,803                        | 95,453                                | 176,326                                  | 5,949                         |
| West Bank and Gaza    | 4        | 1,387,925                      | 190,382                               | 355,232                                  | 11,799                        |
| Rwanda                | 1        | 4,260,092                      | 653,279                               | 1,221,704                                | 40,608                        |
| Rwanda                | 2        | 3,212,135                      | 457,874                               | 855,830                                  | 28,478                        |
| Rwanda                | 3        | 1,749,170                      | 255,902                               | 479,834                                  | 16,022                        |
| Sudan                 | 1        | 14,419,983                     | 2,514,131                             | 4,680,809                                | 155,985                       |
| Sudan                 | 2        | 10,877,483                     | 1,772,406                             | 3,314,864                                | 110,204                       |
| Sudan                 | 3        | 5,777,423                      | 1,008,372                             | 1,878,301                                | 62,797                        |
| Senegal               | 1        | 5,506,930                      | 943,941                               | 1,765,633                                | 58,634                        |
| Senegal               | 2        | 4,152,656                      | 688,535                               | 1,284,545                                | 42,863                        |
| Senegal               | 3        | 2,285,377                      | 427,813                               | 800,324                                  | 26,503                        |
| Senegal               | 4        | 4,809,001                      | 828,514                               | 1,548,750                                | 51,441                        |
| Sierra Leone          | 1        | 2,630,770                      | 424,740                               | 793,710                                  | 26,429                        |
| Sierra Leone          | 2        | 1,994,333                      | 307,273                               | 574,350                                  | 19,120                        |
| Sierra Leone          | 3        | 1,158,003                      | 191,212                               | 360,302                                  | 12,061                        |
| Sierra Leone          | 4        | 2,319,759                      | 370,962                               | 690,723                                  | 22,967                        |
| El Salvador           | 1        | 2,258,282                      | 726,964                               | 1,354,593                                | 45,161                        |
| El Salvador           | 2        | 1,664,922                      | 490,166                               | 916,504                                  | 30,630                        |
| El Salvador           | 3        | 908,668                        | 289,894                               | 538,905                                  | 17,906                        |
| El Salvador           | 4        | 1,965,853                      | 619,691                               | 1,166,954                                | 38,540                        |
| Sao Tome and Principe | 1        | 72,284                         | 11,232                                | 20,945                                   | 696                           |
| Sao Tome and Principe | 2        | 54,913                         | 8,014                                 | 15,110                                   | 500                           |
| Sao Tome and Principe | 3        | 29,482                         | 4,448                                 | 8,484                                    | 284                           |
| Sao Tome and Principe | 4        | 63,572                         | 9,662                                 | 17,971                                   | 607                           |
| Eswatini              | 1        | 363,364                        | 62,144                                | 115,928                                  | 3,869                         |
| Eswatini              | 2        | 266,346                        | 40,924                                | 76,891                                   | 2,558                         |
| Eswatini              | 3        | 119,568                        | 18,886                                | 35,997                                   | 1,187                         |
| Eswatini              | 4        | 313,933                        | 51,988                                | 96,274                                   | 3,204                         |
| Syrian Arab Republic  | 1        | 5,792,480                      | 989,565                               | 1,847,430                                | 61,580                        |
| Syrian Arab Republic  | 2        | 4,370,152                      | 718,417                               | 1,339,838                                | 44,443                        |
| Syrian Arab Republic  | 3        | 2,590,708                      | 461,949                               | 861,860                                  | 28,637                        |
| Syrian Arab Republic  | 4        | 5,101,507                      | 858,728                               | 1,601,690                                | 53,349                        |
| Chad                  | 1        | 5,065,943                      | 601,091                               | 1,124,428                                | 37,285                        |
| Chad                  | 2        | 3,620,550                      | 399,236                               | 745,415                                  | 24,835                        |
| Chad                  | 3        | 1,795,298                      | 213,053                               | 398,406                                  | 13,124                        |
| Chad                  | 4        | 4,330,614                      | 500,213                               | 933,773                                  | 31,055                        |
| Togo                  | 1        | 2,738,322                      | 409,696                               | 766,659                                  | 25,516                        |
| Togo                  | 2        | 2,084,482                      | 294,395                               | 549,644                                  | 18,294                        |
| Country        | Scenario | Total Number of Cases per Year | Total Number of ICU bed days per Year | Total Number of Non-ICU Bed Days per Year | Total Number of Deaths per Year |
|---------------|----------|---------------------------------|----------------------------------------|------------------------------------------|---------------------------------|
| Togo          | 3        | 1,117,766                       | 165,864                                | 310,016                                  | 10,261                          |
| Togo          | 4        | 2,416,838                       | 353,372                                | 600,994                                  | 21,999                          |
| Tajikistan    | 1        | 2,980,381                       | 506,624                                | 946,026                                  | 31,461                          |
| Tajikistan    | 2        | 2,132,997                       | 334,989                                | 624,271                                  | 20,883                          |
| Tajikistan    | 3        | 1,073,617                       | 173,478                                | 325,633                                  | 10,815                          |
| Tajikistan    | 4        | 2,558,537                       | 423,792                                | 791,528                                  | 26,444                          |
| Tunisia       | 1        | 4,156,065                       | 1,421,020                              | 2,652,235                                | 88,352                          |
| Tunisia       | 2        | 2,993,243                       | 934,482                                | 1,744,116                                | 58,014                          |
| Tunisia       | 3        | 1,711,642                       | 556,561                                | 1,039,231                                | 34,718                          |
| Tunisia       | 4        | 3,578,598                       | 1,197,556                              | 2,241,228                                | 74,471                          |
| Turkey        | 1        | 31,029,721                      | 11,408,352                             | 21,265,808                               | 708,020                         |
| Turkey        | 2        | 23,141,898                      | 7,967,972                              | 14,847,504                               | 495,400                         |
| Turkey        | 3        | 14,342,055                      | 5,342,495                              | 9,982,584                                | 331,483                         |
| Turkey        | 4        | 27,262,980                      | 9,879,608                              | 18,427,328                               | 614,391                         |
| Tanzania      | 1        | 19,439,045                      | 2,891,250                              | 5,398,276                                | 180,023                         |
| Tanzania      | 2        | 14,683,607                      | 2,076,716                              | 3,872,581                                | 129,155                         |
| Tanzania      | 3        | 7,943,080                       | 1,196,375                              | 2,231,612                                | 74,240                          |
| Tanzania      | 4        | 17,106,352                      | 2,514,752                              | 4,689,457                                | 156,668                         |
| Uganda        | 1        | 10,795,699                      | 1,767,713                              | 3,302,957                                | 109,887                         |
| Uganda        | 2        | 9,634,472                       | 1,547,767                              | 2,892,964                                | 96,320                          |
| Uganda        | 3        | 12,625,197                      | 2,044,288                              | 3,816,800                                | 126,941                         |
| Yemen, Rep.   | 1        | 8,978,940                       | 1,189,341                              | 2,223,059                                | 74,108                          |
| Yemen, Rep.   | 2        | 8,443,446                       | 752,402                                | 1,407,659                                | 46,809                          |
| Yemen, Rep.   | 3        | 3,134,621                       | 389,461                                | 723,167                                  | 23,985                          |
| Yemen, Rep.   | 4        | 7,619,709                       | 969,123                                | 1,816,361                                | 60,463                          |
| South Africa  | 1        | 20,484,692                      | 4,996,027                              | 9,320,556                                | 310,572                         |
| South Africa  | 2        | 15,232,037                      | 3,438,007                              | 6,410,413                                | 213,792                         |
| South Africa  | 3        | 8,795,217                       | 2,079,589                              | 3,890,085                                | 129,416                         |
| South Africa  | 4        | 17,929,453                      | 4,284,329                              | 7,988,411                                | 266,130                         |
| Zambia        | 1        | 5,908,590                       | 719,278                                | 1,341,163                                | 44,603                          |
| Zambia        | 2        | 4,464,221                       | 514,500                                | 966,758                                  | 32,043                          |
| Zambia        | 3        | 2,130,687                       | 259,718                                | 486,324                                  | 16,192                          |
| Zambia        | 4        | 5,177,648                       | 620,035                                | 1,154,007                                | 38,561                          |
| Zimbabwe      | 1        | 4,572,304                       | 991,499                                | 1,852,342                                | 61,684                          |
| Zimbabwe      | 2        | 3,484,742                       | 817,788                                | 1,524,035                                | 50,875                          |
| Zimbabwe      | 3        | 3,275,399                       | 779,773                                | 1,450,086                                | 48,299                          |
| Zimbabwe      | 4        | 4,110,615                       | 926,563                                | 1,728,563                                | 57,740                          |
2. Health resource use and costing parameters and assumptions

2.1. Summary

We summarise the main parameters used in the estimates of health resources and costing. Further details and references are then provided in the following sections.

In summary, there are five steps in our calculations:
1. Calculation of unit costs per activity for three base countries: Ethiopia (low-income country or ‘LIC’), Pakistan (lower-middle income country or ‘lower-MIC’) and South Africa (upper-middle income country or ‘upper-MIC’)
2. Extrapolation of unit costs in base countries to calculate unit costs across LICs, lower-MICs and upper-MICs
3. Calculation of total costs per country using country-specific unit costs, modelled data on the number of cases, hospitalisations and deaths, as well as other epidemiological and economic assumptions
4. Calculation of country-specific costs per capita, as well as costs per capita as a proportion of gross domestic product (GDP) per capita and various measures of health expenditure per capita
2.2 Calculation of unit costs per activity for three base countries

2.2.1 General Approach

A full economic costing was carried out over a one-year time horizon. Costs were constructed using a bottom-up ingredients-based technique. The costing was carried out from a health systems perspective and included both direct (e.g. medicines) and indirect costs (e.g. facility overheads). No above-service delivery costs were included.

The 76 countries chosen met three inclusion criteria: 1) classify as low-income, lower-middle income or upper-middle income by the World Bank (17), 2) be included in the list of 92 countries for which epidemiological modelling data was available from Pearson et al (2020) (2), and 3) have recent available GDP per capita (adjusted for PPP) data in order to carry out cost extrapolation between countries (17).

2.2.2 Intervention costs

We used official WHO guidance to identify areas related to critical preparedness, readiness and response actions for COVID-19 to define a set of interventions involved in a national response to the pandemic (18). We identified 6 priority areas of work and is further subdivided into 13 activities.

- Emergency response mechanisms at the national level
- Risk communication and community engagement
- Case finding, contact tracing and management
- Surveillance
- Public health measures
- Case management

For the first five areas of work we considered only WHO guidance to define the resource use. For case management costs we assumed less resource-intensive activities thought to be more plausible in low- and middle-income settings (‘real-world’). Assumptions on ‘real world’ resource use were based on the clinical expertise of members of the research team and are detailed below.

Following this guidance on areas of work, we generated a list of activities for which we needed to estimate unit costs (see Table SM5). These unit costs were brought together with the COVID epidemiological model to estimate resource needs.
### 2.2.3 Table SM5: Activities and unit types

| Activity                                                                 | Unit Type                      |
|-------------------------------------------------------------------------|--------------------------------|
| 1.a. Emergency Response Mechanisms: National level                      | Per country per day            |
| 1.b. Emergency Response Mechanisms: Training of health staff            | One-off per site               |
| 2. Risk communication & community engagement                             | Per country per day            |
| 3.a. Case finding, contact tracing and management: Contact tracing       | Per person contacted           |
| 3.b. Case finding, contact tracing and management: Quarantine of contacts | Per person quarantined         |
| 4.a. Surveillance: Case notification                                     | Per positive case              |
| 4.b. Surveillance: Reporting (national level)                            | Per country per week           |
| 5. Public health measures: Hygiene education                             | Per education campaign per month|
| 6. Screening and diagnosis                                               | Per person screened and tested |
| 7.a. Case Management: Home-based care                                    | Per person requiring home-based care|
| 7.b. Case Management: Hospital-based (severe case)                       | Per day of hospitalisation (severe case) |
| 7.c. Case Management: Hospital-based (critical case)                     | Per day of hospitalisation (critical case) |
| 7.d. Case Management: Death                                              | Per COVID-related death        |

### 2.2.4 Defining inputs, inputs quantities and input costs

In order to calculate a unit cost for each of the abovementioned activities, we used an ingredients-based costing to identify a series of input required. For each input we estimated quantities needed and a country-specific price per quantity (see Table SM6). The costs of each input were identified using a range of sources, according to availability of recent primary cost data and appropriateness of cost estimates to the COVID-19 pattern of care. More details can be found below.

To obtain yearly costs per country, the unit costs below were then multiplied by the number of country-specific units (see Table SM12 for more details).

**Example:**

In the case of Emergency Response Mechanisms: National level (1a) we aim to calculate a cost per day. We assumed that the three inputs required per day are: (i) 10 junior-level government officials, (ii) 10 senior-level government officials, as well as (iii) meeting space and equipment for those 20 people. The salary for one day of work for one junior-level government official in Ethiopia was estimated at US$12.27, for one senior-level government official at US$17.29 and the cost of one day’s worth of space and equipment necessary for meetings was estimated at US$13.18 per person. We multiplied inputs by prices: (US$12.27 x 10) + (US$17.29 x 10) + (US$13.18 x 20), which equals US$559.26. This represents the cost per day of the emergency response mechanism at the national level.

In order to determine the annual costs per country, this number was then multiplied by the total number of working days, assumed to be 260 (see Table SM12).
## 2.2.5 Table SM6: Quantities and unit costs per input per activity per country

| Component | Number of Units per Input | Unit Cost per Inputs |
|-----------|---------------------------|----------------------|
|           | Ethiopia | Pakistan | South Africa |
| 1.a. Emergency Response Mechanisms: National level | | | |
| Working day (junior level govt) | 10 | $12.27 | $13.07 | $194.66 |
| Working day (senior level govt) | 10 | $17.29 | $23.94 | $256.72 |
| Meeting/ training costs per person per day | 20 | $13.18 | $20.44 | $159.17 |
| Total (per country per day): | | | |
| | $559.26 | $778.90 | $7,697.16 |
| 1.b. Emergency Response Mechanisms: Training of health staff | | | |
| Working day (health care workers) | 250 | $4.93 | $10.43 | $97.58 |
| Working day (junior level govt) | 10 | $12.27 | $13.07 | $194.66 |
| Working day (senior level govt) | 1 | $17.29 | $23.94 | $256.72 |
| Meeting/ training costs per person per day | 261 | $13.18 | $20.44 | $159.17 |
| Total (one-off per site): | | | |
| | $4,813.58 | $8,096.53 | $68,141.36 |
| 2. Risk communication & community engagement | | | |
| Working day (junior level govt) | 3 | $12.27 | $13.07 | $194.66 |
| Working day (senior level govt) | 2 | $17.29 | $23.94 | $256.72 |
| Media costs per day (office space) | 1 | $2.74 | $4.58 | $36.00 |
| Total (per country per day): | | | |
| | $74.14 | $91.67 | $1,133.44 |
| 3.a. Case finding, contact tracing and management: Contact tracing | | | |
| Working day (junior level govt) | 0.1 | $12.27 | $13.07 | $194.66 |
| Contact tracing household visit | 0.33 | $2.08 | $3.02 | $13.68 |
| Contact tracing phone call | 0.67 | $2.34 | $0.34 | $3.31 |
| Total (per person contacted): | | | |
| | $3.48 | $2.54 | $26.23 |
| 3.b. Case finding, contact tracing and management: Quarantine of contacts | | | |
| Working day (health care workers) | 0.1 | $4.93 | $10.43 | $97.58 |
| Working day (junior level govt) | 0.1 | $12.27 | $13.07 | $194.66 |
| Total (per person quarantined): | | | |
| | $1.72 | $2.35 | $29.22 |
| 4.a. Surveillance: Case notification | | | |
| Working day (health care workers) | 0.1 | $4.93 | $10.43 | $97.58 |
| Working day (junior level govt) | 0.1 | $12.27 | $13.07 | $194.66 |
| Total (per positive case): | | | |
| | $1.72 | $2.35 | $29.22 |
| 4.b. Surveillance: Reporting (national level) | | | |
| Working day (health care workers) | 0.5 | $4.93 | $10.43 | $97.58 |
| Working day (junior level govt) | 0.1 | $12.27 | $13.07 | $194.66 |
| Total (per country per week): | | | |
| | $3.69 | $6.52 | $68.26 |
| 5. Public health measures: Hygiene education | | | |
| Working day (junior level govt) | 2 | $12.27 | $10.43 | $97.58 |
| Working day (senior level govt) | 1 | $17.29 | $13.07 | $194.66 |
| Media costs per day | 1 | $2.74 | $4.58 | $36.00 |
| Total (per education campaign per month): | | | |
| | $44.58 | $38.51 | $425.83 |
| 6. Screening and diagnosis | | | |
| Ambulance trip | 0.0001 | $4.80 | $9.51 | $60.41 |
| Isolation pod/ diagnostic visit | 2 | $0.49 | $0.49 | $7.97 |
| Outpatient visit oral history | 1 | $3.57 | $0.47 | $8.02 |
| Outpatient visit physical exam | 1 | $3.57 | $0.47 | $8.02 |
| Outpatient visit specimen collection | 1 | $4.88 | $1.09 | $17.15 |
| COVID19 test (PCR) | 1 | $23.98 | $23.98 | $23.98 |
| Total (per person screened and tested): | | | |
| | $36.97 | $26.98 | $73.12 |
| Component                                            | Number of Units per Input | Unit Cost per Inputs          | Ethiopia | Pakistan | South Africa |
|------------------------------------------------------|---------------------------|-------------------------------|----------|----------|--------------|
| **7.a. Case Management: Home-based care**            |                           |                               |          |          |              |
| Home-based care bed-day                              | 5                         | $0.94                         | $0.61    | $11.65   |              |
| Community-based care via clinicians visit            | 2                         | $9.11                         | $4.71    | $44.16   |              |
| Total (per person requiring home-based care):        |                           |                               |          |          |              |
|                                                      |                           |                               | $22.90   | $12.45   | $146.57      |

**7.b. Case Management: Hospital-based (severe case)**

| Component                                                                 | Number of Units per Input | Unit Cost per Inputs          | Ethiopia | Pakistan | South Africa |
|---------------------------------------------------------------------------|---------------------------|-------------------------------|----------|----------|--------------|
| Inpatient ward bed-day (severe)                                           | 1                         | $29.90                        | $31.54   | $96.66   |              |
| **Diagnostics**                                                           |                           |                               |          |          |              |
| Pulse oximetry                                                            | 0.125                     | $0.00                         | $0.00    | $0.00    |              |
| Chest X-ray                                                               | 0.125                     | $27.35                        | $2.79    | $21.86   |              |
| Full blood count                                                          | 0.125                     | $2.37                         | $2.29    | $24.28   |              |
| Blood urea and electrolyte test                                          | 0.125                     | $4.20                         | $2.53    | $2.87    |              |
| C-reactive protein test                                                   | 0.125                     | $2.34                         | $0.32    | $5.15    |              |
| HIV test                                                                  | 0.125                     | $4.38                         | $3.87    | $17.13   |              |
| COVID19 test (PCR)                                                        | 0                         | $23.98                        | $23.98   | $23.98   |              |
| Malaria test                                                              | 0.125                     | $0.19                         | $0.19    | $0.19    |              |
| Haemoglobin test                                                          | 0.125                     | $2.29                         | $2.29    | $2.29    |              |
| Total (per day of hospitalisation (severe case)):                        |                           |                               | $35.29   | $33.32   | $105.88      |

**7.c. Case Management: Hospital-based (critical case)**

| Component                                                                 | Number of Units per Input | Unit Cost per Inputs          | Ethiopia | Pakistan | South Africa |
|---------------------------------------------------------------------------|---------------------------|-------------------------------|----------|----------|--------------|
| Inpatient ward bed-day (critical)                                         | 0.33                      | 30.65                         | 32.29    | 97.41    |              |
| ITU bed-day                                                               | 0.67                      | $104.48                       | $101.99  | $662.71  |              |
| **Additional resourcing per COVID-related complication**                   |                           |                               |          |          |              |
| Acute respiratory distress syndrome (ARDS)                                | 0.47                      | $22.46                        | $22.46   | $22.46   |              |
| Acute kidney injury days                                                  | 0.04                      | $10.60                        | $10.60   | $10.60   |              |
| Acute cardiac injury days                                                 | 0.06                      | $46.25                        | $46.25   | $46.25   |              |
| Liver dysfunction days                                                    | 0.06                      | $89.32                        | $89.32   | $89.32   |              |
| Pneumothorax days                                                        | 0.01                      | $6.66                         | $6.77    | $7.02    |              |
| Hospital-acquired pneumonia days                                         | 0.05                      | $18.85                        | $18.85   | $18.85   |              |
| Bacteraemia days                                                         | 0.01                      | $32.55                        | $32.55   | $32.55   |              |
| Urinary tract infection days                                              | 0.01                      | $9.03                         | $9.03    | $9.03    |              |
| Septic shock days                                                        | 0.05                      | $0.64                         | $0.67    | $0.75    |              |
| **Diagnostics**                                                           |                           |                               |          |          |              |
| Pulse oximetry                                                           | 10                        | $0.00                         | $0.00    | $0.00    |              |
| Chest X-ray                                                               | 10                        | $27.35                        | $2.79    | $21.86   |              |
| Full blood count                                                          | 10                        | $2.37                         | $2.29    | $24.28   |              |
| Blood urea and electrolyte test                                          | 10                        | $4.20                         | $2.53    | $2.87    |              |
| C-reactive protein test                                                   | 10                        | $2.34                         | $0.32    | $5.15    |              |
| Venous blood gas test                                                     | 10                        | $4.23                         | $4.23    | $4.23    |              |
| HIV test                                                                  | 0.1                       | $4.38                         | $3.87    | $17.13   |              |
| COVID19 test (PCR)                                                        | 0                         | $23.98                        | $23.98   | $23.98   |              |
| Malaria test                                                              | 0.1                       | $0.19                         | $0.19    | $0.19    |              |
| Haemoglobin test                                                          | 0.1                       | $2.29                         | $2.29    | $2.29    |              |
| Total (per day of hospitalisation (critical)):                           |                           |                               | $505.56  | $221.18  | $1,081.94    |

**7.d. Case Management: Death**

| Component | Number of Units per Input | Unit Cost per Inputs | Ethiopia | Pakistan | South Africa |
|-----------|---------------------------|----------------------|----------|----------|--------------|
| Body Bag  | 1                         | $64.52               | $64.52   | $64.52   |              |
| Total (per COVID-related death): | | | $64.52 | $64.52 | $64.52 |
2.2.6 Input quantities

Activities 1-6:
Quantities of working days required for planning and management and communication were estimated from expert consultation as part of the Disease Control Priorities 3-Universal Health Coverage (DCP3-UHC) project (19). For case finding, surveillance and diagnostic activities, quantities were estimated based on requirements for similar activities for tuberculosis (TB) such as contact tracing from the VALUE TB study and previous studies in South Africa (more below) (20, 21).

Activities 7:
The number of days per patient in general ward and in ICU was set at 8 and 10 respectively and was set to match the assumptions in the epidemiological model (2, 14, 22). Following expert clinician advise we assumed that one-third of critical patient bed days would be treated the general ward and two-thirds in the ICU.

The likelihood of additional COVID-related complications (per day) were estimated using evidence on the clinical course of COVID from patients in Wuhan, China (23), as were assumptions on the duration of symptoms (24, 25). The number of diagnostic tests per hospitalisation was carried out in consultation with expert clinicians in essential critical care.

2.2.7 Input unit costs

2.2.7.1 Estimation of non-bed-day costs (Pakistan)

An ingredients-based approach was used to calculate most of the service costs and prices for Pakistan. The data used was collected as part of the Disease Control Priorities 3-Universal Health Coverage (DCP3-UHC) project (19). For other countries primary data from the TB studies was used (see below).

For Pakistan, staff-related costs were constructed using federal-level pay scales. For most outputs, the number of minutes of staff required per activity were estimated via expert opinion obtained from clinicians working in the Health Planning, System Strengthening & Information Analysis Unit (HPSIU) in the Ministry of National Health Services Regulations and Coordination of Pakistan. For outputs where this was unavailable, health economists agreed a plausible assumed value.

Drug regimens were costed using resource use data obtained through expert opinion (HPSIU) and a number of price sources. An assessment of strengths and weaknesses of different price sources was conducted and hierarchy of sources was established. The primary source of price data was the Sindh Health Department Procurement Price list. If a price was unavailable, the Federal Wholesale Price List for Generic Medicines was used as a second option. As a last resort, private sector market prices were used.

Cost on supplies and equipment were similarly constructed. Resource use was determined through expert opinion (HPSIU) and price source hierarchy established. The primary source
was the Medical Emergency Resilience Fund 2019-2020, and a secondary source was private sector market prices.

For all countries, for additional diagnostic and radiology costs (beyond those available from the TB data) were estimated using available literature and market prices. We assessed strengths and weaknesses of different price sources. For example, we used the ‘Costing and Pricing of Services in Private Hospitals of Lahore: Summary Report’ as our primary source as it contained a methodological appendix that suggested that an ingredients-based approach consistent with ours was followed. If some prices were unavailable we used user fees from the Pakistan Institute of Medical Sciences, procurement prices from the Medical Emergency Resilience Fund procurement prices and user fees from the Aga Khan University Hospital.

Space costs were estimated using data from budget documents from the Federal government (Islamabad Capital Territory Health Infrastructure PC-1).

Oxygen therapy costs per bed-day were calculated by estimating the number of cylinders consumed in 24 hours at different flow rates, assumed to be 10L per minute in the general ward and 30L per minute in the ICU. Cylinder duration (hours) was estimated by dividing pressure by the number of litres per minute, assuming a standard cylinder size of 4.6kg, filled at 1,900 psi pressure (26). Cost per cylinder was obtained from the South African online catalogue of a manufacturer that is active in both South Africa and Pakistan (27).

2.2.7.2 Estimation of non-bed-day costs (Ethiopia and South Africa)

For Ethiopia and South Africa the main source of cost data was the VALUE TB study (20, 21). Cost data were collected from a health provider perspective to estimate the economic costs of TB-related health services. Full costs of health services were estimated. Cost data collection was retrospective, over a one-year period to minimize the risk of bias due to seasonality. Resource use was measured in the VALUE TB study using both top-down and bottom-up methods wherever possible, to allow for comparison. The costs included in the current cost model reflected an average of top-down and bottom-up costs by site. For South Africa, we also used primary data from the XTEND trial (nurses and lay health workers) (28).

Some of the COVID-19 interventions were outside the scope of the VALUE TB and XTEND studies. Values for which a primary unit cost was partially or entirely unavailable from Value TB are listed below. For these interventions, resource use data from Pakistan was used with local Ethiopian or South African prices.

- **Planning & coordination activities**: Working day (mid-level facility); Working day (junior level govt); Working day (senior level govt); Meeting/ training costs per day; Media costs per day; Health hotline (day)
- **Infection control**: Ambulance trip; Isolation pod/ diagnostic visit; Deep clean
- **Home-based care**: Home-based care bed-day; Community-based care via GP
- **Inpatient treatment**: Inpatient ward bed-day including PPE (normative scenario); ICU bed-day, including PPE (normative scenario); Severe case ward bed-day,
including PPE; Critical case ward bed-day, including PPE; ITU bed-day (‘real-world scenario’); Body disposal

- **Additional resourcing per COVID related complication:** Acute respiratory distress syndrome (ARDS); Acute kidney injury; Acute cardiac injury; Liver dysfunction; Pneumothorax; Hospital-acquired pneumonia; Bacteraemia; Urinary tract infection; Septic shock

- **Investigations (lab tests):** Pulse oximetry; Venous blood gas; Mid-stream urine test; COVID-19 confirmatory lab test (PCR); Malaria; Haemoglobin

### 2.2.7.3 Price adjustments

Where Pakistan health care inputs were applied to other settings, we classified them as tradeable or non-tradeable. For tradable inputs, where country-specific price estimates were not available from primary data or from the published literature, the estimate from Pakistan was applied to other countries. For non-tradeable inputs, the estimate from Pakistan was adjusted by an amount reflecting the difference in the two countries’ GDP (adjusted for purchasing power parity, or PPP) (see Table SM7). The rationale behind this approach is that, while exchange rate may be influenced by government policy, PPP seeks to equalise the purchasing power of different currencies and, as such, may better reflect differentials in non-tradeable prices across countries. More details on this method of price adjustment can be found in Section 2.3. Staff costs did not need to be extrapolated as we had country-specific salary information for the three countries.

### 2.2.7.4 Table SM7: Relative GDP adjustment factors

| Country     | Exchange rate (US$) | GDP per capita by country (US$ PPP) | Relative GDP (PPP): Pakistan | Relative GDP (PPP): South Africa | Relative GDP (PPP): Ethiopia |
|-------------|---------------------|------------------------------------|-------------------------------|---------------------------------|-----------------------------|
| Pakistan    | 155.00              | 5,567.06                           | 1.00                          | 0.41                            | 2.75                        |
| South Africa| 32.26               | 2,022.14                           | 2.46                          | 1.00                            | 6.77                        |
| Kenya       | 76.92               | 7,762.88                           | 0.62                          | 0.25                            | 1.71                        |
| India       | 104.17              | 3,467.56                           | 1.39                          | 0.57                            | 3.84                        |
| Ethiopia    | 16.95               | 13,686.88                          | 0.36                          | 0.15                            | 1.00                        |

### 2.2.7.5 Estimation of bed-day costs (all countries)

We took an ingredients-based approach to estimating the costs of general ward and ICU ward bed days, as these were major cost drivers in our cost model. We estimated the plausible number of nursing hours per bed day in an LMIC setting through consultation with members of the research team who have expertise in critical care in LMICs. In ICU the assumption of nurse-to-patient ratio would be 1:1; in the general ward the ratio would be 1:6 during the day time and 1:20 in the night.
To understand the full range of inputs required we obtained the underlying costing data set provided by the authors of a recent costing of hospital-based care (29). The paper reports the results of a detailed activity-based costing in a hospital in Karachi, disaggregated by phase of care. We used the cost data for the ward stay phase, removing any supplies or equipment specific to the surgery, to estimate the average generic costs of a bed-day.

All bed-day costs were compared to and validated against available country-specific estimates from the published literature and from ongoing research and WHO CHOICE (see Table SM8). Rapid literature searches were conducted on the Medline, Embase and EconLit databases on 8-9 April 2020 to identify records reporting on the costs of ICU care in each of the study countries.

We estimated the additional costs of ICU beds compared to standard hospital beds using an ingredients-based approach to cost the equipment and supplies not present in standard hospital wards. We used the procurement price of equipment and assumed depreciation over ten (ventilators and suction pumps) or five years (all other equipment). Supply costs included central and arterial lines, ventilator tubing, and sedatives.

2.2.7.6 COVID-19 specific costs

Finally, we calculated costs of supplies and inputs specific to COVID-19. Personal protective equipment (PPE) per health worker per day (see Table SM8) was calculated and allocated a cost per PPE per minute to clinical staff. We also calculated costs of hygiene per bed day (see Table SM9). We estimated the costs of PPE and hygiene supplies using a list of necessary supplies from a COVID-related budget from the Ministry of Health of Pakistan, which included local prices sourced by the Aga Kahn University. This was complemented for other countries using the WHO’s Essential Supplies Forecasting Tool (ESFT) (30). We divided supplies into single-use and disposable. We determined plausible quantities and useful life for supplies following clinical guidelines and expert opinion.

Oxygen supplementation therapy is the main form of treatment for COVID-19. There are different methods of oxygen delivery which utilise different types of supplies, equipment and require different average levels of oxygen flow. We calculated costs for 6 types of oxygen delivery techniques and assumed a distribution across severe and critical patients according to members of our research team with clinical expertise in critical care in LMICs. Table SM10 shows the assumptions used in our model and how they differ from normative standards.
## 2.2.7.7 Table SM8: PPE costs per general ward bed day and per ICU bed day

| Supply                          | Price US$ | Useful life (days) | Quantity per day | Total per member of staff per day US$ | Assumptions                              |
|---------------------------------|-----------|--------------------|------------------|---------------------------------------|------------------------------------------|
| **PPE for General Ward**       |           |                    |                  |                                       |                                          |
| Single Use                      |           |                    |                  |                                       |                                          |
| Surgical Gowns                  | 0.20      | 1                  | 1                | 0.20                                  |                                          |
| Nitrile Gloves                  | 0.05      | 1                  | 10               | 0.45                                  |                                          |
| Latex Gloves                    | 0.04      | 1                  | 10               | 0.39                                  |                                          |
| Disposable Head                 | 0.03      | 1                  | 4                | 0.10                                  |                                          |
| Shoe Covers                     | 0.02      | 1                  | 4                | 0.06                                  |                                          |
| Surgical Masks                  | 0.08      | 1                  | 10               | 0.77                                  |                                          |
| **Reusable**                    |           |                    |                  |                                       |                                          |
| Goggles                         | 11.61     | 90                 | 1.5              | 0.19                                  | Assuming half a day for washing          |
| Gum Boots                       | 19.35     | 90                 | 1.5              | 0.32                                  | Assuming half a day for washing          |
| **TOTAL**                       |           |                    |                  | 2.50                                  |                                          |
| **PPE for ICU**                 |           |                    |                  |                                       |                                          |
| Single Use                      |           |                    |                  |                                       |                                          |
| N-95 Masks                      | 0.84      | 1                  | 4                | 3.35                                  |                                          |
| Disposable apron                | 0.20      | 1                  | 1                | 0.20                                  |                                          |
| Nitrile Gloves                  | 0.05      | 1                  | 10               | 0.45                                  |                                          |
| Latex Gloves                    | 0.04      | 1                  | 10               | 0.39                                  |                                          |
| Disposable Head                 | 0.03      | 1                  | 4                | 0.10                                  |                                          |
| Shoe Covers                     | 0.02      | 1                  | 4                | 0.06                                  |                                          |
| Surgical Masks                  | 0.08      | 1                  | 10               | 0.77                                  |                                          |
| **Reusable**                    |           |                    |                  |                                       |                                          |
| Face Shields                    | 27.81     | 5                  | 1.5              | 8.34                                  | Assuming half a day for washing          |
| Goggles                         | 11.61     | 90                 | 1.5              | 0.19                                  | Assuming half a day for washing          |
| Gum Boots                       | 19.35     | 90                 | 1.5              | 0.32                                  | Assuming half a day for washing          |
| **TOTAL**                       |           |                    |                  | 14.19                                 |                                          |
2.2.7.8 Table SM9: Hygiene costs per general ward and ICU bed day

| Supply               | Price USD | Useful life (days) | Quantity per day | Total per ICU bed per day USD | Assumptions                                                                 |
|----------------------|-----------|--------------------|-----------------|-------------------------------|----------------------------------------------------------------------------|
| **Single Use**       |           |                    |                 |                               |                                                                            |
| Hand Sanitizers      | 47.97     | 1                  | 0.05            | 2.40                          | 100ml use per day, price assumed to refer to bottle of 2000ml              |
| Biohazard Bags       | 0.23      | 1                  |                 | 0.23                          |                                                                            |
| Disposable bed sheets| 1.94      | 1                  | 1               | 1.94                          |                                                                            |
| Disposable Tissue Boxes | 0.65  | 1                  | 1               | 0.65                          | 1 box per day, price assumed to refer to 1 box                           |
| Disposable Tissue rolls | 0.35 | 1                  | 1               | 0.35                          | 1 roll per day, price assumed to refer to 1 roll                         |
| Disinfectants (1L Dettol) | 3.23  | 1                  | 0.25            | 0.81                          | 250ml used per day, price refers to bottle of 1000ml                    |
| Liquid Soaps (250ml Dettol bottles) | 1.74  | 1                  | 0.2             | 0.35                          | 50ml used per day, price refers to bottle of 250ml                      |
| Ethanol (1L bottles) | 16.13     | 1                  | 0.1             | 1.61                          | 100ml used per day, price refers to bottle of 1000ml                    |
| Liquid Bleach        | 2.58      | 1                  | 0.25            | 0.65                          | 250ml used per day, price assumed to refer to bottle of 1000ml          |
| **Reusable**        |           |                    |                 |                               |                                                                            |
| Waste Bins           | 15.03     | 90                 | 1               | 0.17                          |                                                                            |
| Mackintosh bed sheets | 9.68  | 90                 | 1               | 0.11                          |                                                                            |
| Mops                 | 2.58      | 90                 | 1               | 0.03                          |                                                                            |
| Dusters              | 0.32      | 90                 | 1               | 0.00                          |                                                                            |
| **TOTAL**            |           |                    |                 | 9.28                          |                                                                            |
2.2.7.9 Table SM10: Oxygen supplementation assumptions

|                     | Normative recommendations | ‘Real-world’ scenario |
|---------------------|----------------------------|-----------------------|
|                     | Severe case                | Critical case         |
| Normative           | Acute respiratory distress syndrome | Severe pneumonia (15% of COVID cases) | Acute respiratory distress syndrome (5% of COVID cases) |
| recommendations     | Severe pneumonia (15% of COVID cases) | Critical case         |

| Supplemental oxygen management type | General ward | ICU | General ward | General ward only | ICU |
|-----------------------------------|--------------|-----|--------------|--------------------|-----|
| % ventilator                      | 0%           | 100%| 0%           | 0%                 | 50% |
| % CPAP                            | 0%           | 0%  | 0%           | 0%                 | 25% |
| % high-flow nasal cannula         | 0%           | 0%  | 0%           | 0%                 | 25% |
| % non-rebreather mask             | 25%          | 0%  | 25%          | 100%               | 0%  |
| % nasal cannula                   | 50%          | 0%  | 50%          | 0%                 | 0%  |
| % high-concentration mask         | 25%          | 0%  | 25%          | 0%                 | 0%  |
| % Patients in pathway             | 100%         | 100%| 100%         | 33%                | 67% |
2.3 Extrapolation of unit costs in base countries to calculate unit costs across LICs, Lower-MICs and Upper-MICs

We used the unit costs obtained in our three base countries to extrapolate unit costs to other LICs, Lower-MICs and Upper-MICs. We grouped countries according to income group. Costs for LICs were extrapolated using unit costs from Ethiopia, costs for LMICs were extrapolated from the unit costs from Pakistan, and those for UMICs from the unit costs from South Africa.

In order to carry out the extrapolation, each cost ingredient for each of the unit costs was classified as a tradeable good, non-tradeable good, or staff cost.

Tradeable goods are generally defined as those that can easily be traded in the international market and include goods such as medical or other supplies and medications. The unit costs for our three base countries were initially converted from each local currency into 2019 US$ using market exchange rates. To convert the tradeable good from the base country (e.g. Ethiopia) to a ‘second’ country (e.g. Afghanistan) we apportioned the percentage of the unit cost that was composed of tradeable goods in 2019 US$ from the base country to the second country.

Non-tradeable goods include buildings, heavy machinery, and other equipment. To convert these costs from a base country to a second country we used purchasing power parity (PPP) conversion rates. We multiplied the proportion of the unit cost that was defined as non-tradeable (in 2019 US$) by the ratio of the GDP per capita (adjusted for PPP) of the second county, divided by the GDP per capita (adjusted for PPP) of the base country. Data on GDP per capita (adjusted for PPP) can be found in the World Bank database (17).

To convert staff costs from a base country to a second country we used conversion rates from Serje et al (2018) (31). Serje et al (2018) use regression analysis on a dataset containing wages from health workers of different skill levels for 193 countries in order to predict wages by country income level relative to GDP per capita. We used the multiples per GDP per capita presented in the paper in order to convert the staff wages from the base country to the second country. See Table SM11.
### 2.3.1 Table SM11: Health worker earnings as a multiple of GDP per capita

| World bank income categories          | Health worker cadre   | Average earnings index (multiple of GDP per capita) |
|--------------------------------------|-----------------------|-----------------------------------------------------|
| High-income countries                | Physicians            | 1.9                                                 |
|                                      | Nurses and midwives   | 1.5                                                 |
|                                      | Other health workers  | 0.9                                                 |
| Upper-middle income countries        | Physicians            | 2.7                                                 |
|                                      | Nurses and midwives   | 2.2                                                 |
|                                      | Other health workers  | 1.3                                                 |
| Lower-middle income countries        | Physicians            | 5.1                                                 |
|                                      | Nurses and midwives   | 4.2                                                 |
|                                      | Other health workers  | 2.4                                                 |
| Lower-income countries               | Physicians            | 7.8                                                 |
|                                      | Nurses and midwives   | 6.4                                                 |
|                                      | Other health workers  | 3.7                                                 |
| Global                               | Physicians            | 4.4                                                 |
|                                      | Nurses and midwives   | 3.6                                                 |
|                                      | Other health workers  | 2.1                                                 |
2.4 Calculation of country-specific number of units per activity

The unit cost in each of the 76 countries was used to calculate the total costs per activity per country. Table SM12 shows the quantities that those unit costs were multiplied by in order to calculate the total costs per country, as well as their justification and source.

2.4.1 Table SM12: Number of country-specific units per activity

| Activity                                                                 | Unit Type                      | Quantities per country | Value | Source                           |
|--------------------------------------------------------------------------|--------------------------------|------------------------|-------|----------------------------------|
| 1.a. Emergency Response Mechanisms: National level                       | Per country per day            | Number of working days per year | 260   | Assumption                       |
| 1.b. Emergency Response Mechanisms: Training of health staff             | One-off per site               | Total number of clinical sites | Variable per Country | Calculated by assuming one site for every 200 hospital beds available in the country (32) |
| 2. Risk communication & community engagement                             | Per country per day            | Number of calendar days per year | 365   | N/A                              |
| 3.a. Case finding, contact tracing and management: Contact tracing        | Per person contacted           | Total number of COVID19 cases * | Variable by country | See Table SM4                    |
|                                                                          | % cases that are symptomatic * | 69%                    | (33)  |                                  |
|                                                                          | % of symptomatic cases tested *| 10%                    | Assumption |                                  |
|                                                                          | Average number of contacts per COVID19-positive case | 7 | (34) |                                  |
| 3.b. Case finding, contact tracing and management: Quarantine of contacts | Per person quarantined         | Total number of COVID19 cases * | Variable by country | See Table SM4                    |
|                                                                          | % cases that are symptomatic * | 69%                    | (33)  |                                  |
|                                                                          | % of symptomatic cases tested *| 10%                    | Assumption |                                  |
|                                                                          | Average number of contacts per COVID19-positive case | 7 | (34) |                                  |
| 4.a. Surveillance: Case notification                                     | Per positive case              | Total number of COVID19 cases * | Variable per Country | See Table SM4                    |
|                                                                          | % cases that are symptomatic * | 69%                    | (33)  |                                  |
| Activity                                           | Unit Type                                      | Quantities per country                      | Value            | Source                                                                 |
|---------------------------------------------------|-----------------------------------------------|---------------------------------------------|------------------|-------------------------------------------------------------------------|
| 4.b. Surveillance: Reporting (national level)     | Per country per day                           | Total number of clinical sites *            | Variable per Country | Calculated by assuming one site for every 200 hospital beds available in the country (32) |
|                                                   |                                               | % of symptomatic cases tested *             | 10%              | Assumption                                                              |
|                                                   |                                               | Weeks per year                             | 52               | N/A                                                                     |
| 5. Public health measures: Hygiene education      | Per education campaign                        | Months per year                            | 12               | N/A                                                                     |
| 6. Screening and diagnosis‡                       | Per person screened and tested                | (Total number of COVID19 cases *           | Variable per Country | See Table SM4                                                           |
|                                                   |                                               | % of cases requiring hospitalisation *      | 18.50%           | (2, 14)                                                                 |
|                                                   |                                               | Number of people tested per positive case +| 11.31            | See Table SM13                                                           |
|                                                   |                                               | (Total number of COVID19 cases *           | Variable per Country | See Table SM4                                                           |
|                                                   |                                               | % cases that are symptomatic *             | 69%              | (33)                                                                    |
|                                                   |                                               | % of symptomatic cases tested *             | 10%              | Assumption                                                              |
|                                                   |                                               | Number of people tested per positive case  | 11.31            | See Table SM13                                                           |
| 7.a. Case Management: Home-based care‡           | Per person requiring home-based care          | Proportion of borderline mild-to-severe cases | 10%              | Assumption                                                              |
| 7.b. Case Management: Hospital-based (severe case)‡ | Per day of hospitalisation (severe case)      | Average number of days of hospitalisation for severe cases | 8               | (2, 22)                                                                 |
| 7.c. Case Management: Hospital-based (critical case)‡ | Per day of hospitalisation (critical case)    | Average number of days of hospitalisation for critical cases | 10              | (2, 14)                                                                 |
| 7.d. Case Management: Death‡                      | Per COVID-related death                       | Total number of deaths from COVID19        | Variable per Country | See Table SM4                                                           |

Note: Scenario 1 modelled an unmitigated epidemic. Therefore, only activities marked with ‡ were included in calculating the costs for Scenario 1. Scenarios 2-4 included costs in all the activities mentioned in Table SM13.
### 2.4.2. Table SM13: Test positivity rate by country and average

| Country      | % of positive tests | Source |
|--------------|---------------------|--------|
| South Africa | 0.169               | (35)   |
| Kenya        | 0.103               | (34)   |
| Ethiopia     | 0.0739              | (36)   |
| India        | 0.0612              | (37)   |
| Pakistan     | 0.0351              | (38)   |
| **Average**  | **0.08844**         |        |

### 2.5 Country-specific per capita costs and per capita costs as a proportion of gross domestic product (GDP) per capita and other measures of health expenditure per capita

Total costs per country were used to calculate the COVID-19-related costs per capita per country per scenario by dividing the total costs by the population of the country (17). The cost per capita was then calculated as a proportion of GDP per capita (nominal) (17) and three measures of health expenditure per capita (39): 1) total health expenditure including out-of-pocket payments, 2) total health expenditure excluding out-of-pocket payments, and 3) government health spending per capita. Data on GDP per capita and health expenditure per capita per country can be found in Table SM14.
### 2.5.1 Table SM14: Population, GDP and health spending per country

| Country       | Country income classification | Total population per country | Gross Domestic Product per Capita (Nominal) (US$) | Gross Domestic Product per Capita (PPP) (US$) | Total Health Spending per Capita (including out-of-pocket spending) (US$) | Total Health Spending per Capita (excluding out-of-pocket spending) (US$) | Government Health Spending per Capita (US$) |
|---------------|-------------------------------|-------------------------------|-----------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------|
| Afghanistan   | LIC                           | 37,172,396                   | $251                                          | $1,955                                        | $271                                                                     | $102                                                                       | $3                                                        |
| Albania       | Upper-MIC                     | 2,866,376                    | $5,269                                        | $13,364                                       | $272                                                                     | $429                                                                       | $112                                                      |
| Algeria       | Upper-MIC                     | 42,228,429                   | $4,115                                        | $15,482                                       | $260                                                                     | $341                                                                       | $176                                                      |
| American Samoa | Upper-MIC                    | 55,465                        | $11,467                                       | N/A                                           | $900                                                                     | $129                                                                       | $9                                                       |
| Anguilla      | Lower-MIC                     | 30,809,762                   | $3,432                                        | $6,452                                        | $95                                                                     | $123                                                                       | $42                                                      |
| Argentina     | Upper-MIC                     | 44,494,502                   | $11,684                                       | $20,611                                       | $955                                                                     | $1,106                                                                     | $711                                                     |
| Armenia       | Upper-MIC                     | 2,951,776                    | $4,212                                        | $10,343                                       | $359                                                                     | $648                                                                       | $59                                                      |
| Azerbaijan    | Upper-MIC                     | 9,942,334                    | $4,721                                        | $18,044                                       | $268                                                                     | $480                                                                       | $54                                                      |
| Bangladesh    | Lower-MIC                     | 161,356,039                  | $1,698                                        | $4,372                                        | $344                                                                     | $59                                                                        | $6                                                        |
| Belarus       | Upper-MIC                     | 9,485,386                    | $6,290                                        | $19,995                                       | $318                                                                     | $432                                                                       | $195                                                     |
| Belize        | Upper-MIC                     | 383,071                      | $4,885                                        | $8,648                                        | $304                                                                     | $373                                                                       | $201                                                     |
| Benin         | LIC                           | 11,485,048                   | $902                                          | $2,425                                        | $30                                                                     | $44                                                                        | $6                                                        |
| Bhutan        | Lower-MIC                     | 754,994                      | $3,243                                        | $10,168                                       | $96                                                                     | $110                                                                       | $68                                                      |
| Bolivia       | Lower-MIC                     | 11,353,142                   | $3,549                                        | $7,873                                        | $213                                                                     | $273                                                                       | $140                                                     |
| Bosnia and Herzegovina | Upper-MIC | 3,323,929                   | $6,066                                        | $14,624                                       | $444                                                                     | $571                                                                       | $314                                                     |
| Botswana      | Upper-MIC                     | 2,284,126                    | $8,259                                        | $18,616                                       | $380                                                                     | $400                                                                       | $212                                                     |
| Brazil        | Upper-MIC                     | 209,469,333                  | $8,921                                        | $16,096                                       | $1,016                                                                   | $1,458                                                                     | $338                                                     |
| Bulgaria      | Upper-MIC                     | 7,024,216                    | $9,273                                        | $21,960                                       | $962                                                                     | $906                                                                       | $310                                                     |
| Burkina Faso  | LIC                           | 19,751,535                   | $775                                          | $1,985                                        | $81                                                                     | $54                                                                        | $16                                                      |
| Burundi       | LIC                           | 11,175,378                   | $272                                          | $744                                          | $18                                                                     | $24                                                                        | $5                                                        |
| Cabo Verde    | Lower-MIC                     | 543,767                      | $3,635                                        | $7,454                                        | $159                                                                     | $200                                                                       | $90                                                      |
| Cambodia      | Lower-MIC                     | 16,249,798                   | $1,510                                        | $4,361                                        | $78                                                                     | $123                                                                       | $17                                                      |
| Cameroon      | Lower-MIC                     | 25,216,237                   | $1,534                                        | $3,785                                        | $96                                                                   | $109                                                                       | $9                                                       |
| Central African Republic | LIC | 4,666,377                   | $476                                          | $860                                          | $16                                                                     | $23                                                                        | $2                                                        |
| Chad          | LIC                           | 15,477,751                   | $728                                          | $1,968                                        | $32                                                                     | $51                                                                        | $36                                                      |
| China         | Upper-MIC                     | 1,392,730,000                | $9,771                                        | $18,237                                       | $398                                                                     | $541                                                                       | $231                                                     |
| Colombia      | Upper-MIC                     | 49,648,685                   | $6,668                                        | $15,013                                       | $340                                                                     | $409                                                                       | $216                                                     |
| Comoros       | Lower-MIC                     | 832,322                      | $1,415                                        | $2,913                                        | $90                                                                     | $102                                                                       | $9                                                        |
| Congo, Dem. Rep. | LIC                         | 84,068,091                   | $562                                          | $932                                          | $91                                                                     | $28                                                                        | $3                                                        |
| Congo, Rep.   | Lower-MIC                     | 5,244,383                    | $2,148                                        | $5,662                                        | $70                                                                     | $105                                                                       | $30                                                      |
| Costa Rica    | Upper-MIC                     | 4,959,441                    | $12,027                                       | $17,871                                       | $389                                                                     | $1,086                                                                      | $664                                                     |
| Cote d'Ivoire | Lower-MIC                     | 25,069,229                   | $1,716                                        | $4,207                                        | $368                                                                     | $95                                                                       | $17                                                      |
| Cuba          | Upper-MIC                     | 11,338,138                   | $8,822                                        | N/A                                           | $971                                                                     | $1,071                                                                      | $870                                                     |
| Djibouti      | Lower-MIC                     | 958,920                      | $3,083                                        | N/A                                           | $70                                                                     | $88                                                                        | $32                                                      |
| Dominica      | Upper-MIC                     | 71,625                       | $7,691                                        | $11,130                                       | $419                                                                     | $542                                                                       | $269                                                     |
| Dominican Republic | Upper-MIC | 10,827,165                 | $8,051                                        | $17,748                                       | $414                                                                     | $599                                                                       | $189                                                     |
| Ecuador       | Upper-MIC                     | 17,094,357                   | $6,345                                        | $11,734                                       | $305                                                                     | $709                                                                       | $258                                                     |
| Egypt, Arab Rep. | Lower-MIC                    | 98,423,595                   | $2,549                                        | $12,412                                       | $131                                                                     | $212                                                                       | $38                                                      |
| El Salvador   | Lower-MIC                     | 6,420,144                    | $4,058                                        | $8,332                                        | $294                                                                     | $314                                                                       | $189                                                     |
| Equatorial Guinea | Upper-MIC                   | 1,308,914                    | $10,262                                       | $22,744                                       | $281                                                                     | $486                                                                       | $66                                                      |
| Eritrea       | LIC                           | 1,136,191                    | $4,146                                        | $10,638                                       | $221                                                                     | $242                                                                       | $153                                                     |
| Ethiopia      | LIC                           | 109,224,559                  | $772                                          | $2,022                                        | $28                                                                     | $38                                                                        | $8                                                       |
| Fiji          | Upper-MIC                     | 883,483                      | $6,267                                        | $10,879                                       | $180                                                                     | $217                                                                       | $115                                                     |
| Gabon         | Upper-MIC                     | 2,119,275                    | $7,953                                        | $17,876                                       | $220                                                                     | $270                                                                       | $142                                                     |
| Country                          | Country income classification | Total population per country | Gross Domestic Product per Capita (Nominal) (US$) | Gross Domestic Product per Capita (PPP) (US$) | Total Health Spending per Capita (including out-of-pocket spending) (US$) | Total Health Spending per Capita (excluding out-of-pocket spending) (US$) | Government Health Spending per Capita (US$) |
|---------------------------------|------------------------------|------------------------------|--------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------|
| Gambia, The                     | LIC                          | 2,280,102                    | $916                                             | $2,612                                        | $916                                                                     | $2,612                                                                     | $916                                         |
| Georgia                         | Upper-MIC                    | 3,731,000                    | $4,717                                           | $12,005                                       | $308                                                                     | $479                                                                     | $113                                         |
| Ghana                           | Lower-MIC                    | 29,767,108                   | $2,502                                           | $4,747                                        | $368                                                                     | $93                                                                      | $26                                          |
| Grenada                         | Upper-MIC                    | 111,454                      | $10,640                                          | $15,558                                       | $516                                                                     | $815                                                                     | $213                                         |
| Guatemala                       | Upper-MIC                    | 17,247,307                   | $4,549                                           | $8,462                                        | $341                                                                     | $370                                                                     | $90                                          |
| Guyana                          | LIC                          | 12,414,318                   | $879                                             | $2,505                                        | $377                                                                     | $56                                                                      | $35                                          |
| Guinea-Bissau                   | LIC                          | 1,874,309                    | $778                                             | $1,799                                        | $39                                                                      | $53                                                                      | $17                                          |
| Haiti                           | Upper-MIC                    | 11,123,176                   | $868                                             | $1,867                                        | $38                                                                      | $53                                                                      | $96                                          |
| Honduras                        | Lower-MIC                    | 9,587,522                    | $2,500                                           | $5,139                                        | $200                                                                     | $289                                                                     | $92                                          |
| India                           | Lower-MIC                    | 1,352,617,328                | $2,010                                           | $7,763                                        | $93                                                                      | $103                                                                     | $16                                          |
| Indonesia                       | Lower-MIC                    | 267,663,435                  | $3,894                                           | $13,080                                       | $112                                                                     | $153                                                                     | $50                                          |
| Iran, Islamic Rep.              | Upper-MIC                    | 81,800,269                   | $5,628                                           | N/A                                           | $415                                                                     | $577                                                                     | $226                                         |
| Iraq                            | Upper-MIC                    | 38,433,600                   | $5,834                                           | $17,436                                       | $153                                                                     | $272                                                                     | $32                                          |
| Jamaica                         | Upper-MIC                    | 2,934,855                    | $9,354                                           | $9,327                                        | $296                                                                     | $363                                                                     | $179                                         |
| Jordan                          | Upper-MIC                    | 9,956,011                    | $4,242                                           | $9,479                                        | $224                                                                     | $286                                                                     | $141                                         |
| Kazakhstan                      | Upper-MIC                    | 18,276,499                   | $9,813                                           | $27,880                                       | $262                                                                     | $355                                                                     | $154                                         |
| Kenya                           | Lower-MIC                    | 51,393,010                   | $1,711                                           | $3,468                                        | $66                                                                      | $85                                                                      | $24                                          |
| Kiribati                        | Lower-MIC                    | 115,847                      | $1,625                                           | $2,294                                        | $188                                                                     | $188                                                                     | $116                                         |
| Korea, Dem. People’s Rep.       | LIC                          | 25,549,819                   | N/A                                              | N/A                                           | N/A                                                                     | N/A                                                                     | N/A                                          |
| Kosovo                          | Upper-MIC                    | 1,845,300                    | $4,302                                           | $11,348                                       | $236                                                                     | $155                                                                     | $228                                         |
| Kyrgyz Republic                 | Upper-MIC                    | 6,315,800                    | $1,281                                           | $3,885                                        | $273                                                                     | $115                                                                     | $28                                          |
| Laos PDR                        | Lower-MIC                    | 7,061,507                    | $2,542                                           | $7,440                                        | $355                                                                     | $81                                                                      | $18                                          |
| Lebanon                         | Lower-MIC                    | 6,848,925                    | $8,270                                           | $13,081                                       | $366                                                                     | $875                                                                     | $345                                         |
| Lesotho                         | Lower-MIC                    | 2,108,132                    | $1,299                                           | $3,219                                        | $96                                                                      | $102                                                                     | $55                                          |
| Liberia                         | LIC                          | 4,818,977                    | $677                                             | $1,309                                        | $368                                                                     | $101                                                                     | $10                                          |
| Libya                           | Upper-MIC                    | 6,678,567                    | $7,242                                           | $20,764                                       | $300                                                                     | $300                                                                     | N/A                                          |
| Madagascar                      | LIC                          | 26,262,368                   | $528                                             | $1,891                                        | $32                                                                      | $30                                                                      | $11                                          |
| Malawi                          | LIC                          | 16,143,315                   | $389                                             | $1,311                                        | $30                                                                      | $33                                                                      | $38                                          |
| Malaysia                        | Upper-MIC                    | 31,528,585                   | $11,313                                          | $31,782                                       | $362                                                                     | $497                                                                     | $182                                         |
| Maldives                        | Upper-MIC                    | 515,696                      | $10,331                                          | $15,306                                       | $1,048                                                                   | $1,248                                                                   | $370                                         |
| Mali                            | LIC                          | 19,077,690                   | $900                                             | $2,317                                        | $30                                                                      | $40                                                                      | $39                                          |
| Marshall Islands                | LIC                          | 58,413                       | $3,788                                           | $3,989                                        | $88                                                                      | $88                                                                      | $178                                         |
| Mauritania                      | Lower-MIC                    | 4,403,319                    | $1,189                                           | $4,151                                        | $377                                                                     | $71                                                                      | $17                                          |
| Mauritius                       | Upper-MIC                    | 1,265,303                    | $11,239                                          | $23,751                                       | $953                                                                     | $819                                                                     | $244                                         |
| Mexico                          | Upper-MIC                    | 126,190,788                  | $9,673                                           | $19,845                                       | $462                                                                     | $648                                                                     | $241                                         |
| Micronesia, Fed. Sts.           | Lower-MIC                    | 112,640                      | $3,568                                           | $3,553                                        | $387                                                                     | $397                                                                     | $108                                         |
| Moldova                         | Lower-MIC                    | 3,345,883                    | $3,227                                           | $7,272                                        | $171                                                                     | $250                                                                     | $84                                          |
| Mongolia                        | Lower-MIC                    | 3,170,208                    | $1,422                                           | $13,800                                       | $141                                                                     | $191                                                                     | $80                                          |
| Montenegro                      | Upper-MIC                    | 622,345                      | $8,844                                           | $20,690                                       | $532                                                                     | $660                                                                     | $399                                         |
| Morocco                         | Lower-MIC                    | 36,029,138                   | $3,238                                           | $8,587                                        | $171                                                                     | $255                                                                     | $80                                          |
| Mozambique                      | LIC                          | 29,495,962                   | $499                                             | $1,460                                        | $19                                                                      | $21                                                                      | $10                                          |
| Myanmar                         | Lower-MIC                    | 53,708,395                   | $1,326                                           | $6,674                                        | $96                                                                      | $108                                                                     | $12                                          |
| Namibia                         | Upper-MIC                    | 2,448,255                    | $5,931                                           | $11,102                                       | $403                                                                     | $434                                                                     | $249                                         |
| Nauru                           | Upper-MIC                    | 12,704                       | $9,889                                           | $16,504                                       | $1,012                                                                   | $1,024                                                                   | $615                                         |
| Nepal                           | LIC                          | 28,087,871                   | $1,034                                           | $3,090                                        | $45                                                                      | $71                                                                      | $88                                          |
| Country                  | Country income classification | Total population per country | Gross Domestic Product per Capita (Nominal) (US$) | Gross Domestic Product per Capita (PPP) (US$) | Total Health Spending per Capita (including out-of-pocket spending) (US$) | Total Health Spending per Capita (excluding out-of-pocket spending) (US$) | Government Health Spending per Capita (US$) |
|-------------------------|-------------------------------|------------------------------|--------------------------------------------------|------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------|
| Nicaragua               | Lower-MIC                     | 6,465,513                    | $2,029                                           | $5,534                                          | $188                                                                    | $249                                                                                       | $115                                         |
| Niger                   | LIC                           | 22,442,348                   | $414                                            | $1,063                                          | $23                                                      | $36                                                                                       | $36                                          |
| Nigeria                 | Lower-MIC                     | 198,874,740                  | $2,028                                          | $5,991                                          | $79                                                     | $199                                                                                       | $16                                         |
| North Macedonia         | Upper-MIC                     | 2,082,958                    | $6,084                                          | $16,359                                         | $328                                                    | $444                                                                                       | $208                                         |
| Pakistan                | Lower-MIC                     | 212,215,030                  | $1,482                                          | $5,567                                          | $40                                                      | $65                                                                                       | $11                                         |
| Papua New Guinea        | Lower-MIC                     | 8,606,316                    | $2,730                                          | $4,336                                          | $55                                                      | $59                                                                                       | $39                                         |
| Paraguay                | Upper-MIC                     | 6,956,071                    | $5,822                                          | $13,600                                         | $327                                                    | $451                                                                                       | $169                                        |
| Peru                    | Upper-MIC                     | 31,889,256                   | $6,941                                          | $14,418                                         | $316                                                    | $406                                                                                       | $203                                        |
| Philippines             | Lower-MIC                     | 106,651,922                  | $3,103                                          | $8,951                                          | $129                                                    | $199                                                                                       | $41                                         |
| Romania                 | Upper-MIC                     | 19,473,936                   | $12,301                                         | $28,206                                         | $476                                                    | $575                                                                                       | $372                                        |
| Russian Federation      | Upper-MIC                     | 144,476,050                  | $11,289                                         | $27,147                                         | $449                                                    | $659                                                                                       | $267                                        |
| Rwanda                  | LIC                           | 12,301,939                   | $773                                            | $2,252                                          | $48                                                      | $51                                                                                       | $18                                         |
| Samoa                   | Upper-MIC                     | 196,130                      | $4,183                                          | $6,484                                          | $327                                                    | $254                                                                                       | $113                                        |
| Sao Tome and Principe   | Lower-MIC                     | 211,028                      | $2,001                                          | $3,419                                          | $105                                                    | $120                                                                                       | $42                                         |
| Senegal                 | Lower-MIC                     | 15,854,360                   | $1,522                                          | $3,783                                          | $53                                                      | $80                                                                                       | $18                                         |
| Serbia                  | Upper-MIC                     | 6,982,084                    | $7,247                                          | $17,435                                         | $494                                                    | $695                                                                                       | $287                                        |
| Sierra Leone            | LIC                           | 7,850,154                    | $534                                            | $1,602                                          | $86                                                      | $122                                                                                       | $10                                         |
| Solomon Islands         | Lower-MIC                     | 652,858                      | $2,138                                          | $2,423                                          | $106                                                    | $111                                                                                       | $74                                         |
| Somalia                 | LIC                           | 15,008,154                   | $315                                            | N/A                                             | N/A                                                      | N/A                                                                                       | N/A                                         |
| South Africa            | Upper-MIC                     | 57,779,622                   | $6,374                                          | $13,687                                         | $428                                                    | $461                                                                                       | $230                                        |
| South Sudan             | LIC                           | 10,975,920                   | $1,120                                          | N/A                                             | N/A                                                      | N/A                                                                                       | N/A                                         |
| Sri Lanka               | Upper-MIC                     | 216,810,000                  | $4,102                                          | $13,474                                         | $153                                                    | $230                                                                                       | $66                                         |
| St. Lucia               | Upper-MIC                     | 181,889                      | $10,566                                         | $12,881                                         | $490                                                    | $728                                                                                       | $206                                        |
| St. Vincent and the Grenadines | Upper-MIC       | 110,210                      | $7,361                                          | $12,288                                         | $250                                                    | $302                                                                                       | $192                                        |
| Sudan                   | Lower-MIC                     | 41,801,533                   | $977                                            | $4,759                                          | $472                                                    | $264                                                                                       | $30                                         |
| Suriname                | Upper-MIC                     | 575,991                      | $6,234                                          | $15,510                                         | $336                                                    | $434                                                                                       | $247                                        |
| Syrian Arab Republic    | LIC                           | 16,906,283                   | $2,033                                          | N/A                                             | N/A                                                      | N/A                                                                                       | N/A                                         |
| Tajikistan              | LIC                           | 9,100,837                    | $827                                            | $3,450                                          | $96                                                      | $99                                                                                       | $16                                         |
| Tanzania                | LIC                           | 56,318,348                   | $1,051                                          | $3,227                                          | $35                                                      | $43                                                                                       | $14                                         |
| Thailand                | Upper-MIC                     | 69,428,524                   | $7,274                                          | $19,051                                         | $222                                                    | $249                                                                                       | $173                                        |
| Timor-Leste             | Lower-MIC                     | 1,267,972                    | $2,036                                          | $7,658                                          | $80                                                      | $87                                                                                       | $45                                         |
| Togo                    | LIC                           | 7,889,094                    | $679                                            | $1,774                                          | $39                                                      | $58                                                                                       | $88                                         |
| Tonga                   | Upper-MIC                     | 103,197                      | $4,364                                          | $6,420                                          | $203                                                    | $225                                                                                       | $134                                        |
| Tunisia                 | Lower-MIC                     | 11,565,204                   | $3,448                                          | $12,503                                         | $257                                                    | $359                                                                                       | $145                                        |
| Turkey                  | Upper-MIC                     | 82,319,724                   | $9,370                                          | $28,069                                         | $449                                                    | $546                                                                                       | $368                                        |
| Turkmenistan            | Upper-MIC                     | 5,850,908                    | $6,967                                          | $19,304                                         | $423                                                    | $745                                                                                       | $378                                        |
| Tuvalu                  | Upper-MIC                     | 11,508                       | $3,701                                          | $4,050                                          | $507                                                    | $511                                                                                       | $429                                        |
| Uganda                  | LIC                           | 42,723,139                   | $643                                            | $2,038                                          | $38                                                      | $53                                                                                       | $36                                         |
| Ukraine                 | Lower-MIC                     | 44,822,516                   | $3,095                                          | $9,233                                          | $141                                                    | $218                                                                                       | $60                                         |
| Uzbekistan              | Lower-MIC                     | 32,955,400                   | $1,532                                          | $8,556                                          | $135                                                    | $206                                                                                       | $62                                         |
| Vanuatu                 | Lower-MIC                     | 292,680                      | $3,124                                          | $3,221                                          | $110                                                    | $119                                                                                       | $59                                         |
| Venezuela, RB           | Upper-MIC                     | 28,870,195                   | $16,054                                         | N/A                                             | N/A                                                      | N/A                                                                                       | N/A                                         |
| Vietnam                 | Lower-MIC                     | 95,540,395                   | $2,567                                          | $7,448                                          | $123                                                    | $178                                                                                       | $58                                         |
| Country          | Country income classification | Total population per country (in thousands) | Gross Domestic Product per Capita (Nominal) (US$) | Gross Domestic Product per Capita (PPP) (US$) | Total Health Spending per Capita (including out-of-pocket spending) (US$) | Total Health Spending per Capita (excluding out-of-pocket spending) (US$) | Government Health Spending per Capita (US$) |
|------------------|--------------------------------|---------------------------------------------|--------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------|
| West Bank and Gaza | Lower-MIC                         | 4,569,087                                   | $3,199                                           | $5,158                                        | N/A                                                                      | N/A                                                                      | N/A                                     |
| Yemen, Rep.      | LIC                                 | 28,498,887                                  | $944                                             | $2,575                                        | 37                                                                       | $130                                                                     | 37                                      |
| Zambia           | Lower-MIC                          | 17,351,822                                  | $1,540                                           | $4,224                                        | $57                                                                      | $63                                                                      | $22                                     |
| Zimbabwe         | Lower-MIC                          | 14,439,018                                  | $2,147                                           | $3,030                                        | $94                                                                      | $114                                                                     | $44                                     |
2.6 Confirmed cases to date

The table below shows the number of cases confirmed in each country from the start of the pandemic to the end of January 2021, obtained from Dong et al. (2020) (40).

2.6.1 Table SM15: Number of confirmed cases of COVID-19 up to 31 January 2021

| Country                    | Cases reported to 31 January 2021 |
|----------------------------|-----------------------------------|
| Afghanistan                | 55,008                            |
| Algeria                    | 107,122                           |
| Angola                     | 19,782                            |
| Argentina                  | 1,922,264                         |
| Bangladesh                 | 534,770                           |
| Benin                      | 3786                              |
| Bolivia                    | 215,397                           |
| Botswana                   | 21,293                            |
| Brazil                     | 9,176,975                         |
| Burkina Faso               | 10,580                            |
| Burundi                    | 1613                              |
| Cabo Verde                 | 13,981                            |
| Cambodia                   | 465                               |
| Cameroon                   | 29,617                            |
| Central African Republic   | 4981                              |
| Chad                       | 3347                              |
| Colombia                   | 2,086,806                         |
| Comoros                    | 2718                              |
| Congo, Dem. Rep.           | 22,604                            |
| Congo, Rep.                | 7887                              |
| Costa Rica                 | 193,276                           |
| Cote d’Ivoire              | 28,178                            |
| Dominican Republic         | 212,553                           |
| Ecuador                    | 249,779                           |
| Egypt, Arab Rep.           | 165,418                           |
| El Salvador                | 53,989                            |
| Equatorial Guinea          | 5516                              |
| Eswatini                   | 15,666                            |
| Ethiopia                   | 137,021                           |
| Gabon                      | 10,748                            |
| Gambia, The                | 4090                              |
| Ghana                      | 65,427                            |
| Guatemala                  | 159,118                           |
| Guinea                     | 14,475                            |
| Guinea-Bissau              | 2532                              |
| Haiti                      | 11,460                            |
| Honduras                   | 147,100                           |
| India                      | 10,746,174                        |
| Iraq                       | N/A                               |

Supplemental material

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| Country                  | Cases reported to 31 January 2021 |
|-------------------------|-----------------------------------|
| Jordan                  | 325,674                           |
| Kenya                   | 100,675                           |
| Lebanon                 | 298,913                           |
| Lesotho                 | 8649                              |
| Liberia                 | 1939                              |
| Libya                   | 117,650                           |
| Madagascar              | 18,743                            |
| Malawi                  | 23,497                            |
| Mali                    | 8069                              |
| Mauritania              | 16,608                            |
| Mauritius               | 569                               |
| Mexico                  | 1,857,230                         |
| Morocco                 | 470,691                           |
| Mozambique              | 37,705                            |
| Namibia                 | 33,832                            |
| Nepal                   | 270,854                           |
| Nicaragua               | 6253                              |
| Niger                   | 4516                              |
| Nigeria                 | 130,557                           |
| Pakistan                | 544,813                           |
| Paraguay                | 132,548                           |
| Peru                    | 1,133,022                         |
| Sao Tome and Principe   | 1256                              |
| Senegal                 | 26,213                            |
| Sierra Leone            | 3528                              |
| South Africa            | 1,449,236                         |
| Sri Lanka               | 63,293                            |
| Sudan                   | 29,291                            |
| Syrian Arab Republic    | 13,998                            |
| Tajikistan              | 13,308                            |
| Tanzania                | 509                               |
| Togo                    | 5041                              |
| Tunisia                 | 207,468                           |
| Turkey                  | 2,470,901                         |
| Uganda                  | N/A                               |
| West Bank and Gaza      | N/A                               |
| Yemen, Rep.             | 2120                              |
| Zambia                  | 53,352                            |
| Zimbabwe                | 33,273                            |
3. References

1. Backer JA, Klinkenberg D, Wallinga J. Incubation period of 2019 novel coronavirus (2019-nCoV) infections among travellers from Wuhan, China, 20-28 January 2020. Euro Surveill. 2020;25(5).

2. Pearson C, van Zandvoort K, Jarvis C, Davies N, Checchi F, CMMID nCov Working Group, et al. Projections of COVID-19 epidemics in LMIC countries. Update: June 2020. [Available from: https://cmmid.github.io/topics/covid19/LMIC-projection-reports.html.]

3. Davies NG, Kleppac P, Liu Y, Prem K, Jit M, group CC-w, et al. Age-dependent effects in the transmission and control of COVID-19 epidemics. Nat Med. 2020;26(8):1205-11.

4. Prem K, Cook AR, Jit M. Projecting social contact matrices in 152 countries using contact surveys and demographic data. PLoS Comput Biol. 2017;13(9):e1005697.

5. WorldPop, Center for International Earth Science Information Network, (CIESIN). 2020.

6. Rees EM, Nightingale ES, Jafari Y, Waterlow NR, Clifford S, Pearson CAB, et al. COVID-19 length of hospital stay: a systematic review and data synthesis. medRxiv. 2020.2020.04.30.20084780.

7. Bhatraju PK, Ghassemieh BJ, Nichols M, Kim R, Jerome KR, Nalla AK, et al. COVID-19 in Critically Ill Patients in the Seattle Region - Case Series. N Engl J Med. 2020;382(21):2012-22.

8. Cai Q, Huang D, Ou P, Yu H, Zhu Z, Xia Z, et al. COVID-19 in a designated infectious diseases hospital outside Hubei Province, China. Allergy. 2020;75(7):1742-52.

9. Chen J, Qi T, Liu L, Ling Y, Qian Z, Li T, et al. Clinical progression of patients with COVID-19 in Shanghai, China. J Infect. 2020;80(5):e1-e6.

10. Liu L, Gao J-Y, Hu W-m, Zhang X-x, Guo L, Liu C-q, et al. Clinical characteristics of 51 patients discharged from hospital with COVID-19 in Chongqing, China. medRxiv. 2020;2020.02.20.20025536.

11. Walker PG, Whittaker C, Watson O, Baguelin M, Ainslie K, Bhatia S, et al. The global impact of covid-19 and strategies for mitigation and suppression. WHO Collaborating Centre for Infectious Disease Modelling, MRC Centre for Global Infectious Disease Analysis, Abdul Latif Jameel Institute for Disease and Emergency Analytics, Imperial College London. 2020.

12. Xie H, Zhao J, Lian N, Lin S, Xie Q, Zhuo H. Clinical characteristics of non-ICU hospitalized patients with coronavirus disease 2019 and liver injury: A retrospective study. Liver Int. 2020;40(6):1321-6.

13. Zhao W, Yu S, Zha X, Wang N, Pang Q, Li D, et al. Clinical characteristics and durations of hospitalized patients with COVID-19 in Beijing: a retrospective cohort study. medRxiv. 2020;2020.03.13.20035436.

14. Cao B, Wang Y, Wen D, Liu W, Wang J, Fan G, et al. A Trial of Lopinavir-Ritonavir in Adults Hospitalized with Severe Covid-19. N Engl J Med. 2020;382(19):1787-99.

15. Linton NM, Kobayashi T, Yang Y, Hayashi K, Akhmetzhanov AR, Jung SM, et al. Incubation Period and Other Epidemiological Characteristics of 2019 Novel Coronavirus Infections with Right Truncation: A Statistical Analysis of Publicly Available Case Data. J Clin Med. 2020;9(2).

16. Davies NG, Kucharski AJ, Eggo RM, Gimma A, Edmunds WJ. The effect of non-pharmaceutical interventions on COVID-19 cases, deaths and demand for hospital services in the UK: a modelling study. medRxiv. 2020;2020.04.01.20049908.

17. World Bank. World Bank Open Data. 2020.

18. World Health Organization. COVID-19 Strategic Preparedness and Response Plan: Operational Planning Guidelines to Support Country Preparedness and Response. 2020.

19. Phase DCT. Universal Health Coverage: Essential Package of Health Services for Pakistan: A report for review by the International Advisory Group. Ministry of National Health Services, Government of Pakistan and World Health Organisation.; 2020.

20. Kairu A, Orangi S, Oyando R, Kabia E, Ng’ang’a J, et al. The costs of providing TB services in healthcare facilities in Kenya. 51st Union World Conference on Lung Health 2020.
21. Chatterjee S, Toshniwal MN, Bhide P, Sachdeva KS, Rao R, Vassall A, et al. Examining the cost of delivering TB prevention, diagnosis and treatment in India, 2018 51st Union World Conference on Lung Health2020.
22. NHSDigital. Hospital admitted patient care activity 2018–19 [Available from: https://digital.nhs.uk/data-andinformation/publications/statistical/hospital-admitted-patient-care-activity/2018-19.
23. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. The Lancet Respiratory Medicine. 2020.
24. Li J, al. e. Epidemiology of COVID-19: A Systematic Review and Meta-analysis of Clinical Characteristics, Risk factors and Outcomes. Journal of Medical Virology.
25. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-9.
26. Srivastava U. Anaesthesia gas supply: gas cylinders. Indian J Anaesth. 2013;57(5):500-6.
27. Afrlox. Medical Oxygen 2020 [Available from: https://www.afrloxshop.co.za/shop/en/za/medical-oxygen.
28. Vassall A, Siapka M, Foster N, Cunnama L, Ramma L, Fielding K, et al. Cost-effectiveness of Xpert MTB/RIF for tuberculosis diagnosis in South Africa: a real-world cost analysis and economic evaluation. Lancet Glob Health. 2017;5(7):e710-e9.
29. Khan RM, Albutt K, Qureshi MA, Ansari Z, Drevin G, Mukhopadhyay S, et al. Time-driven activity-based costing of total knee replacements in Karachi, Pakistan. BMJ Open. 2019;9(5):e025258.
30. WHO. COVID-19 Essential Supplies Forecasting Tool. 29 April 2020 [Available from: https://www.who.int/publications/m/item/covid-19-essential-supplies-forecasting-tool.
31. Serje J, Bertram MY, Brindley C, Lauer JA. Global health worker salary estimates: an econometric analysis of global earnings data. Cost Eff Resour Alloc. 2018;16:10.
32. World Health Organization. Global Health Observatory (GHO) data [Available from: http://www.who.int/gho/en/.
33. Nishiura H, Linton NM, Akhmetzhanov AR. Serial interval of novel coronavirus (COVID-19) infections. medRxiv. 2020;2020.02.03.20019497.
34. Health KMo. COVID-19 Outbreak in Kenya. Daily Situation Report -78 [updated 3 June 2020. Available from: https://www.health.go.ke/wp-content/uploads/2020/06/Kenya-COVID-19-SITREP-078-03-Jun-2020.pdf.
35. Africa RoS. COVID-19 Corona Virus South African Resource Porta 2020 [Available from: https://sacorovirus.co.za/.
36. Ethiopia MoHo. Ethiopia COVID 19 Monitoring Platform 2020 [Available from: http://www.moh.gov.et/ejcc/en/node/196.
37. India Go. COVID Statewide Status [Available from: https://https://www.mygov.in/corona-data/covid19-statewise-status/.
38. Pakistan Go. COVID19 Health Advisory Platform [Available from: http://covid.gov.pk/.
39. Organization WH. WHO Global Health Expenditure Database.
40. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis. 2020;20(5):533-4.