Table S1. Completed Covid-19 vaccination coverage in countries of the world [4]

|  |  |
| --- | --- |
| Country | % |
| Afghanistan | 11.4 |
| Albania | 42.5 |
| Algeria | 13.7 |
| Andorra | 69.0 |
| Angola | 17.7 |
| Antigua and Barbuda | 62.5 |
| Argentina | 81.2 |
| Armenia | 33.0 |
| Aruba | 76.1 |
| Australia | 82.8 |
| Austria | 73.0 |
| Azerbaijan | 47.3 |
| Bahamas | 39.5 |
| Bahrain | 69.6 |
| Bangladesh | 69.0 |
| Barbados | 52.6 |
| Belarus | 58.3 |
| Belgium | 78.5 |
| Belize | 51.8 |
| Benin | 19.5 |
| Bhutan | 4.7 |
| Bolivia | 49.1 |
| Bosnia and Herzegovina |  |
| Botswana | 53.9 |
| Brazil | 75.5 |
| Brunei | 91.8 |
| Bulgaria | 29.8 |
| Burkina Faso | 5.5 |
| Burundi | 0.1 |
| Cambodia | 83.1 |
| Cameroon | 3.9 |
| Canada | 82.0 |
| Cape Verde | 54.6 |
| Central African Republic | 18.3 |
| Chad | 4.5 |
| Chile | 90.6 |
| China | 86.1 |
| Colombia | 68.3 |
| Comoros | 33.9 |
| Congo | 12.0 |
| Cook Islands | 83.5 |
| Costa Rica | 78.0 |
| Cote d'Ivoire | 17.0 |
| Croatia | 54.9 |
| Cuba | 87.6 |
| Curacao | 59.8 |
| Cyprus |  |
| Czechia | 64.0 |
| Democratic Republic of Congo | 0.6 |
| Denmark | 82.6 |
| Djibouti | 10.9 |
| Dominica | 41.6 |
| Dominican Republic | 54.3 |
| Ecuador | 77.2 |
| Egypt | 30.9 |
| El Salvador | 65.8 |
| England | 73.5 |
| Equatorial Guinea | 14.5 |
| Estonia | 63.6 |
| Eswatini | 27.2 |
| Ethiopia | 17.8 |
| Fiji | 69.6 |
| Finland | 77.7 |
| France | 77.8 |
| Gabon | 11.1 |
| Gambia | 12.8 |
| Georgia | 31.6 |
| Germany | 75.3 |
| Ghana | 16.0 |
| Greece | 73.3 |
| Grenada | 33.6 |
| Guatemala | 32.9 |
| Guinea | 18.4 |
| Guinea-Bissau | 16.9 |
| Guyana | 45.8 |
| Haiti | 1.0 |
| Honduras | 45.5 |
| Hungary | 64.2 |
| Iceland | 78.7 |
| India | 60.0 |
| Indonesia | 58.2 |
| Iran | 67.1 |
| Iraq | 17.6 |
| Ireland | 80.5 |
| Israel | 66.0 |
| Italy | 79.3 |
| Jamaica | 22.8 |
| Japan | 80.0 |
| Kazakhstan | 48.4 |
| Kenya | 14.9 |
| Kiribati | 45.6 |
| Kosovo | 46.1 |
| Kuwait | 75.9 |
| Kyrgyzstan | 18.9 |
| Laos | 62.5 |
| Latvia | 69.8 |
| Lebanon | 32.6 |
| Lesotho | 33.7 |
| Liberia | 20.9 |
| Libya | 16.3 |
| Liechtenstein | 69.0 |
| Lithuania | 69.6 |
| Luxembourg | 72.6 |
| Madagascar | 3.7 |
| Malawi | 4.4 |
| Malaysia | 78.9 |
| Maldives | 70.6 |
| Mali | 4.7 |
| Malta | 90.5 |
| Mauritania | 22.3 |
| Mauritius | 76.2 |
| Mexico | 61.2 |
| Moldova | 26.3 |
| Monaco |  |
| Mongolia | 65.3 |
| Montenegro | 44.9 |
| Morocco | 62.6 |
| Mozambique | 41.1 |
| Myanmar | 40.2 |
| Namibia | 14.9 |
| Nauru | 70.6 |
| Nepal | 64.9 |
| Netherlands | 72.2 |
| New Zealand | 79.4 |
| Nicaragua | 65.6 |
| Niger | 6.2 |
| Nigeria | 4.5 |
| Niue | 87.8 |
| North Macedonia | 40.1 |
| Northern Ireland | 70.3 |
| Norway | 73.7 |
| Oman | 57.9 |
| Pakistan | 51.4 |
| Panama | 69.3 |
| Papua New Guinea | 2.8 |
| Paraguay | 46.1 |
| Peru | 78.4 |
| Philippines | 59.7 |
| Poland | 59.2 |
| Portugal | 92.6 |
| Qatar | 88.5 |
| Romania | 42.3 |
| Russia | 50.0 |
| Rwanda | 61.4 |
| Saint Kitts and Nevis |  |
| Saint Lucia | 28.6 |
| Saint Vincent and the  Grenadines | 27.1 |
| Samoa | 66.0 |
| San Marino | 69.4 |
| Sao Tome and Principe | 38.9 |
| Saudi Arabia | 69.6 |
| Senegal | 6.0 |
| Serbia | 47.6 |
| Seychelles | 81.0 |
| Sierra Leone | 13.8 |
| Singapore | 91.1 |
| Slovakia | 50.7 |
| Slovenia | 58.7 |
| Solomon Islands | 17.4 |
| Somalia | 8.3 |
| South Africa | 30.0 |
| South Korea | 86.8 |
| South Sudan | 4.2 |
| Spain | 86.1 |
| Sri Lanka | 67.1 |
| Sudan | 7.5 |
| Suriname | 0.1 |
| Sweden | 75.0 |
| Switzerland | 68.6 |
| Syria | 7.4 |
| Taiwan | 76.8 |
| Tajikistan | 49.8 |
| Tanzania | 5.0 |
| Thailand | 72.0 |
| Timor | 44.0 |
| Togo | 18.4 |
| Tonga | 65.8 |
| Trinidad and Tobago | 50.6 |
| Tunisia | 53.2 |
| Turkey | 62.3 |
| Turkmenistan |  |
| Tuvalu |  |
| Uganda | 17.0 |
| Ukraine |  |
| United Arab Emirates | 96.3 |
| United Kingdom | 72.6 |
| United States | 65.7 |
| Uruguay | 81.9 |
| Uzbekistan | 41.8 |
| Vanuatu | 27.1 |
| Venezuela | 49.8 |
| Vietnam | 79.2 |
| Yemen | 1.3 |
| Zambia | 11.9 |
| Zimbabwe | 23.7 |
| Regions of the World |  |
| South America | 73.2 |
| Asia | 67.7 |
| Europe | 65.3 |
| Oceania | 62.9 |
| North America | 62.7 |
| Africa | 15.4 |
| World | 58.2 |

Table S2. Critical vaccination coverage (Vc) required to establish herd immunity against SARS-CoV-2 with reproductive numbers (Ro) from 1.1 to 10 by vaccination effectiveness

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ro of SARS-CoV-2c | Critical vaccination coverage (%)a  for Covid-19 vaccine effectiveness from 10% to 100% | | | | | | | | | |
| 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
| 1.1 | 90.9 | 45.5 | 30.3 | 22.7 | 18.2 | 15.2 | 13.0 | 11.4 | 10.1 | 9.1 |
| 1.25 | − | 100 | 66.7 | 50.0 | 40.0 | 33.3 | 28.6 | 25.0 | 22.2 | 20.0 |
| 1.5 | − | − | − | 83.3 | 66.7 | 55.6 | 47.6 | 41.7 | 37.0 | 33.3 |
| 1.75 | − | − | − | − | 85.7 | 71.4 | 61.2 | 53.6 | 47.6 | 42.9 |
| 2 | − | − | − | − | 100 | 83.3 | 71.4 | 62.5 | 55.6 | 50.0 |
| 2.25 | − | − | − | − | − | 92.6 | 79.4 | 69.4 | 61.7 | 55.6 |
| 2.5 | − | − | − | − | − | 100 | 85.7 | 75.0 | 66.7 | 60.0 |
| 2.75 | − | − | − | − | − | − | 90.9 | 79.5 | 70.7 | 63.6 |
| 3 | − | − | − | − | − | − | 95.2 | 83.3 | 74.1 | 66.7 |
| 3.25 | − | − | − | − | − | − | 98.9 | 86.5 | 76.9 | 69.2 |
| 3.5 | − | − | − | − | − | − | − | 89.3 | 79.4 | 71.4 |
| 3.75 | − | − | − | − | − | − | − | 91.7 | 81.5 | 73.3 |
| 4 | − | − | − | − | − | − | − | 93.8 | 83.3 | 75.0 |
| 4.25 | − | − | − | − | − | − | − | 95.6 | 85.0 | 76.5 |
| 4.5 | − | − | − | − | − | − | − | 97.2 | 86.4 | 77.8 |
| 4.75 | − | − | − | − | − | − | − | 98.7 | 87.7 | 78.9 |
| 5 | − | − | − | − | − | − | − | 100 | 88.9 | 80.0 |
| 6 | − | − | − | − | − | − | − | − | 92.6 | 83.3 |
| 7 | − | − | − | − | − | − | − | − | 94.0 | 84.6 |
| 8 | − | − | − | − | − | − | − | − | 95.2 | 85.7 |
| 9 | − | − | − | − | − | − | − | − | 98.8 | 88.9 |
| 10 | − | − | − | − | − | − | − | − | 100 | 90.0 |

1. Vc = Ic/Effectiveness. The critical vaccination coverage is not indicated (−) when herd immunity could not be established with 100% vaccination coverage
2. Ic = 1 − (1/Ro).
3. The basic reproduction number Ro indicates the average number of secondary cases generated per infected case in a completely susceptible population

Table S3. Critical vaccination coverage (Vc) required to establish herd immunity against SARS-CoV-2 with different basic reproductive numbers (Ro) by Covid-19 vaccination effectiveness, with 10% of individuals protected and 9.8% infections among vaccinated individuals

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ro of SARS-CoVc | Critical vaccination coverage (%)a  for Covid-19 vaccine effectiveness from 10% to 100% | | | | | | | | | |
| 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
| 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.25 | − | 98.0 | 49.5 | 33.1 | 24.9 | 19.9 | 16.6 | 14.2 | 12.5 | 11.1 |
| 1.5 | − | − | − | 77.3 | 58.0 | 46.5 | 38.8 | 33.2 | 29.1 | 25.9 |
| 1.75 | − | − | − | − | 81.7 | 65.5 | 54.6 | 46.8 | 41.0 | 36.4 |
| 2 | − | − | − | − | − | 79.7 | 66.4 | 57.0 | 49.9 | 44.3 |
| 2.25 | − | − | − | − | − | 90.7 | 75.7 | 64.9 | 56.8 | 50.5 |
| 2.5 | − | − | − | − | − | − | 83.1 | 71.2 | 62.3 | 55.4 |
| 2.75 | − | − | − | − | − | − | 89.1 | 76.4 | 66.9 | 59.5 |
| 3 | − | − | − | − | − | − | 94.1 | 80.7 | 70.7 | 62.8 |
| 3.25 | − | − | − | − | − | − | 98.4 | 84.4 | 73.9 | 65.7 |
| 3.5 | − | − | − | − | − | − | − | 87.5 | 76.6 | 68.1 |
| 3.75 | − | − | − | − | − | − | − | 90.2 | 79.0 | 70.2 |
| 4 | − | − | − | − | − | − | − | 92.6 | 81.0 | 72.1 |
| 4.25 | − | − | − | − | − | − | − | 94.7 | 82.9 | 73.7 |
| 4.5 | − | − | − | − | − | − | − | 96.5 | 84.5 | 75.1 |
| 4.75 | − | − | − | − | − | − | − | 98.2 | 86.0 | 76.4 |
| 5 | − | − | − | − | − | − | − | − | 87.3 | 77.6 |
| 6 | − | − | − | − | − | − | − | − | 91.4 | 81.3 |
| 7 | − | − | − | − | − | − | − | − | 94.4 | 83.9 |
| 8 | − | − | − | − | − | − | − | − | 96.6 | 85.9 |
| 9 | − | − | − | − | − | − | − | − | 98.4 | 87.5 |
| 10 | − | − | − | − | − | − | − | − | 99.8 | 88.7 |

1. Vc = Ic/Effectiveness. Ic = 1 − (1/Ro). The critical vaccination coverage is not indicated (−) when herd immunity could not be established with 100% vaccination coverage
2. The basic reproduction number Ro indicates the average number of secondary cases generated per infected case in a completely susceptible population

Table S4. Critical vaccination coverage (Vc) required to establish herd immunity against SARS-CoV-2 with different basic reproductive numbers (Ro) by vaccine effectiveness, with 20% of individuals protected and 9.8% infections among vaccinated individuals

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ro of SARS-CoVc | Critical vaccination coverage (%)a  for Covid-19 vaccine effectiveness from 10% to 100% | | | | | | | | | |
| 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
| 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.5 | − | − | 66.0 | 44.2 | 33.2 | 26.6 | 22.1 | 19.0 | 16.6 | 14.8 |
| 1.75 | − | − | − | 75.7 | 56.9 | 45.5 | 38.0 | 32.6 | 28.5 | 25.3 |
| 2 | − | − | − | 99.3 | 74.6 | 59.8 | 49.8 | 42.7 | 37.4 | 33.3 |
| 2.25 | − | − | − | − | 88.4 | 70.8 | 59.1 | 50.6 | 44.3 | 39.4 |
| 2.5 | − | − | − | − | 99.5 | 79.7 | 66.4 | 57.0 | 49.9 | 44.3 |
| 2.75 | − | − | − | − | − | 86.9 | 72.5 | 62.2 | 54.4 | 48.4 |
| 3 | − | − | − | − | − | 93.0 | 77.5 | 66.5 | 58.2 | 51.7 |
| 3.25 | − | − | − | − | − | 98.1 | 81.8 | 70.1 | 61.4 | 54.6 |
| 3.5 | − | − | − | − | − | − | 85.4 | 73.3 | 64.1 | 57.0 |
| 3.75 | − | − | − | − | − | − | 88.6 | 76.0 | 66.5 | 59.1 |
| 4 | − | − | − | − | − | − | 91.4 | 78.3 | 68.6 | 61.0 |
| 4.25 | − | − | − | − | − | − | 93.8 | 80.4 | 70.4 | 62.6 |
| 4.5 | − | − | − | − | − | − | 96.0 | 82.3 | 72.0 | 64.1 |
| 4.75 | − | − | − | − | − | − | 97.9 | 84.0 | 73.5 | 65.4 |
| 5 | − | − | − | − | − | − | 99.7 | 85.5 | 74.8 | 66.5 |
| 6 | − | − | − | − | − | − | − | 90.2 | 79.0 | 70.2 |
| 7 | − | − | − | − | − | − | − | 93.6 | 81.9 | 72.9 |
| 8 | − | − | − | − | − | − | − | 96.2 | 84.2 | 74.8 |
| 9 | − | − | − | − | − | − | − | 98.1 | 85.9 | 76.4 |
| 10 | − | − | − | − | − | − | − | 99.7 | 87.3 | 77.6 |

1. Vc = Ic/Effectiveness. Ic = 1 − (1/Ro). The critical vaccination coverage is not indicated (−) when herd immunity could not be established with 100% vaccination coverage
2. The basic reproduction number Ro indicates the average number of secondary cases generated per infected case in a completely susceptible population