

Science You Can Use

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Dear Science: I heard that the US is giving away millions of doses of COVID-19 vaccine to other countries, but we haven't managed to get enough people in parts of this country vaccinated yet. Shouldn't we "look after our own" before we "look after others"? -- Buck R.

Dear Buck: The short answer to your question is that in order to "look after our own" material well-being in the current pandemic, we have no choice but to "look after (the material well-being of) others" at the same time. There are at least two major reasons for this. All else being the same, in order to maximize the US's interests, we have to (a) *minimize the generation of significantly infectious, virulent COVID-19 mutants that are not controllable by current vaccines*, and (b) *minimize the disruption caused by the pandemic, of the US's critical supply chains*.

Here's some detail.

Generation of significantly infectious, virulent mutants that are not controllable by current vaccines. All viruses mutate. In order to mutate, they must replicate; to replicate, they must infect cells. Viral replication is not perfect, and imperfect replication gives rise to mutant viruses. It often takes less than a year in an infected population of a million individuals for a virus to generate tens of new mutants. (In viruses that mutate extremely fast – such as HIV – on average one new mutant can be produced *per infected individual per day*.) All else being the same, the more individuals (or cells) a virus infects in a given time in a population, the faster new mutants are produced. Some mutants transmit faster and produce effects that are more severe than their ancestors did. In the last year, for example, the virus that causes COVID-19 has spawned at least three mutants that appear to transmit more easily, and have harsher effects, than the viruses from which they descended.

All else being the same, the only known reliable way to achieve adequate protection against COVID-19 and its current mutants for even *one* country is to ensure full vaccination of at least 70% of the population of *every* country, within a year. Why is this? Consider an example. Suppose at least 70% of the population of every country (including the US) except one – call it X -- were fully vaccinated for COVID-19. Suppose X does not have the resources to vaccinate even one percent of its population. Then all else being the same, significantly infectious and virulent COVID-19 mutants that lie outside the control of current vaccines will eventually arise in X's population. Epidemiological science is not advanced enough to be able to tell us when such mutants will arise. To be conservative, we must assume they can arise within a year. Because we can never absolutely prevent the movement of COVID-19 across national borders, X will unleash significantly infectious and virulent COVID-19 mutants that cannot be controlled by current vaccines – a replay, or worse, of the current pandemic. To prevent this scenario, countries such as the US (more broadly, the G7) have to give X enough resources to fully vaccinate 70% of X's population within a year. The cost and logistics of support are indisputably daunting.

Disruption of critical supply chains. Supply chains essential to the public health, employment, cost-of-living, and national defense of the US significantly depend on products and raw materials produced in other countries. These critical chains include PCs, computer chips, rare-earth minerals (for computer and TV displays), generic pharmaceuticals and pharmaceutical components, aluminum and aluminum ore, copper, lithium (batteries), chromium, cobalt (batteries for electronics, metal for jet engines), and automobiles and automobile parts. Many of these supply chains have been significantly, and in some cases, disastrously, disrupted by the pandemic in the supplying countries.

Some countries that supply critical goods and raw materials to the US are the only practical source of those products and materials. Even for some of the chains that have potential alternatives, it would take 5-10 years to bring them to full operational status.

Some of the least vaccinated countries are major suppliers of critical materials for the US. To put this “perfect storm” in perspective, here is short list of countries (as of 24 June 2021) that are critical suppliers for the US. The list shows the fraction of the population of those countries that is fully vaccinated, and, to the right of that (in parentheses) the approximate fraction of the US total consumption of those items that supplied by those countries:

- Chile: 55% (35% of copper; 33% of lithium)
- Mainland China: 38% (60% of rare earths; 80% of PCs; 13% of aluminum)
- Turkey: 27% (20% of chromium)
- South Korea: 18% (20% computer chips)
- Mexico: 16% (12% of cars; 15% of car parts)
- India: 10% (35% of generic drugs)
- Taiwan: 4% (60% computer chips)
- South Africa: 2% (40% of chromium)
- Democratic Republic of Congo: 1% (70% of cobalt)

As of 24 June 2021, none of these countries had achieved full vaccination for at least 70% of their respective populations.

For further information, See CNN Health, “Tracking COVID-19 vaccinations worldwide”, <https://www.cnn.com/interactive/2021/health/global-covid-vaccinations/> .

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