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## Policy Paper

**THE CASE FOR U.S. INVESTMENT IN GLOBAL COVID-19 VACCINATIONS: “No One Is Safe Until Everyone Is Safe”**



## Executive Summary

- Since the WHO declared COVID-19 a global pandemic on March 11, 2020, the total damage to the United States economy has been significant — at its height nearly \$1 trillion in United States GDP contraction, 23 million jobs lost, and significant business disruptions and closures.
- The first surge (Spring 2020) delivered a strong economic shock, producing high unemployment and immediate economic contraction. Subsequent spikes in cases and hospitalizations have led to a highly disruptive cycle of opening and shutting down the economy.
- The United States government has spent an estimated \$6 trillion through legislative and executive actions to develop vaccines, purchase protective equipment, bolster industries hit hard by COVID, and provide financial assistance to Americans who lost their jobs<sup>i</sup>.
- While the United States has accelerated its vaccination efforts, the threat of COVID variants jeopardize these gains, which makes achieving global herd immunity as quickly as possible a national priority.
- International efforts to acquire vaccines for low-to-medium-income countries are lagging with the World Health Organization coordinated Access to COVID-19 Tools Accelerator (ACT-A) estimating a \$19 billion funding gap<sup>ii</sup>.
- Acquiring vaccine is not sufficient to counter risks of COVID variants — transporting, delivering, and administering vaccines are key to preventing new 'hot beds' for variants and halting the spread of current strains.

- A CARE Report estimates that the total cost of vaccine administration will be five times the cost of vaccine purchases<sup>iii</sup>, translating to an estimated \$190 billion to achieve global herd immunity.
- Using a GDP insurance model and the OECD-DAC recommended calculation, the U.S. fair share of that cost is between \$15-26B.
- Providing additional funding for global vaccinations will enable the United States to fully capitalize on its national investment in vaccines and transform COVID from pandemic to manageable endemic.
- Conversely, a recent study found if advanced economies are fully vaccinated but the current uncoordinated approach to global vaccine distribution continues, the world risks a global GDP loss of as much as \$9.2 trillion in 2021 alone.
- Up to 49% of these GDP losses will be borne by advanced economies regardless of their own vaccination rates. According to several recent studies, the cost of not achieving global vaccine equity could damage the U.S. economy to the tune of \$207B - \$671B.
- **No one is safe until everyone is safe.** Without an initial United States commitment of \$15-\$26 billion over the next 2-3 years (2021-2023) to support global vaccine distribution and ongoing support in the outyears, the United States investment in vaccines and efforts to reopen the economy could be jeopardized.



## The COVID-19 pandemic has delivered a devastating human and economic toll on the U.S.

Since the declaration of a global pandemic in March 2020 by the World Health Organization (WHO), more than 550,000 Americans and 2.8 million lives worldwide have been lost to the COVID-19 virus. This human toll has been compounded by significant economic disruptions and dislocations caused by the virus which, in turn, has amplified human suffering. Examples include:

- Historic contraction in economic activity due to both mandatory restrictions and voluntary changes in behavior by households and businesses<sup>iv</sup>
- Contraction in United States GDP by \$800 billion to \$1 trillion
- Job losses for 23 million Americans (at the height of the pandemic) with an additional 10 million working involuntarily on a part time basis<sup>v</sup>
- A 32.6% decrease in small businesses compared to January 2020<sup>vi</sup>
- Catastrophic losses to several sectors including airlines, cruise and hospitality, and retail

## The economic harm to the U.S. will grow as the pandemic persists globally, potentially costing the U.S. economy an estimated \$207B - \$671B over the next five years.

In a highly integrated and tightly connected global economy, a prolonged pandemic will continue to negatively impact the United States economy. The ability to obtain or distribute intermediate inputs and final goods via global supply chains are all driven by interlocking trade relationships. Specifically, low- and middle-income countries' (LMIC) infection rates can reduce foreign demand for products whereas economic lockdowns can interrupt supply chain flow.

Multiple studies have concluded that global equitable access to COVID-19 vaccines, or lack thereof, will have considerable impact on global economic stability and growth, significantly threatening the economic recovery of high-income countries like the United States.<sup>vii</sup> The results from one of these studies is described below and others are summarized in appendices.

A study<sup>viii</sup> commissioned by the International Chamber of Commerce (ICC) Research Foundation assessing the immediate economic costs of uncoordinated COVID-19 global vaccination that are solely due to international linkages concluded that a globally coordinated drive for the production and the distribution of the COVID-19 vaccine is necessary. It also emphasized that advanced economies have strong economic incentives to quickly support their trading partners in eliminating the pandemic locally. While this study has a higher estimated economic impact than others, it is more comprehensive.<sup>ix</sup> It highlights that **if advanced economies are fully vaccinated but the current uncoordinated approach to global vaccine distribution continues, the world risks a global GDP loss of as much as \$9.2 trillion in 2021 alone.**

Furthermore, their estimates suggest that up to 49% of these costs will be borne by advanced economies, regardless of their own vaccination rates. In a scenario where developing countries vaccinate half of their population by the end of 2021, total global economic losses could be \$3.8 trillion, \$671 billion in the United States (3.14% of 2019 levels of GDP). **In such a scenario, if the United States unilaterally bridged the World Health Organization’s Access to COVID-19 Tools Accelerator (ACT-A) funding gap<sup>x</sup>, it would net a domestic return on investment of over 30X.**

Other analysis using more conservative models still project the potential damage done to the U.S. economy if we fail to achieve vaccine justice in LMIC to be in the billions of dollars. A study was conducted by the Eurasia Group to assess economic impacts of global equitable access to COVID-19 vaccines to 10 major economies. The results concluded that these economies would benefit by at least \$153 billion in 2020–21 and \$466 billion by 2025 (more than 12 times the \$38 billion estimated total cost of the ACT Accelerator). According to their analysis, the US would risk \$78.8 billion in economic benefits in 2020-21 and \$207.1 billion at risk from 2020-25.

## **An effective response must be comprehensive, covering the acquisition of vaccines and getting those vaccines to the most vulnerable. And it must be expedited.**

Effective mitigation strategies to end the pandemic globally will require a comprehensive approach to ensure that the most economically vulnerable nations receive sufficient assistance to fully vaccinate their populations and stem the potential emergence of variants.<sup>xi xii</sup> The greater the opportunity for the virus to transmit and multiply, the greater the likelihood that mutations and variants are produced. This natural process creates a race against time. The risk to public health is greatest when variants and mutations render vaccines ineffective. The best strategy to escape this cycle is to vaccinate as many people as possible in the shortest amount of time to reduce the number of potential hosts and reduce community spread. In addition, ongoing efforts in the United States are focused on researching the efficacy of existing vaccines against COVID-19 variants of concern; optimizing schedule, doses, and boosters; exploring safety and adverse effects after immunization; and focusing on global surveillance for mutations. The intent of all these actions is to turn what is largely an unmanageable global pandemic into a more predictable, manageable endemic with less opportunity for viral mutation. But even as these efforts increase, strengthening health care services in LMIC settings will be a critical success factor in combatting COVID — the risks of viral mutation can occur anywhere in the world and result in immediate health and economic impacts for the United States.

Another important consideration is the speed of vaccination in LMICs, which will be uneven. In some countries, such as Rwanda, 95% of its COVAX doses were used because of the country’s robust investments in its health systems. On the other hand, Cote d’Ivoire has only used 10% of their vaccines in the same time frame. In addition, it will be critical to use existing, trusted vaccination institutions and processes developed over the past few decades in response to malaria and other diseases. This will allow countries to maximize the HIC financial contributions through efficient, effective, and equitable distribution of vaccines while also preventing against potential dangers associated with fraud and graft.



These and other factors, however, will make for an **uneven global vaccination process, with some countries accelerating quickly toward herd immunity while others may take two or four years to realistically accomplish this objective.**

The Access to COVID-19 Tools Accelerator (ACT-A) “is a time-limited global collaboration designed to rapidly leverage existing global public health infrastructure and expertise to accelerate the development, production, and equitable access to COVID-19 tests, treatments, and vaccines in order to expedite the end of the acute phase of the COVID-19 pandemic. It is coordinated through a small Executive Hub hosted by the World Health Organization.”<sup>xiii</sup> As of April 2021, ACT-A faces a \$19 billion dollar financial shortfall in the funds needed in 2021<sup>xiv</sup> to procure and distribute sufficient doses to 20% of people in low- and middle-income countries (the minimum threshold required to slow down the pandemic in 2021). ACT-A faces funding shortfalls across its four pillars, including vaccines (COVAX) as well as for the Diagnostics/Therapeutics and Health Systems Connect Pillars in 2021, which will limit technical assistance and supplemental equipment and supplies (e.g., PPE) they had planned to offer countries.

Fully funding ACT-A alone, however, will not be enough to ensure equitable delivery. As the United States and other high-income countries (HICs) have learned through their own vaccination experiences, “putting shots in arms” involves far more than procuring sufficient quantities of the vaccine itself. Efficient and equitable delivery of vaccines requires investments in core healthcare infrastructure, including in a strong healthcare workforce. ACT-A was never designed to cover the full costs of vaccine delivery on the ground and many low- and middle-income countries — many of whom already have weak and chronically underfunded health systems — will not be able to cover all the costs of vaccine delivery through domestic financing. These countries will need additional funding from the United States Agency for International Development including health systems strengthening efforts to pay, protect, train, and recruit frontline

health workers and ensure countries are equipped for efficient and effective vaccine delivery to the last mile. According to a recent CARE report Our Best Shot, the missing delivery costs equate to approximately \$5 for every \$1 in vaccine purchase price currently accounted for in ACT-A<sup>xv</sup>. To extrapolate what total delivery costs might be to support global vaccinations, see below:

ESTIMATE OF TOTAL DISTRIBUTION COSTS
ACT-A estimates that \$9.5 billion will be required to procure sufficient vaccine to inoculate 20% of the populations in the 88 LMICs <sup>xvi,xvii</sup>
The 20% threshold will slow down the pandemic, but it is generally accepted that herd immunity requires 75%-80% inoculation rates
Assuming ACT-A’s cost projections are accurate and using an 80% vaccination rate, it would require roughly \$38 billion over a two-to-three-year period to acquire sufficient vaccine to achieve herd immunity
When multiplied against CARE’s 5:1 ratio that encompasses full administration of inoculations (“shots into arms”), total delivery cost of inoculation in the LMIC would be an estimated \$190 billion
Using two different costing models, a GDP insurance model as well as the OECD-DAC recommended fair share calculation model detailed in Appendix D, the U.S. “fair share” of the total cost of equitable vaccine delivery in LMIC is between \$15-\$26B

Simply stated, current investments (e.g., \$4 billion in U.S. commitments to COVAX) will fall short of the global needs, which are far greater and require significant investments (both immediate and sustaining) in the overall healthcare capacity of LMICs to safely deliver vaccinations to their populations.

**The United States fair share investment of \$15B-\$26B in equitable vaccine delivery worldwide is critical to end the pandemic globally, preventing further harm to the U.S. economy, and ensuring strong U.S. economic recovery post-pandemic.<sup>xviii</sup>**

The United States sits at a critical juncture in the COVID-19 pandemic. More than half a million Americans have succumbed to the virus and over 3 million have perished worldwide.<sup>xix</sup> Trillions in taxpayer dollars have been used to bolster and reinforce the U.S. economy and, in the process, increased our national debt. Variants threaten to undermine our collective efforts and drive continued community spread that prolongs the pandemic and its economic toll. But the accomplishments and outcomes we have achieved are equally immense, even miraculous: The creation of multiple vaccines in record time that hold the potential to reduce COVID-19 to a manageable endemic and restore a sense of societal normalcy and economic predictability.

As noted above, two approaches were used to determine potential levels of U.S. investment and they are quickly summarized below and in Appendix D.

**Method 1: U.S. GDP Insurance = \$800 billion.8% = \$15 billion**  
lost GDP in past year = 7.8% of all global GDP loss. We multiplied estimated \$190B gap  
\*7  
**Method 2: Fair Share = to achieve herd immunity (\$190b), according to OEDC-DAC**  
\$63 billion should come for donor countries and U.S. GNI of 0.41 multiplied against  
that number = **\$26 billion**

Assuming the investment cost of \$190 billion to ensure the equitable delivery of vaccines to all 88 LMICs is correct, **the U.S. faces a choice — invest between \$15-\$26 billion to support global vaccine delivery or run the risk of a continued pandemic that has already drained \$6 trillion dollars in federal stimulus and investment, and could continue to damage the U.S. economy by as much as \$671B if we fail to achieve global herd immunity over the next few years.**



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## Appendix A: Measuring U.S. investments in COVID-19 Vaccine Development

Since March 2020, the United States has spent nearly \$6 trillion in taxpayer dollars to respond to the COVID-19 pandemic. This includes more than \$24 billion in expenditures to design and develop a vaccine: \$18 billion on vaccine candidates, \$952 million on vaccine supplies,<sup>xx</sup> more than \$340 million to states in support of Operation Warp Speed and vaccine distribution,<sup>xxi</sup> and \$4.38 billion on expenses related to supplies, staffing, training, and transportation.<sup>xxii</sup> These expenses were all incurred before the \$1.9 trillion COVID relief bill was passed in March 2021. Investments in vaccine development yielded remarkable successes, producing multiple vaccines in record time. This offers hope that a national vaccination effort can blunt further long-term health care and economic consequences.

## Appendix B: Additional Economic Harm Analysis

The Eurasia Group<sup>xxiii</sup> study referenced above also dives deeper into specific economic sectors. It predicts, for example, that the Oil and Gas sectors (total losses to the oil sector of the net-energy exporters are estimated at \$190.4 billion and total losses to the gas sector are estimated at \$181.4 billion between 2020-25), manufacturing (\$14.1 billion in 2020-21 and \$46.3 billion cumulatively in 2020-25) and foreign tourism (\$9.3 billion in 2020-21 and \$26.1 billion in 2020-25) will account for the most significant potential losses. For international tourism, losses rise to \$24.0 billion in 2020-21 and \$41.7 billion in 2020-25 if major events — the 2021 Olympics in Japan, 2021 Hajj, 2021-22 Dubai Expo, and 2022 World Cup in Qatar — are considered.

Additionally, the International Monetary Fund<sup>xxiv</sup> is calling for greater international collaboration to end the pandemic, predicting that the cumulative loss in output relative to the pre-pandemic projected path will grow from \$11 trillion over 2020–21 to \$28 trillion over 2020–25. However, when shifting their baseline to account for countries working together to quickly produce and widely distribute treatments and vaccines to all parts of the world, they are estimating a cumulative increase in global income of almost \$9 trillion by the end of 2025.

## Appendix C: Addressing the Persistent Risks of COVID-19 Variants

In recent weeks, the United States has greatly accelerated vaccination efforts and is on track to vaccinate 70-85% of its eligible population.<sup>xxv xxvi</sup> President Biden has committed to sharing our country's excess vaccine supply and providing a \$4 billion down payment to support the COVID-19 Vaccines Global Access (COVAX) initiative. The first \$2 billion is designated for global vaccine support and the second half for collaborative efforts to strengthen health system capacity and streamline health system integration across the globe to prevent and defend against the next pandemic threat.<sup>xxvii</sup> While these are critical steps to help stem COVID-19, they will not be in-and-of-themselves sufficient to counter the risks of viral variants that may develop in low- and middle-income countries (LMICs) as their vaccination programs lag behind those in high income countries (HICs).

This lag is particularly problematic because *most* viruses mutate or change their nucleic acid sequences as they reproduce in hosts. These mutations can enhance transmission, enable evasion of the immune system (and immune system responses generated by vaccines), provide antiviral resistance, decrease the susceptibility of the virus to therapeutic agents, and better enable the virus to evade detection by specific tests. Mutations can also create a new yet stable version of the virus, distinct from the original, creating what is called a variant. Numerous COVID-19 variants of concern have been identified since December 2020 and several of these variants (e.g., B.1.1.7, B.1.351, B.1.427, B.1.429, P.1)<sup>xxviii</sup> have proven more infectious,<sup>xxix</sup> more fatal,<sup>xxx</sup> and/or more able to partially evade immunity. The “Brazilian” (or

P.1) variant offers an illustration. Home to less than 3% of the world population, Brazil currently accounts for almost one-third of the daily global deaths from COVID-19 with the Brazil variant being a major driver. Death tolls now top 3,000 per day, a toll suffered only by the more populous U.S.<sup>xxx</sup>

Three factors make managing these risks in LMICs challenging:

- Underinvestment in vaccine distribution and delivery
- Inefficient and/or ineffective vaccine delivery to the point of inoculation
- Vaccine skepticism and misinformation in localized communities

### Appendix D: Calculating the cost of reaching herd immunity globally

We used two different methods to calculate an estimated/projected budget number:

METHOD	CALCULUS	FINAL PROPOSED CONTRIBUTION
“GDP Insurance”	The U.S. lost \$800 billion in GDP over the past year to COVID (or 7.8% of the total \$10.3 trillion global GDP loss). Based on the CARE ration identified, it will take an estimated \$190 billion to get LMICs to herd immunity. Investing 7.8% of the \$190 billion deficit (or \$15 billion total) would proportionally insure against future GDP losses.	\$15 billion
“Fair Share”	OECD-DAC lays out a two-part criteria for humanitarian cost sharing: <sup>xxxii</sup> 1) One-third should come from donor countries and two-thirds from LMICs and 2) The proportion of Gross National Income (GNI) commands within their category should determine the appropriate cost share.  To address the \$190 billion deficit to achieve herd immunity, \$63 billion should come from donor countries and since the U.S. commands 41% of donor GNI, \$26 billion would be the appropriate share of contribution.	\$26 billion

# Appendix E: Challenges Experienced in HICs with Vaccine Distribution

CHALLENGE	DESCRIPTION
Supply Chain	Creating a sustainable supply chain that moves the vaccine securely and within proper handling guidelines (e.g., Cold Storage)
Distribution Strategies	Developing distribution and inoculation strategies that account for cultural or regional variations (e.g., urban v. rural distribution)
Workforce	Securing sufficient qualified health workers able to administer vaccinations
Equipment	Acquiring sufficient personal protective equipment to vaccinate safely, the supplies needed to deliver shots in arms, and mechanisms for proper disposal of biohazard waste
Tracking Systems	Deploying systems to track receipt of both doses (for non-Jhonsen and Johnson vaccines)
Communications	Engaging with population to encourage vaccinations, dispel misinformation, and sharing logistics (timing, logistics)

The above are challenges even for high-income countries but are exacerbated in LMICs because they lack core health care infrastructure systems and services to support distribution. In addition, in a significant number of LMICs, safety and security needs in transporting vaccines in war-torn parts of the globe may be required and health care workers may encounter vaccine skepticism and disinformation in localized communities.

## Appendix E: Potential Scenario

One of the worst cyclical outbreaks of coronavirus occurred in September 2022 in South Asia. Over a two-month period, alarming spikes in cases stemming from an emergent ‘double variant’ caused a significant rise in infections (more than 1.2 million new cases) and deaths (300,000). While public health officials could not exactly pinpoint the double variant’s origin, early cases were documented in Cambodia, Myanmar, and in the Rohingya refugee camps in Bangladesh. Low levels of vaccination in those regions, vulnerable populations, and weaker health systems were cited as contributing factors in the emergence of this more lethal variant. Fearing the return of a global pandemic, neighboring countries such as India, China, Thailand, Vietnam, Malaysia, the Philippines rushed to implement highly restrictive travel and economic policies consistent with measures used in 2020 and generated fears of another pandemic recession. These fears proved justified. While the ‘double variant’ outbreak was ultimately controlled and did not result in the return to full global pandemic status, the direct and secondary economic consequences were stark. A year after these outbreaks, the leaders of the G20 met in Mumbai. The Chairman of the Federal Reserve Board and Head of the European Central Bank reviewed the global financial consequences. At the top line, since the outbreak, the world experienced a -2.75% contraction in global GDP and their predictions of a slow and uneven recovery in 2023 (-1.0% to 1.0% growth) and 2024 (1.0-2.0% growth) proved true. Complicating matters, the economic shutdowns in South Asia caused severe supply chain disruptions; vulnerable industries such as air travel, tourism, and retail suffered record levels of bankruptcies and job losses; and the U.S. was forced to engaged in continued stimulus spending to bolster the economy, adding an additional \$2.5 trillion in COVID related relief — raising the total since March 2020 to approximately \$9 trillion.

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## End Notes

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- <sup>i</sup> Estimated by the Center for Responsible Federal Budget, [www.covidmoneytracker.org](http://www.covidmoneytracker.org)
- <sup>ii</sup> ACT-Accelerator Strategy Budget 2021 FINAL, p. 7
- <sup>iii</sup> <https://www.care.org/news-and-stories/health/our-best-shot-women-frontline-health-workers-around-the-world-are-keeping-you-safe-from-covid-19/>
- <sup>iv</sup> Monetary Policy Report (Rep.). (2021, February 17).  
[https://www.federalreserve.gov/monetarypolicy/files/20210219\\_mprfullreport.pdf](https://www.federalreserve.gov/monetarypolicy/files/20210219_mprfullreport.pdf)
- <sup>v</sup> CRS Report, p. 71
- <sup>vi</sup> Opportunity Insights Economic Tracker: <https://tracktherecovery.org/>
- <sup>vii</sup> For more detail on additional economic hard studies, see Appendix B.
- <sup>viii</sup> [The Economic Case for Global Vaccinations: An Epidemiological Model with International Production Networks](#)
- <sup>ix</sup> It is important to note the trade costs calculated in this study are much larger than those estimated by other studies for two reasons:
- Its estimates are based on an economic-epidemiological framework that incorporates the effects of infection dynamics through sector heterogeneity in exports and imports
  - Its calibration is based on a much larger set of countries (not just 10 economies)
- <sup>x</sup> [https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-urgent-priorities-financing-requirements-final-single-11nov20.pdf?sfvrsn=939242b5\\_2](https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-urgent-priorities-financing-requirements-final-single-11nov20.pdf?sfvrsn=939242b5_2)
- <sup>xi</sup> [https://www.rand.org/pubs/research\\_briefs/RBA769-1.html](https://www.rand.org/pubs/research_briefs/RBA769-1.html)
- <sup>xii</sup> For more information on the threat of continued emerging variants, see Appendix C.
- <sup>xiii</sup> [https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-how-it-works-at-6april2021.pdf?sfvrsn=ad5f829f\\_1&download=true](https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-how-it-works-at-6april2021.pdf?sfvrsn=ad5f829f_1&download=true)
- <sup>xiv</sup> <https://www.who.int/publications/m/item/access-to-covid-19-tools-tracker>
- <sup>xv</sup> <https://www.care.org/news-and-stories/health/our-best-shot-women-frontline-health-workers-around-the-world-are-keeping-you-safe-from-covid-19/>
- <sup>xvi</sup> [https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-urgent-priorities-financing-requirements-final-single-11nov20.pdf?sfvrsn=939242b5\\_2](https://www.who.int/docs/default-source/coronaviruse/act-accelerator/act-a-urgent-priorities-financing-requirements-final-single-11nov20.pdf?sfvrsn=939242b5_2)
- <sup>xvii</sup> <https://www.who.int/publications/m/item/act-a-prioritized-strategy-and-budget-for-2021>
- <sup>xviii</sup> For more background on U.S. investments in global pandemic response so far, see Appendix A.
- <sup>xix</sup> Data as of 3/28/2021; <https://coronavirus.jhu.edu/map.html>
- <sup>xx</sup> <https://crsreports.congress.gov/product/pdf/IN/IN11560>
- <sup>xxi</sup> <https://www.hhs.gov/sites/default/files/national-governors-association-questions-on-vaccine-distribution-planning.pdf>
- <sup>xxii</sup> <https://www.fema.gov/press-release/20210317/fema-covid-19-vaccination-update>
- <sup>xxiii</sup> [Global equitable access to COVID-19 vaccines estimated to generate economic benefits of at least US\\$ 153 billion in 2020–21, and US\\$ 466 billion by 2025, in 10 major economies, according to new report by the Eurasia Group](#)
- <sup>xxiv</sup> <https://blogs.imf.org/2020/10/13/a-long-uneven-and-uncertain-ascent/>
- <sup>xxv</sup> <https://www.nytimes.com/2020/12/24/health/herd-immunity-covid-coronavirus.html>
- <sup>xxvi</sup> <https://www.cnbc.com/2021/03/25/biden-will-announce-new-covid-vaccine-goal-200-million-shots-within-his-first-100-days.html>
- <sup>xxvii</sup> <https://www.devex.com/news/in-brief-us-covax-pledge-is-down-payment-on-a-larger-strategy-99351>
- <sup>xxviii</sup> [SARS-CoV-2 Variants of Concern | CDC](#)
- <sup>xxix</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/959360/Variant\\_of\\_Concern\\_VOC\\_202012\\_01\\_Technical\\_Briefing\\_3.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/959360/Variant_of_Concern_VOC_202012_01_Technical_Briefing_3.pdf)
- <sup>xxx</sup> <https://www.nature.com/articles/s41586-021-03426-1>
- <sup>xxxi</sup> Brazil variant article published 3/27: <https://www.wsj.com/articles/covid-19-variant-rages-in-brazil-posing-global-risk-11616845889>
- <sup>xxxii</sup> <https://pai.org/resources/just-math-methodology-calculating-u-s-share-cost-addressing-unmet-need-contraception-developing-countries/>