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ECONOMIC SAVINGS IN AMERICA

A STORY OF PUBLIC-PRIVATE
PARTNERSHIP IN RAPID COVID-19
VACCINE DEVELOPMENT AND
DEPLOYMENT

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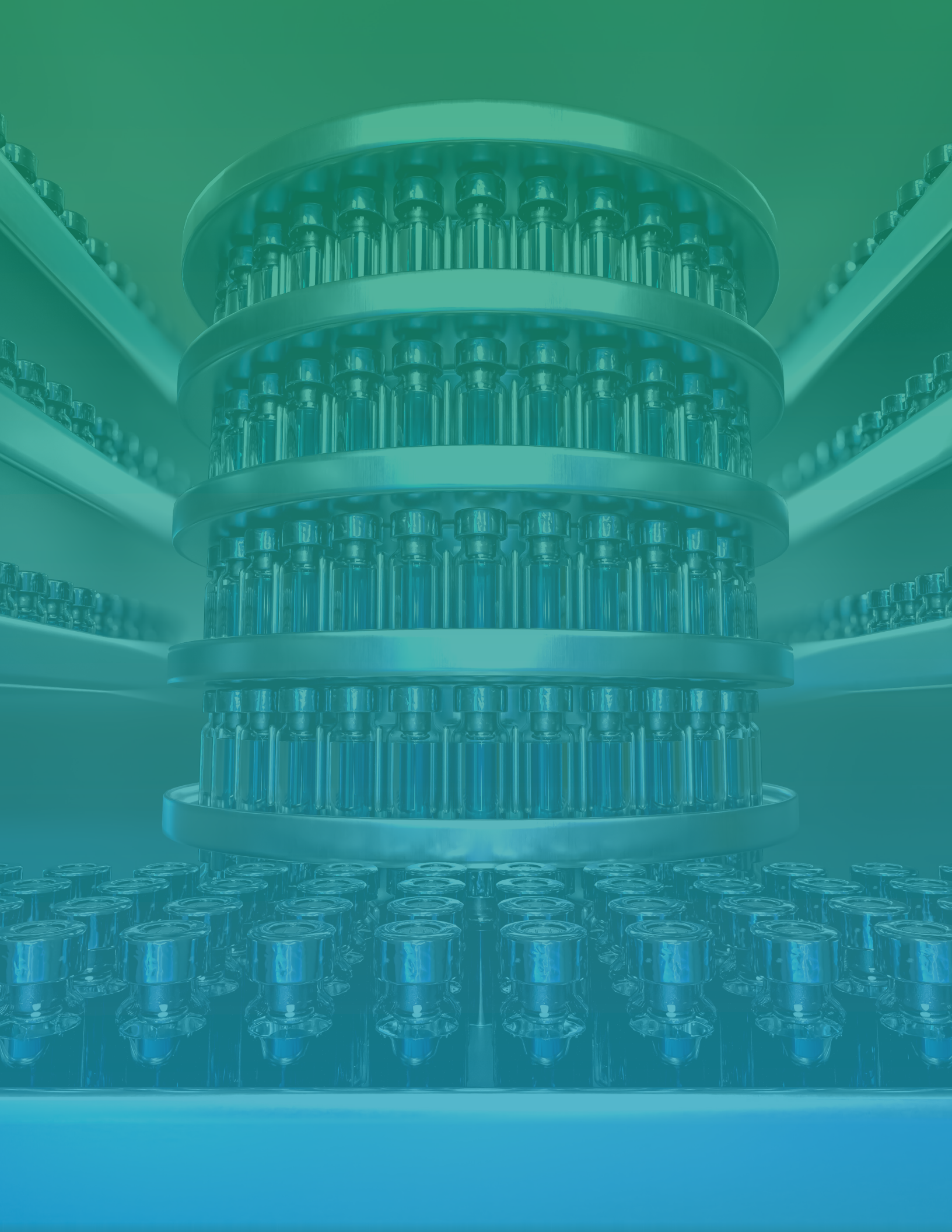
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ABOUT HEARTLAND FORWARD

Heartland Forward's mission is to improve economic performance in the center of the United States by advocating for fact-based solutions to foster job creation, knowledge-based and inclusive growth and improved health outcomes. We conduct independent, data-driven research to facilitate action-oriented discussion and impactful policy recommendations.

The views expressed in this report are solely those of Heartland Forward.



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Since joining Heartland Forward in 2019, DeVol has raised the profile of the organization through media engagement with quotes in the New York Times, Wall Street Journal, the Economist and Axios and op-eds in the Dallas Morning News, Milwaukee Journal Sentinel, Chicago Tribune and Des Moines Register as well as TV appearances throughout the heartland. DeVol is a former chief research officer for the Milken Institute where he spent nearly 20 years, an economic think tank headquartered in California. He oversaw research on international, national and comparative regional growth performance, access to capital and its role in economic growth and job creation and health-related topics. He has been ranked among the "Superstars of Think Tank Scholars" by International Economy magazine.



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Dave Shideler joins Heartland Forward after more than a decade at Oklahoma State University, most recently serving as a professor and Community and Economic Development Specialist in the Department of Agricultural Economics. In these roles, he oversaw projects in community and rural development and small business development, and published peer-reviewed research articles on the economic impacts of internet access, incentive programs, and local food production.

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EXECUTIVE SUMMARY

The rapid development and deployment of vaccines during the COVID-19 pandemic lessened the impact of the virus on the economy, generating an estimated economic savings in the U.S. of \$438 billion in terms of 2021 real GDP gain, or 2.3% of 2021 real GDP. These savings, and the development of the vaccine itself, are possible because of the United States' unique public-private partnership between government agencies, academia and the biopharmaceutical industry that supports innovations in disease therapy. Specifically, the biopharmaceutical industry was and continues to respond to the pandemic swiftly with new therapies

because it has been allowed to commercialize other therapies in the past which then provides available capital for new research and development activities. While much is unknown about the latest variant of the COVID-19 virus, Omicron, one thing is for certain: the angst and uncertainty would be far greater if not for the availability of the COVID-19 vaccines and other therapies under development. As we look ahead, this public-private partnership is an example many industries long for and one that cannot be comprised without lessening medical innovation of our future.



INTRODUCTION

Lifesaving vaccines and therapies routinely save thousands of lives, lower economic burden of disease through the health care system and maintain a productive workforce. Building upon existing expertise and prior research on SARS and other related conditions, the rapid development and deployment of the COVID-19 vaccine mitigated severe adverse effects of the pandemic through easing the burden on the health care system, boosting the economy and improving quality of life. Thus, it can be concluded that what we have experienced is not as severe as it would have been economically had there been no vaccine. In the world of economics this is defined as economic savings.¹ Because of the COVID-19 vaccine's availability, this report estimates economic savings in the U.S. to be \$438 billion in terms of 2021 real GDP gain, or 2.3% of 2021 real GDP.

Usually, the economic burden of a disease (or health conditions) implies a toll on health care and adversely impacts an economy (through changes in labor market activities). As the incidence of disease rises, health care costs increase due to increased use of services (including more expensive site of services such as hospitalization and emergency rooms). In addition, it also indirectly impacts the economy through lower workforce participation and productivity loss. For example, if an ailing worker misses work or might not perform at their potential, it negatively affects the economy by lowering Gross Domestic Product (GDP). Additional adverse impacts of a disease could include diminished quality of life (due to disability and death) and declines in behavioral health. In extreme situations, dropping

out of the labor market (e.g., due to long-term medical leave or death) results in lower tax revenue generation that could have been used by the government for various programs. Further, there is a loss to society if the disease's death toll is immense. With COVID-19, we witnessed employers allowing employees to work from home which would have sounded like an insurmountable shift just two years ago. This drastically reduced the spread of the virus and kept many people employed and working.

Vaccines or other therapies mitigate this economic burden by minimizing a disease's severity, and thus preventing death, loss of productivity and the need for expensive health care services. So, the sooner a vaccine or therapy is innovated and implemented, the higher chance of lessening the economic burden of the disease. For instance, as we see spikes in COVID-19 cases and the onslaught of the most recent variant, Omicron, spread, the world senses a renewed urgency to suppress the disease and maintain the economy.

However, vaccine and therapy development are costly. Typically, it takes years to bring therapies and vaccines from bench to bedside through long-term collaborations across the entire ecosystem—government, private companies and academia—involving substantial investment.



For this reason, development and deployment of the COVID-19 vaccine with such a quick turnaround is one of the most successful collaborations in recent years – one worthy of applauding and replicating in the future.

This report showcases the scope of collaboration that enabled the innovation of the COVID-19 vaccine in an astronomically short time. It continues by estimating the economic savings realized in the U.S. economy from having the COVID-19 vaccine, and it reflects on how current policy proposals could impact medical innovation in the future.

In light of such success, one might want to give pause and look at the interesting lessons learned through this collaboration. It is a collaboration happening across all levels of government. It is a collaboration that has evaluated and modernized policies with new voices being part of the conversation. These leaders at the table of collaboration are leading the charge and implementing programs that directly impact health care like Medicaid and Medicare both of which impact the rising cost of drugs. It is also a collaboration that can help in developing policies to incentivize private-public partnerships for research, development and the deployment of new medical interventions.

RAPID DEVELOPMENT OF THE COVID-19 VACCINE: A SUCCESSFUL COLLABORATION OF ACADEMIA, GOVERNMENT AND PRIVATE COMPANIES

In most instances, U.S. biopharmaceutical companies take tremendous financial risks to innovate and bring vaccines and therapies to the marketplace. The research and development (R&D) costs of bringing a new product through the U. S. Food and Drug Administration (FDA) review process to market often takes more than 10 years and averages \$2.6 billion. In addition, less than 12% of the candidate medicines that make it into Phase 1 clinical trials are approved by the FDA.²

To encourage and enable continued innovations by biopharmaceutical companies, the federal government often steps up to support private companies. Government involvement usually takes place in the form of early-stage federal investments, namely through the National Institutes of Health (NIH) and federally funded university research. NIH provides much of the basic research in therapeutic development that would not otherwise have been initiated because the risks of developing such therapies outweighs potential (monetary) returns. Further, NIH has the expertise to conduct and fund translational science, the act of applying basic scientific knowledge (such as understanding the structure of a virus protein) to developing medical interventions and therapies, which lowers the cost of biomedical product development. In the case of the COVID-19 vaccine development, NIH scientists, in partnership with academia and private companies, created a prototype Coronavirus to study the spike protein,³ by building on the decades of U.S. government tax dollars spent on basic research facilities at NIH for HIV and other viruses.

NIH's role is necessary, and to build for the future it needs added expertise to carry product development to the next stage beyond the basic and translational research. To advance the innovation to the next level, NIH partners with academia and private biopharmaceutical companies to develop the vaccines and scale production for distribution.⁴ Research universities' contributions in this success should not be overlooked — National Institute of Allergy and Infectious Diseases (NIAID) collaborated with the University of Texas at Austin researchers to identify coronavirus spike proteins that eventually enabled mRNA⁵ vaccine developers to design candidate vaccines.⁶ In addition, NIAID and other NIH Institutes leveraged the clinical trial networks located at academic research institutions (e.g., University of Maryland, Emory University, Yale University). These consortia conducted phase I through IV trials, including clinical trials with industry partners; Moderna's phase I clinical trial was conducted at Kaiser Permanente Washington Health Research Institute (KPWHRI) in Seattle, for example.⁷

But beyond the initial research help by NIH and academia, it was the private biopharmaceutical companies that truly had the capacity to develop the vaccine and produce it on a commercial scale. As the global leader in biopharmaceutical innovation, America's biopharmaceutical companies continue to invest in critical R&D and manufacturing. U.S. firms conduct over half the world's R&D in pharmaceuticals (\$75 billion) and hold the intellectual property rights on most new medicines.⁸ With the prototype Coronavirus (from NIH), identifying protein spikes (from academia) and using in-house scientific knowledge on various infectious diseases, biopharmaceutical research companies made unprecedented progress in an incredibly short time span of six to seven months⁹—March 30, 2020 to December 2020— when three of seven vaccine candidates achieved emergency use authorization (EUA) from the FDA.¹⁰ Given the unique urgency of the pandemic, the government further lowered the risk of failure by covering the scale up costs to manufacture the COVID-19 vaccine, committing to advance purchase of vaccine candidates and actively helping in clinical trial processes through Advance Market Commitments (AMC)¹¹ and Operation Warp Speed (OWS). In total, it is estimated that the U.S. government directly invested \$18-23 billion in the development of the COVID-19 vaccine.¹²

In addition to developing the vaccine, the private sector worked in other ways to support the government in an effort to defeat the pandemic. For example, when the vaccine was available, Business Roundtable and its CEOs launched a campaign called “Move the Needle”, to increase vaccine uptake. The campaign was designed to support businesses of all sizes and policymakers at all levels to protect the populations from the virus and rebuild America's economy equitably.¹³

As COVID-19 created havoc in the U.S. since March, 2020¹⁴, the U.S. government collaborated with academia and private companies in the development of the COVID-19 vaccines. The federal government's long-term investment in biomedical research efforts, along with specific investment for COVID-19 vaccine development, enabled rapid innovations by private companies.



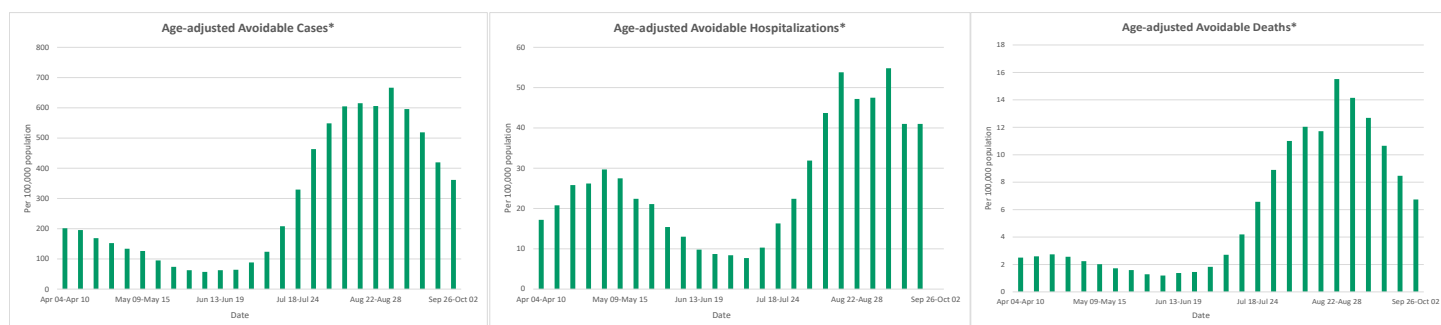
COVID-19 VACCINE: IS IT WORKING?

Before the vaccine was available in the U.S., innumerable COVID-19 cases, hospitalization and deaths overwhelmed the health care system. However, COVID-19's spread and disease incidences were not evenly distributed across regions. There is a strong linkage between risk factors and disease prevalence. Less healthy states, such as those with high obesity and smoking rates, realized higher levels of COVID-19 cases and deaths. Because the elderly population was also more susceptible to COVID-19, states with higher shares of the elderly in their population were also impacted greater than others. Many of the heartland states¹⁵ were high-risk for COVID-19 due to the high prevalence of many chronic diseases. According to Chronic Disease Index,¹⁶ which ranks all 50 states according to the prevalence of major chronic diseases, 10 out of the 20 heartland states ranked among the bottom half of the index: Tennessee (49th), Arkansas (48th), Kentucky (47th) and Mississippi (46th) were in the bottom five unhealthiest states.¹⁷ None of the heartland states ranked in top 10. However, Minnesota (11th), Texas (12th), North Dakota (14th) and Illinois (15th) ranked in the top 15.

Although the heartland overall does not have a large elderly population share, many of the former manufacturing centers – Cleveland, Detroit, Milwaukee, and other northern heartland metros – have a higher share of elderly than the national average and are, therefore, more at risk.¹⁸

Since EUA was issued for the three vaccines available in the U.S., there has been a substantial reduction in COVID-19 cases, hospitalization rates and deaths. In April 2021, COVID-19 cases (deaths) for unvaccinated persons were more than 10 times (14 times) those of fully vaccinated individuals, and adult hospitalization for unvaccinated persons was more than 14 times that of vaccinated individuals. By August 2021 (after the emergence of the Delta variant), unvaccinated persons had a 6.1 times greater risk of testing positive, 11.3 times greater risk of dying from COVID-19 and 18.5 times greater risk to be hospitalized. These statistics testify to the effectiveness of the vaccine in reducing impacts to the health care industry and economy.

Higher Vaccination Rates Mitigate COVID-19 Effects



The above charts illustrate the avoidable incidence of cases, deaths and hospitalizations — even after considering breakthrough cases due to the Delta variant.

As suspected, some of the heartland states experienced the highest number of COVID-19 cases (per 100,000 persons) and death rates (per 100,000 population) between January 2020 through November 2021.¹⁹ North Dakota, Tennessee, South Dakota, Arkansas, Alabama, Kentucky and Mississippi

were among the top 15 U.S. states with the highest number of cases (per 100,000 persons), and similarly, Mississippi, Alabama, Louisiana, Arkansas, Oklahoma and South Dakota ranked with most death rates (per 100,000) in the country. As discussed earlier, most of these states ranked as unhealthy states, but North Dakota is an exception. It ranked 14th in the Chronic Disease Index but still experienced a high caseload in the country.



Cases and Severity of COVID-19 in Heartland States

January 2020 - November 2021					October 29 - November 11, 2021				
Heartland States	Cases (per 100,000)	Case Rank (out of 50 states)	Deaths (per 100,000)	Deaths Rank (out of 50 states)	Cases (per 100,000)	Case Rank (out of 50 states)	Deaths (per 100,000)	Deaths Rank (out of 50 states)	Fully vaccinated (as of November 11, 2021)
Alabama	17,079	11	325	2	11	43	0.7	9	45%
Arkansas	17,154	10	282	7	15	37	0.43	23	48%
Illinois	13,675	33	228	28	25	27	0.18	45	61%
Indiana	15,500	22	252	17	30	23	0.33	31	50%
Iowa	15,863	19	227	29	41	16	0.44	19	56%
Kansas	15,309	23	228	27	33	22	0.79	7	54%
Kentucky	17,064	12	228	26	27	24	0.88	3	51%
Louisiana	16,426	18	315	4	9	48	0.24	39	48%
Michigan	13,284	38	242	22	45	13	0.48	18	54%
Minnesota	14,749	28	160	40	60	5	0.42	24	62%
Mississippi	17,061	13	342	1	10	45	0.23	40	46%
Missouri	14,402	30	213	33	20	33	0.34	30	50%
Nebraska	15,146	24	144	42	42	15	0.11	48	57%
North Dakota	20,138	1	241	23	67	2	0.43	20	48%
Ohio	13,566	35	216	32	36	19	0.63	10	52%
Oklahoma	16,444	17	275	10	14	40	0	50	51%
South Dakota	17,953	5	257	14	44	14	0.39	25	53%
Tennessee	18,495	3	241	24	16	36	0.37	27	49%
Texas	14,703	29	250	19	10	46	0.3	34	54%
Wisconsin	15,687	20	166	39	50	10	0.36	28	59%
United States	14,092	-	229	-	23	-	0.37	-	59%
Source: Published by NY Times. Data sourced from various state/county organizations and CDC. (accessed on November 11, 2021)									

ECONOMIC SAVINGS DUE TO COVID-19 VACCINES

Data in the previous section on how vaccination rates have affected COVID-19 cases and severity indicates the strong possibility of economic savings in the U.S. The COVID-19 vaccine decreases the incidence and severity of illness, meaning that workers are less likely to be ill, or die, minimizing labor productivity losses due to the pandemic. The vaccine also minimizes the need for social distancing and forced business closures, enabling people to return to pre-pandemic activities like shopping, eating at restaurants and working close together, minimizing revenue losses from closed or restricted businesses.

Estimating the total benefit generated from the COVID-19 vaccine is a difficult task, so it is not surprising that there is not a consensus around the economic savings associated with COVID-19 vaccines in the U.S. The approach most commonly used for this type of estimation is to compare actual economic activity to expected (or predicted) economic activity without the economic shock, or pandemic in this case. One limitation of this methodology is that it cannot capture intangible benefits like quality-of-life factors. Based on this approach, the report estimates the economic savings in the U.S. due to the availability of COVID-19 vaccines is between \$288 billion and \$588 billion in improved GDP, the midpoint estimate is \$438 billion.²⁰

This estimate includes decreases in health care cost due to COVID-19 vaccination since vaccination lowered cases and severity of COVID-19 patients leading to a drop in the rate of hospitalization and ER visits and lowering health care expenditures. The result of decreased emergency medical expenditures accounts for part of the estimated economic savings.

Another significant portion of the estimated economic savings comes from the majority of vaccinated workers who did not become ill or

leave the labor market. These workers' employers were able to maintain production, serve customers and deliver goods and services which otherwise would have experienced temporary shutdowns or greatly reduced output. In addition, the estimates include stimulated household consumption that resulted from consumer confidence associated with the availability of the vaccine. Since consumption represents roughly two-thirds of the U.S. economy, this is not an insignificant component of economic savings.

The estimate of economic savings does not, however, capture additional, less tangible benefits, such as improvements to quality of life or mental health. Loss of life among friends and loved ones, fear of contracting the virus, concern about economic security, and the effects of isolation and loneliness have all taken a toll on the mental health of the population during the pandemic.²¹ The introduction and distribution of the COVID-19 vaccine cannot bring back the lives of those lost during the pandemic, but it has brought hope, optimism and the expectation of a return to normal life, albeit not completely, such as the return to school, houses of worship and workplaces.





A PLAN FOR THE FUTURE: INNOVATION IS CRITICAL

The recent COVID-19 pandemic has made it more imperative that the innovation pipeline continues, so the country -- and the world, is better prepared for diseases and future pandemics. As many prescription drugs prices have been rising in the U.S.,²² high costs of producing these drugs are blamed for their increasing prices. As a result, Congress has been contemplating legislation to lower costs of production, allow competition and bring down drug prices. Whatever Congress does should tackle these important issues with a mindset of innovation, capitalism and consequences to the future generation. Some of the proposed legislation that aims to reform drug prices through direct price negotiations between Medicare and drug manufacturers, might have short-term gains in bringing down the drug prices as access to less expensive drugs is a blessing to consumers. In many communities, including the heartland, availability of cheaper, affordable and generic drugs would help manage their care effectively. But at the expense of creating barriers to innovate—both in terms of volume and patterns of future innovation.

Some of the proposed legislation alludes to provision regarding shortened exclusivity periods, a godsend for many consumers that seeks affordable prescription drugs through generics. Limiting biopharmaceutical companies' pricing power through shorter exclusivity periods brings in several potential changes that might occur in the innovation pipeline. Over this exclusivity of

13-14 years, biopharmaceutical companies expect a sufficient rate of return on their capital enabling them to reinvest in further R&D. This may include innovation of drugs and therapies beyond those originally developed for treating a particular disease but that were found to work for other diseases with appropriate modifications.

This is what happened in developing the COVID-19 vaccines:

- Pharmaceutical companies had been investing in the development of mRNA sequencing for other diseases, but this technology was critical to developing the COVID-19 vaccines.
- In addition, there are about 1,750 clinical trials testing COVID-19 treatments and vaccines worldwide, including about 420 in the U.S.²³
- Of the 1,600 active clinical trials testing treatments, about half (57%) are targeting the virus directly, while the rest focus on related effects of COVID-19, such as pneumonia.
- There are over 150 clinical trials underway to test 74 vaccine candidates.²⁴

Companies' ability to respond to the COVID-19 pandemic with such speed and numerous activities results from their prior successes in commercializing drugs and therapies for other illnesses and diseases.

In addition, depending on what types of therapies and drugs would face exclusivity period, the pattern of future innovation might be affected by impacting the period a biopharmaceutical company has to recoup its investment in a new therapy. As for example, policies could shift development to large biologics (i.e., medicines that are mainly injected, which have higher profit margins and receive longer exclusivity periods) and away from small molecule drugs (i.e., generally given in the form of pills). This can lead to more innovation substitution in favor of biologics and less for small molecule drugs.²⁵ If that is the case, then there should be provisions for more small molecule drugs to be available, either incentivizing more generic drugs or providing enough incentives to cover the risk involved in developing new drugs. In addition, the government should pay attention to the fact that the most expensive drugs that will be up for negotiations are also used for the treatment of cancer, rheumatoid arthritis, etc. Facing such negotiations could also discourage innovation in these types of drugs and therapies.

Policymakers should be thoughtful to the significant financial and social impacts when making decisions. Weighing in on alternative models to lower cost to have less impact on the innovation pipeline is an important consideration. As an example, the Affordable Care Act (ACA) increased the cost for manufacturers through expanded Medicaid and Medicare mandatory rebates (i.e., rebates drug manufacturers must provide for all Medicaid beneficiaries and brand-name drugs provided through Medicare Part D coverage), expansion of the 340B prescription drug discount program, and new taxes on all drug manufacturers and importers

of brand-name prescription drugs. Collectively, these regulations have cost the industry an estimated \$14.1 billion over five years (roughly the cost of developing four new therapies).²⁶ And not to overlook the enormous effect, this industry has on other allied sectors and communities in terms of employment and growth. Policymakers, therefore, should take into account what is required to support such private-public partnerships in addition to deep consideration of changes that would adversely affect innovation in ways we now realize can mean the difference between life and death as well as economic stability.

The public-private partnerships that are the foundation of vaccine and drug therapy development in the U.S. were critical to spurring the development and deployment of the COVID-19 vaccine. While Congress faces pressure to both lower the cost of government services and lower the costs of prescription drugs to their constituents, it should not lose sight of the incentives private companies have to innovate and produce new therapies. They should seek policy with an opportunity to seek well and do good. The COVID-19 vaccine not only mitigated the incidence and severity of the disease, but it allowed for an estimated economic savings of \$438 billion (many times the direct cost of vaccine development).



APPENDIX

Methodology: Estimated Impact of COVID-19 Vaccine on 2021 Real GDP Gain

Real GDP growth in 2020 was predicted to be around 2.0 percent prior to COVID-19. Actual real GDP contracted 3.4 percent in 2020, a difference of roughly 5.4 percentage points attributable mostly due to COVID-19. In August 2020 (before a COVID-19 vaccine was available), Goldman Sachs again raised its 2021 US GDP forecast to 6.2 percent from 5.6 percent, driven by heightened expectations that at least one COVID-19 vaccine would be “widely distributed by the end of the second quarter next year,”²⁷ which was earlier than previously expected. The latest estimate for actual real GDP growth in 2021 from major economic forecasting firms is 5.6 percent;²⁸ several factors, such as the Delta variant, lower vaccination rates and supply-chain problems, restricted growth. This growth rate gives us a projection of 2021 real GDP to be \$19,416.17 billion based on 2020 GDP of \$18,386.52 billion.

Goldman Sachs estimated a four percent permanent loss to GDP if no vaccine had been developed, which equates to a loss of \$735.46 billion in economic output. Since only 59.6 percent of the eligible U.S. population was fully vaccinated as of December 1, 2021,²⁹ we estimate that the economic savings from the vaccine is \$438 billion.

The economic benefit from vaccines may not be linear, however. A lower estimate reflects the fact that, until herd immunity is reached, economic savings from vaccination might only be \$287.6 billion (roughly 39 percent of the population has immunity); this could result from impacts due to variants, or it could be that the wrong segments of the workforce are getting vaccinated (e.g., front-line workers are not getting vaccinated as quickly as remote workers and the elderly). As an upper bound, one might consider achieving herd immunity through vaccination as the goal, and when economic savings will be maximized, which would yield estimated economic savings to be \$588.4 billion (80 percent of the population has immunity).

Other effects, including policies such as social distancing, mask mandates, travel bans, and other factors not associated with vaccines, also contributed to economic growth. The Penn Wharton Budget Model attributes 23 percent of growth between 2020 and 2021 to these non-vaccine policies.³⁰ As a check on our estimates, the growth from all other factors would be \$792.83 billion, not all of which would result from vaccines. (For example, many businesses innovated during the pandemic and realized higher revenue during the pandemic.) Our estimated range of \$287.6 - \$588.4 billion in economic savings from the rapid development and deployment of vaccines seems reasonable.

END NOTES

¹ Simply put, economic savings is the overall gain (benefit) realized due to decreases in economic burden (of a disease or health condition) resulting from the use of vaccines or therapies as compared to the situation without the availability of such remedies.

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³ National Institutes of Health. (accessed on 2021, November 11). [COVID-19 Vaccine Development: Behind the Scenes | NIH COVID-19 Research](#)

⁴ Frank, R. G., Dach, L., Lurie, N. (2021, May 14). It Was The Government That Produced COVID-19 Vaccine Success. Health Affairs Blog. [It Was The Government That Produced COVID-19 Vaccine Success | Health Affairs](#)

⁵ Messenger Ribonucleic acid(mRNA)

⁶ Herman, B. (2020, June 25). The NIH claims joint ownership of Moderna's coronavirus vaccine. Axios. <https://www.axios.com/moderna-nih-coronavirus-vaccine-ownership-agreements-22051c42-2dee-4b19-938d-099afd71f6a0.html>

National Institutes of Allergy and Infectious Diseases. NIH Scientists Identify Atomic Structure of Novel Coronavirus Protein. (2020, February 19). <https://www.niaid.nih.gov/news-events/atomic-structure-novel-coronavirus-protein>

⁷ Harris, J.E. (2021, March). The Repeated Setbacks of HIV Vaccine Development Laid the Groundwork for SARS-CoV-2 Vaccines. National Bureau of Economic Research. Working paper 28587. [The Repeated Setbacks of HIV Vaccine Development Laid the Groundwork for SARS-CoV-2 Vaccines | NBER](#)

⁸ SelectUSA. (accessed on 2021, December 9). [Biopharmaceutical Industry Spotlight | SelectUSA.gov](#)

⁹ Brothers, W. (2020, December 3). A Timeline of COVID-19 Vaccine Development. BioSpace. [A Timeline of COVID-19 Vaccine Development | BioSpace](#)

Although the vaccine was a result of years of R&D investment, the plan for rapid development on COVID 19 vaccine was initiated on March 30 through the OWS program.

¹⁰ One of the 3 is now fully approved by the FDA.

¹¹ Gavi, the Vaccine Alliance. (2020, May). [What is an Advance Market Commitment and how could it help beat COVID-19? | Gavi, the Vaccine Alliance](#)

¹² U.S. Government Accountability Office. (2021, February). Operation Warp Speed: Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges. GAO-21-319.

[Operation Warp Speed: Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges | U.S. GAO](#)

¹³ "Move the Needle": Business Roundtable. (accessed on 2021, December 7). [Move the Needle | Business Roundtable](#)

¹⁴ The first confirmed COVID-19 case in the U.S. was on January 20, 2020.

¹⁵ DeVol, R., (2018 May 4). [Perspectives on Defining the American Heartland. Bentonville, AR. Heartland Forward. Perspectives on Defining the American Heartland - Heartland Forward](#)

16 DeVol, R., & Bedroussian, A. (2007). AN UNHEALTHY AMERICA: The Economic Burden of Chronic Disease: Charting a New Course to Save Lives and Increase Productivity and Economic Growth. Santa Monica, CA. Milken Institute.

17 The other six Heartland states in the bottom half of the index are Oklahoma (42nd), Alabama (41st), Louisiana (37th), South Dakota (36th), Ohio (29th) and Michigan (28th).

18 DeVol, R., (2021 March 4). Coronavirus Regional Economic Impacts and Policy Responses. Bentonville, AR. Heartland Forward. [Coronavirus Regional Economic Impacts and Policy Responses - Heartland Forward](#)

19 The New York Times. (accessed on 2021, November 11). Coronavirus in the U.S.: Latest Map and Case Count

[Covid in the U.S.: Latest Map and Case Count - The New York Times \(nytimes.com\)](#)

20 For a detailed methodology, please see the Appendix.

21 It is estimated that about 80 million additional individuals with these mental health conditions related to COVID-19 existed during the peak of pandemic and lockdown. Cutler, D.M. & Summers, L.H. (2020, October). The COVID-19 Pandemic and the \$16 Trillion Virus. JAMA Network. <https://jamanetwork.com/journals/jama/fullarticle/2771764>

22 [Price Increases Continue to Outpace Inflation for Many Medicare Part D Drugs | KFF](#)

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24 Clinical trial data as of February 26, 2021.

25 Kolchinsky, P. (2021, November). Drug pricing bill's unintended consequences will distort drug development. STAT. [Democrats' drug pricing bill will distort drug development - STAT \(statnews.com\)](#)

26 Hayes, T. O. (2018, June). Understanding Policies that Influence the Cost of Drugs. American Action Forum. [Understanding the Policies that Influence the Cost of Drugs - AAF \(americanactionforum.org\)](#)

27 Nagarajan, S. (2020, August 10). Goldman Sachs lifts 2021 US GDP forecast to 6.2% and predicts a COVID-19 vaccine will be 'widely distributed' by mid-2021. Insider. <https://markets.businessinsider.com/news/stocks/goldman-sachs-lifts-gdp-forecast-widely-distributed-vaccine-hopes-2020-8>

28 Source: Moody's.com

29 Mayo Foundation for Medical Education and Research. (n.d.). *U.S. COVID-19 vaccine tracker: See your state's progress*. Mayo Clinic. Retrieved December 21, 2021, from <https://www.mayoclinic.org/coronavirus-covid-19/vaccine-tracker>

30 Using initial estimates from the Penn Wharton Budget Model on CARES Act and further assumptions on effects of other related policies, the report estimates about 23 percent of change in GDP is explained by COVID-19 related policy changes by the government.

[Short-Run Economic Effects of the CARES Act — Penn Wharton Budget Model \(upenn.edu\)](#)



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