Breaking Barriers to Universal Vaccination

Rohan Dharia

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Introduction

In 1796, Dr. Edward Jenner broke scientific barriers by administering the first vaccine—an inoculation of inactive, attenuated, or active viral organisms to prevent contraction of a certain disease.¹ This significant discovery introduced the concept of universal vaccination, or the eradication of vaccine-preventable diseases by immunizing entire populations. The incorporation of universal vaccination on a global scale originally faced political, economic, geographic, and social barriers. Over the past 80 years, overcoming the political, economic, and geographic barriers has led both to raised immunization rates and to the elimination of many diseases today, but the social barriers still remain.

The First Vaccine: Breaking Scientific Barriers

Before universal vaccination could even be conceived, a viable vaccine had to be developed. Dr. Jenner first discovered that inoculating a patient with cowpox would prevent him/her from ever contracting smallpox, a severe and possibly fatal disease.²,³ On May 14, 1796, he injected cowpox matter from a dairymaid’s hand sore into a healthy eight-year-old boy.⁴ The boy manifested symptoms of cowpox for nine days, but felt completely healthy by the tenth day.⁵ Then, as Jenner wrote in a report, in order to verify the patient’s immunity to smallpox, “he was


² Ibid.


inoculated the 1st of July following with [smallpox] matter, immediately taken from a pustule...the matter was carefully inserted, but no disease followed.” By discovering the first vaccine, Jenner’s work represented the first crack that would eventually help shatter the scientific barriers of immunization, opening the door to universal vaccination.

**Breaking Barriers to Universal Vaccination**

Society has faced four main types of challenges to enable global access to vaccines: *political*, with the lack of governmental support; *economic*, with the difficulty of providing expensive vaccines to the indigent; *geographic*, with the isolation of unvaccinated populations from industrialized areas; and *social*, with the public skepticism of vaccine safety. Currently, social barriers remain the most significant obstacle to universal vaccination.⁷

As these barriers have been broken over the past 80 years, vaccination rates have radically improved, leading to “the global eradication of smallpox, the nearly global eradication of polio, and the drastic decrease in the morbidity and mortality associated with other infectious diseases.”⁸ For example, on May 8th, 1980, the World Health Organization declared that “the world and all its peoples ha[d] won freedom from smallpox.”⁹ Although smallpox is the only vaccine-preventable disease that has been officially eradicated worldwide, in 2016, the United States announced several others to be eliminated from the country, such as diphtheria,

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⁶ Ibid.

⁷ Hotez, Peter, M.D., Ph.D. Interview. 18 Nov. 2019.


*Haemophilus influenzae*, measles, mumps, rubella, and tetanus.\(^{10}\) In addition, over the past few decades, polio cases have substantially decreased by about 99%, from 350,000 cases to only 40 cases currently in three remaining endemic countries—Afghanistan, Pakistan, and Nigeria.\(^{11,12,13}\) These improvements resulted from overcoming the political, economic, and geographic barriers to universal vaccination.

**Breaking Political Barriers**

For more than 165 years after the introduction of vaccination, the United States government remained uninvolved in helping to eradicate vaccine-preventable diseases.\(^{14}\) However, legislation passed over the last 60 years has almost entirely eliminated these political barriers.

The Vaccination Assistance Act of 1962 broke the first political barrier in the United States by allotting $36 million for fiscal years 1963-1965 “to enable the Surgeon General to make grants . . . to pay [a] portion of the cost of intensive community vaccination.”\(^{15,16}\) This

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early funding demonstrated the government’s first attempt at improving vaccination rates. Concurrently, the United States Surgeon General established the Advisory Committee on Immunization Practice (ACIP) in March 1964.\textsuperscript{17} Notably, this committee designed the first full child vaccination schedule in 1995, which raised awareness for the necessity of vaccines and simplified decisions for parents as to when to vaccinate their children.\textsuperscript{18}

Before 1977, nearly 20 million children in the United States were missing “at least one dose of one vaccine in order to be fully protected.”\textsuperscript{19} Having nearly one out of three children under-vaccinated increased the risk of an outbreak.\textsuperscript{20} On April 6, 1977, President Carter set a goal of achieving an immunization rate of 90\% in children against diphtheria, tetanus, pertussis (DTP), measles, mumps, rubella (MMR), and polio through the Childhood Immunization Initiative.\textsuperscript{21} With a combination of increased funding, public awareness, cooperation, and volunteers, the initiative successfully provided access to vaccines for children across the country and ensured newborns were promptly vaccinated.\textsuperscript{22} After only five years, over 95\% of students


\textsuperscript{18} Ibid.


\textsuperscript{22} Hinman, Alan R. \textit{The New U.S. Initiative in Childhood Immunization}. 2nd ed., vol. 13, 1979, \textit{Bull Pan Am Health Organ}. 
beginning school had received immunizations against measles, rubella, DTP, and polio, and over 90% had received immunizations against mumps.\textsuperscript{23, 24, 25}

In 1986, lawsuits over adverse events following immunization (AEFI), including “allegations that DTP caused permanent brain damage,” led Congress to authorize the National Childhood Vaccine Injury Act and subsequently the National Vaccine Injury Compensation Program to compensate those harmed by recommended vaccines.\textsuperscript{26, 27} This step broke political and social barriers by both increasing political involvement and decreasing the number of frivolous lawsuits against vaccine manufacturers that impaired universal vaccination rates.

In 1993, President Clinton created a second Childhood Immunization Initiative and requested $300 million to ensure children received their necessary vaccinations in the United States.\textsuperscript{28} Similar to President Carter’s earlier initiative, this one aimed to vaccinate 90% of children in America by 1996 against DTP, polio, \textit{Haemophilus influenzae} type b (Hib), measles,

\begin{footnotesize}
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\item \textsuperscript{23} “Current Trends Childhood Immunization Initiative, United States -- 5-Year Follow-Up.” \textit{Centers for Disease Control and Prevention}, Centers for Disease Control and Prevention, 7 May 1982, https://www.cdc.gov/mmwr/preview/mmwrhtml/00001091.htm.
\item \textsuperscript{25} Conis, Elena. \textit{Vaccine Nation: Americas Changing Relationship with Immunization}. The University of Chicago Press, 2016.
\end{enumerate}
\end{footnotesize}
and hepatitis B.\textsuperscript{29} However, the second initiative specifically targeted children under two years old and also aspired to “eliminate financial barriers to vaccination.”\textsuperscript{30} Additionally, it aimed to strengthen the United States’ vaccine infrastructure by “providing funding for communities to extend clinic hours, provide more staff, and increase information and education efforts and for the planning and implementation of a national immunization tracking system.”\textsuperscript{31} By 1996, it had begun to demonstrate early signs of success, as the DTP, polio, Hib, and measles immunization rates rose to a national average of over 90% each.\textsuperscript{32} In addition, the hepatitis B vaccination rate increased from 8% to 82%.\textsuperscript{33} These successes exemplified the importance of breaking political barriers on improving universal vaccination rates in the United States.

\textit{Breaking Economic Barriers}

Conquering economic barriers to universal vaccination involved expanding access to vaccines in low-income countries and required assistance from both governments and private institutions.

The United Nations founded the United Nations International Children’s Emergency Fund (UNICEF) on December 11, 1946 to help children affected by World War II.\textsuperscript{34} In addition

\footnotesize{\textsuperscript{29} Ibid.}

\footnotesize{\textsuperscript{30} Ibid.}


\footnotesize{\textsuperscript{33} Ibid.}

to providing general care to children, the program seeks out and immunizes unvaccinated youth in third-world countries.\textsuperscript{35} Over the past 70 years, UNICEF’s efforts have drastically improved vaccine prices, allowing financially-challenged families to better afford immunizations. For example, the program’s work has reduced “the cost of fully immunizing children in low-income countries [to] just US $18 per child [in 2018], down from US $24.5 in 2013.”\textsuperscript{36} Through accomplishments such as this, UNICEF has made considerable progress towards breaking economic barriers to universal vaccination.

In 2000, more than five decades after the creation of UNICEF, a group of activists including the Bill and Melinda Gates Foundation, the World Health Organization, and the World Bank formed the Global Alliance for Vaccines and Immunization (GAVI). This alliance intended to provide vaccines to “the 73 poorest countries in the world” to lift economic barriers.\textsuperscript{37} Since its founding, GAVI has accomplished incredible feats by vaccinating over 960 million people, preventing more than 13 million deaths, and saving $150 billion in vaccine production.\textsuperscript{38} The program’s future plans focus on continuing to improve immunization rates in poor countries with the long-term goal of autonomy for these nations, a critical step to achieving complete universal vaccination.\textsuperscript{39}


\textsuperscript{39} Gavi, the Vaccine Alliance. “Gavi’s Strategy, Phase IV (2016-20).” \textit{Gavi, the Vaccine Alliance}, Gavi, the Vaccine Alliance, 18 June 2014, https://www.gavi.org/about/strategy/phase-iv-2016-20/.
In 2010, the Bill and Melinda Gates Foundation announced a $10 billion donation towards universal vaccination, beginning the Decade of Vaccines (DoV) Collaboration with the help of GAVI, UNICEF, and the United States National Institute of Allergies and Infectious Diseases.\textsuperscript{40,41} In 2012, the 194 countries of the 65th World Health Assembly agreed to the DoV’s Global Vaccine Action Plan (GVAP).\textsuperscript{42} By 2017, a record 116 million infants were fully vaccinated with DTP internationally. Additionally, 1.8 million fewer children were under-vaccinated in 2017 as compared to 2010, and the Western Pacific region experienced an all-time low incidence of measles.\textsuperscript{43} Africa more than doubled its immunization spending since 2010, which broke economic barriers by reducing the monetary strain that hinders families from receiving vaccines.\textsuperscript{44} On the other hand, “19.9 million children were under-vaccinated in 2017[...], several countries... lost their measles elimination status [and]... only seven countries reported no vaccine hesitancy,” meaning this project still remains imperfect.\textsuperscript{45} Although the plan is not meeting its preset goals at this time, its actions have still greatly improved immunization rates worldwide. As the end of this decade has arrived, the GVAP has outlined plans to continue increasing vaccination rates for the next ten years.\textsuperscript{46}


\textsuperscript{44} Ibid.

\textsuperscript{45} Ibid.

\textsuperscript{46} Ibid.
Breaking Geographic Barriers

Certain countries face geographic isolation, which hinders access to proper vaccinations. Various programs have been established in these countries to break barriers by augmenting access to vaccines and maintaining this framework for the future.

One example is the Expanded Program on Immunization (EPI), founded in 1974 by the World Health Organization. This project increased vaccine availability in third-world countries without much geographic access to health care. It focused mainly on six major vaccines: diphtheria, pertussis, tetanus, polio, measles, and tuberculosis and proved successful in multiple ways. Overall vaccination rates in targeted countries improved from less than 5% to over 80% from 1974 to 2014. Specifically, after intervention of the EPI in Thailand, immunization rates for all three doses of the hepatitis B vaccine improved from 82.3% in 1999 to 97.3% in 2004. Next, hepatitis B vaccine coverage in children less than 18 years of age (born before EPI) rose from 20.3% in 1999 to 71.7% in 2004. Additionally, measles immunization rates increased globally from about 15% in 1980 to nearly 90% in 2012, neonatal tetanus mortality rates in newborn babies dropped by 96% from 1988 to 2017, and DTP vaccination rates for 12-23


48 Ibid.


51 Ibid.
month-olds rose from 38.4% in 1983 to 85.9% in 2018, all due in large part to the work of this program.\textsuperscript{52,53,54}

UNICEF has also contributed to overcoming geographic obstacles to universal vaccination. In addition to reducing the cost of the vaccines they provide, this program seeks out geographically isolated populations in over 95 countries to the extent that its “health workers climb mountains . . . cross rivers . . . travel by boat . . . by bicycle . . . and by air,” all to provide vital vaccines to those who need them.\textsuperscript{55} Through these efforts, they reach 45% of young children worldwide with vaccinations and break geographic barriers.\textsuperscript{56}

\textbf{Ongoing Social Barriers to Universal Vaccination}

Although the political, economic, and geographic barriers to universal vaccination have largely been broken, the social barriers unfortunately still remain. Parental skepticism regarding vaccines remains the chief social barrier that inhibits worldwide immunization and increases the threat of future disease epidemics.\textsuperscript{57} Many of these “vaccine skeptics” believe that immunizations are harmful and can lead to conditions such as autism. Some also consider

\begin{thebibliography}{9}
\bibitem{56} Ibid.
\bibitem{57} Hotez, Peter, M.D., Ph.D. Interview. 18 Nov. 2019.
\end{thebibliography}
conspiracy theories alleging that the government and pharmaceutical companies “bribe researchers to fake their data, cover up evidence of the harmful side effects of vaccines, and inflate statistics on vaccine efficacy.” In part due to these reasons, in 2019, 3.3% of parents in the United States refused vaccination for their children. With this vaccine hesitancy, diseases that were once completely eradicated, such as measles, have returned. Although measles is still officially considered eradicated from the United States, health facilities documented 1,282 total measles cases in 2019, compared to only 86 in 2000. This 14-fold increase over a period of just 19 years demonstrates the comeback of disease due to under-vaccination.

Anti-vaccination beliefs have existed for as long as vaccines have, but modern movements began in 1998 with a paper alleging that the MMR vaccine caused autism. According to Dr. Peter Hotez, a pediatrics professor, father of an autistic daughter, and Dean of the National School of Tropical Medicine at Baylor College of Medicine, the situation’s severity has been significantly amplified in the past decade with the development of social media, and

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now, anti-vaccination supporters can pressure parents against immunizations through the Internet.\textsuperscript{64} For example, on the Amazon website, many of the first search results for books about vaccines come from vaccine skeptics.\textsuperscript{65} These web activists often use made-up information to convince parents who want what is best for their children to decide against immunizations.\textsuperscript{66}

The influence of vaccine skeptics has escalated so greatly that state, and even federal, legislatures have begun to ease the process of obtaining a non-medical vaccine exemption, or a pardon from receiving the necessary vaccines for personal, rather than health, reasons.\textsuperscript{67} In Texas, a political action committee called “Texans for Vaccine Choice” has risen into power, protesting for the “liberty” of vaccine choice.\textsuperscript{68} These legislative groups are introducing new types of political barriers regarding government stance on universal vaccination. California, New York, West Virginia, and Mississippi are the only states that have completely disallowed non-medical vaccine exemptions.\textsuperscript{69} Interestingly, most of these states suffered the highest incidences of measles during the recent outbreak just before their legislature passed the law, meaning, sadly, it took an epidemic to finally convince lawmakers to take action.\textsuperscript{70}

\textsuperscript{64} Hotez, Peter, M.D., Ph.D. Interview. 18 Nov. 2019.
\textsuperscript{65} Ibid.
\textsuperscript{66} Ibid.
\textsuperscript{67} Ibid.
\textsuperscript{68} Ibid.
\textsuperscript{69} Ibid.
\textsuperscript{70} Ibid.
The Future

While breaking barriers to universal vaccination has improved most immunization rates, the anti-vaccination movement continues to plague those for newer vaccines, such as ones against Human Papilloma Virus (HPV). Only 20-30% of Texans have been vaccinated against this virus, while most other immunization rates are above 90%.\textsuperscript{71,72} To solve this problem, Dr. Hotez believes a massive effort is necessary from doctors, scientists, and researchers who are aware of the true validity of vaccines.\textsuperscript{73} He has outlined a plan for opposition, published in *Newsweek*, that includes neutralizing political committees and taking down the false information online.\textsuperscript{74,75}

The barriers to universal vaccination are also playing roles in the current COVID-19 pandemic. Countless researchers worldwide are searching for a vaccine against the deadly virus, and as of May 21, 2020, eight of the over one hundred potential COVID-19 vaccines are in their early clinical trial phases.\textsuperscript{76} Once a vaccine is approved for use, the programs, legislation, and organizations created over the last 80 years to break barriers to universal vaccination will be instrumental in quickening the universal vaccination process for the vaccine. Despite this, social

\textsuperscript{71} Ibid.  
\textsuperscript{73} Hotez, Peter, M.D., Ph.D. Interview. 18 Nov. 2019.  
\textsuperscript{74} Ibid.  
barriers may still hinder universal COVID-19 vaccination. About one in four adults in the United States has already stated that he/she will not consent to a COVID-19 vaccination, “even if it is deemed safe and effective,” which is a barrier that may need to be broken in order to control COVID-19.\textsuperscript{77}

\textbf{Conclusion}

The ongoing involvement of government, reduction of vaccine cost in third-world countries, and increased vaccine distribution to isolated areas worldwide have dramatically broken political, economic, and geographic barriers to universal vaccination. As a result, many countries have eradicated numerous diseases through increased immunization rates. However, social barriers remain an ongoing impediment to global immunization, and significant counter-active measures from the scientific community will be crucial to prevent detrimental future epidemics that could threaten mankind.

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