ABSTRACT

The Historical Precedent of Vaccine Hesitancy and its Manifestations in Covid-19

Rebecca J. Bila

Director: Dr. Walter M. "Sparky" Matthews, MD, MS, MPH, FAsMA

In an "unprecedented" world, vaccine hesitancy is a supremely *precedented* phenomenon. For this thesis, Baylor University students were surveyed regarding their opinions and behaviors with respect to Covid-19 vaccination. While in a modern, contextually-anchored package, responses revealed themes common not only among each other, but common since the early nineteenth century when the first vaccine was invented. In this study of historical vaccines and their echoes in modernity, it is apparent that many of the objections cited against vaccination today are indicative of a repetitive history. As it stands, vaccination is one of the most, if not *the* most important preventive measure against endemic and epidemic communicable disease, but an intensely diverse group of people decline to be vaccinated against Covid-19. Baylor students' opinions have proven both insightful and illuminating with regard to *why* exactly people decline Covid-19 vaccines, providing a launchpad for future research tailored to the specific concerns of a young-adult population well on their way to becoming the policymakers of the future.

APPROVED BY DIRECTOR OF HONORS THESIS:

Dr. Walter M. “Sparky” Matthews, MD, MS, MPH, FAsMA
Honors Program

APPROVED BY THE HONORS PROGRAM:

_____

Dr. Elizabeth Corey, Director

DATE: _____

The Historical Precedent of Vaccine Hesitancy and its Manifestations in Covid-19

A Thesis Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the Requirements for the

Honors Program

By

Rebecca J. Bila

Waco, Texas

May 2022

Table of Contents

CHAPTER ONE

Introduction

Vaccine hesitancy and refusal is a critically important topic of discussion in this day and age for a multitude of reasons. Many individuals in highly developed countries must have once thought modern medicine inerrant; in the United States, for example, the general population had not encountered (in living memory) an epidemic for which there was no developed vaccine. Before Covid-19, it was easy to take for granted the fact that we as a society do not encounter most of the deadly diseases of old. Americans no longer have to worry about contracting smallpox or polio, both of which used to strike fear into the hearts of many. With the arrival of Covid-19, we no longer have the luxury of regarding infectious disease as something either abstract and far away or nothing more than a nuisance.

The Covid-19 pandemic has been life-altering almost by definition. Prior to the development of vaccines against SARS-CoV-2,[1] Covid-19 caused a major death toll and meant physical and social isolation for millions. Announcements regarding the development of vaccines began on March 15th, 2020, leading to the three licensed Covid-19 vaccines in the United States at time of writing.[2] Though some still require hospitalization for Covid-19, vaccination has proven largely effective in

[1] SARS-CoV-2 is the causative pathogen for COVID-19.

[2] "Explaining Operation Warp Speed," Missouri Department of Health & Senior Services, n.d., https://health.mo.gov/living/healthcondiseases/communicable/novel-coronavirus-lpha/pdf/fact-sheet-operation-warp-speed.pdf.

preventing severe disease and death and has even been shown to be somewhat effective in preventing infection. Vaccine safety has been demonstrated over the course of a year since the release of the three vaccines currently licensed in the United States. With this in mind, however, many people are unable to be vaccinated due to underlying health conditions or being immunocompromised. Still others decline vaccination on other bases. The question arises: what are these other reasons people give to decline a vaccine against the first pandemic disease in living memory?

To answer this question, we must look first to history and then to the present. To begin, four pre-modern diseases will be discussed, examining the history of vaccination for each and evidence of vaccine hesitancy or refusal specific to that disease. Next, three modern diseases and their vaccines, along with reasons for hesitancy, will be detailed. Following this overview of historical vaccines will be information about vaccines against Covid-19, rounding out the background material that will provide context for the heart of this work: a study on the Covid-19 vaccine decisions made by Baylor University students and the opinions and perceptions that have led them there. To conclude will be a discussion of the results of the study, how they tie into the history of vaccine hesitancy, and conclusions on how that hesitancy may be best addressed in young adult populations.

With history in mind, the reasons why Baylor University students decline the Covid-19 vaccine, while in a modern, contextually-anchored package, are nothing new. The same or similar reasons to decline vaccines have existed throughout the history of vaccination.

CHAPTER TWO

Overview of Covid-19 and Vaccines

Coronaviridae is a family of viruses with spikes on their surface. The appearance of these spikes on electron microscopic images gives the appearance of a crown, which lends this virus family its name. Human coronaviruses were identified for the first time in the 1960s.[1] Including SARS-CoV-2, there are seven known human coronaviruses.[2] The common cold is the innocent result of infection with several of these common coronavirus species; according to the CDC, common human coronaviruses typically cause relatively mild upper respiratory tract illnesses.

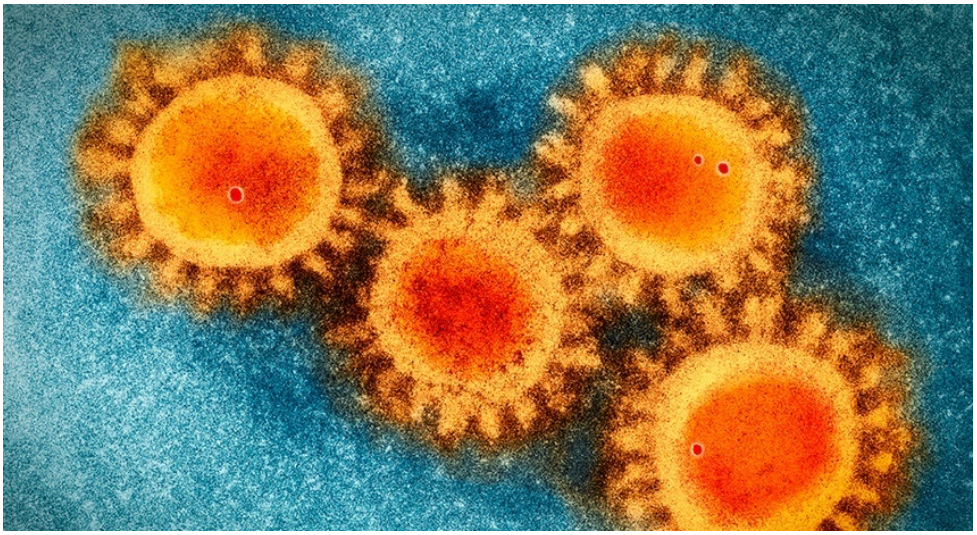


Figure 1: An electron microscopy photo of SARS-CoV-2 showing its crown-like spike proteins.

[1] "Human Coronavirus Types | CDC," March 17, 2021, https://www.cdc.gov/coronavirus/types.html.

[2] "Properties of Coronavirus and SARS-CoV-2 - PubMed," accessed April 9, 2022, https://pubmed.ncbi.nlm.nih.gov/32342926/.

The 2019 coronavirus (SARS-CoV-2), first known as the novel coronavirus, is the causative pathogen in Covid-19 illness and is spread by respiratory droplets.[3]

Coronaviruses contain numerous antigens, including spike proteins, membrane proteins, envelope proteins, and a nucleocapsid protein. The key protein to be discussed is the spike protein: it allows the virus to attach to host cells.[4]

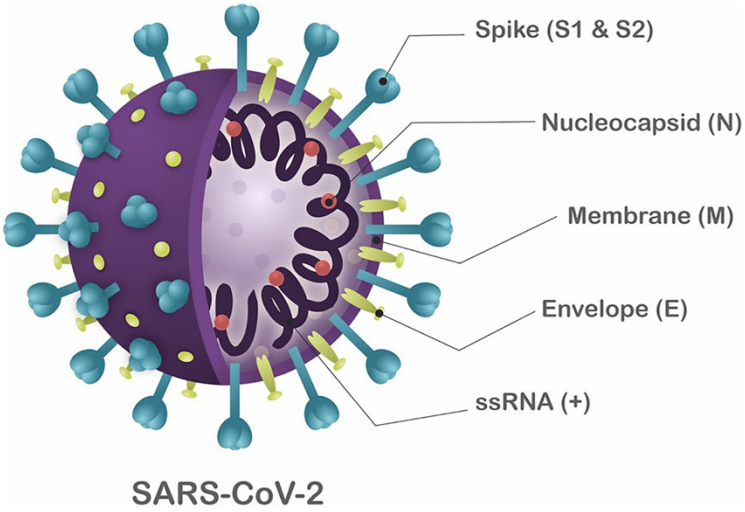


Figure 2: A schematic diagram of SARS-CoV-2 and its component parts.

A discussion of vaccines (and immunization, in a broader sense) is not complete without definitions for key terms. Furthermore, these definitions have at times come under attack in the Covid-19 era, necessitating transparency in their substance lest they be rendered meaningless. Furthermore, these definitions may indicate assumptions made on the part of governing bodies, the author, the public, or others that must be kept in

[3] "Common Human Coronaviruses | CDC," May 27, 2020, https://www.cdc.gov/coronavirus/general-information.html.

Figure 1: "The COVID-19 Coronavirus Epidemic Has a Natural Origin, Scientists Say," accessed April 17, 2022, https://www.scripps.edu/news-and-events/press-room/2020/20200317-andersen-covid-19-coronavirus.html.

[4] "Properties of Coronavirus and SARS-CoV-2 - PubMed."

Figure 2: Igor de Andrade Santos et al., "Antivirals Against Coronaviruses: Candidate Drugs for SARS-CoV-2 Treatment?," *Frontiers in Microbiology* 11 (2020), https://www.frontiersin.org/article/10.3389/fmicb.2020.01818.

mind. Below are relevant definitions of terms to be used throughout subsequent chapters.

According to the Merriam-Webster Medical Dictionary, as accessed online in February 2022, a vaccine is "a preparation administered (as by injection) to stimulate the body's immune response against a specific infectious agent or disease." The first sub-definition covers most vaccines prior to Covid-19: "An antigenic preparation of a typically inactivated or attenuated pathogenic agent (such as a bacterium or virus) or one of its components or products (such as a protein or toxin.)" The second sub-definition, which was added after Covid-19 vaccines were introduced, is as follows: "a preparation of genetic material (such as a strand of messenger RNA) that is used by the cells of the body to produce an antigenic substance (such as a fragment of virus spike protein.)"[5] The alteration of Webster's definition of a vaccine has been a point of some contention among the public, with particular attention being paid not to the aforementioned addendum for Covid-19, but to a single word change. Merriam Webster's base definition formerly said vaccines stimulate "immunity" rather than "the body's immune response," the point of difference being that "stimulates immunity" implies a lack of susceptibility to infection while the new wording does not; it entails an immune *response*, whether or not that response makes one entirely immune to infection. This change was made in May 2021, seemingly to allay concerns about the possibility of breakthrough

[5] "Vaccine Definition & Meaning," in *Merriam-Webster.Com Dictionary*, April 11, 2022, https://www.merriam-webster.com/dictionary/vaccine#medicalDictionary.

infections,[6] but has done little to appease those who believe Covid-19 vaccines are not "real" vaccines. On the other hand, definitions have not always been static in general, and medical dictionaries in particular are subject to change based on new discoveries.

According to the 16th edition of Taber's Medical Dictionary, printed in 1989, a vaccine is "a suspension of infectious agents or some part of them, given for the purpose of establishing resistance to an infectious disease." Immunization is defined as "becoming immune or the process of rendering a patient immune." Immunization under this definition can be deliberate or natural; deliberate immunization is defined as "the administration, usually by injection, of immunogens as a means of protecting individuals from developing specific diseases" while natural immunization is "The development of immunity to the great number of antigens present in the bacteria to which an individual is exposed," adding, "These are the microorganisms normally present in the intestinal tract, and on the skin."[7]

Despite changes to the definition of a vaccine, Covid-19 vaccines do still fall under the 1989 definition; they are given to establish resistance to an infectious disease and they contain a subcomponent of the infectious agent, though not in exactly the same sense as the authors of *Taber's* must have foreseen. Covid-19

[6] A breakthrough infection is when a fully vaccinated person becomes infected with the disease, in this case Covid-19. CDC, "COVID-19 Vaccination," Centers for Disease Control and Prevention, February 11, 2020, https://www.cdc.gov/coronavirus/2019-ncov/vaccines/effectiveness/why-measure-effectiveness/breakthrough-cases.html.

[7] *Taber's Medical Dictionary*, 16th ed., 1989.

vaccines can be categorized according to the 1989 definition of deliberate immunization.

Since the invention of the vaccine, in the push to make communicable diseases a thing of the past, many more vaccines have been developed for myriad diseases. Children in the United States receive multiple vaccines beginning in infancy, with additional vaccines required to attend public school. Vaccination continues beyond the start of school through young adulthood in part because many vaccines require multiple doses to be maximally effective. Because of vaccination, smallpox, polio, measles, chickenpox, yellow fever, and a host of other diseases have been (at least at one time) effectively eradicated in the United States. Since 1900, deaths from communicable disease in the United States have decreased from 39.2% of deaths to 3.7% in 1997.[8] At present, there are fifteen vaccines on the CDC's birth-18 years immunization schedule. Today, vaccination is an ever-present aspect of U.S. medical care and one of the most (if not the most) important preventive measures against endemic and epidemic communicable disease.[9]

Ingredients in a vaccine

Adjuvants and preservatives are some of the most hotly debated/cited vaccine ingredients by individuals who are opposed to vaccines. An adjuvant is an

[8] Dr. Walter M. Matthews, "Communicable Disease Control and STDs" (Lecture, Waco, Texas, February 2022).

[9] "Principles of Epidemiology | Lesson 1 - Section 11," CDC Web Archive, December 20, 2021, https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html.

irritant that induces a stronger immune response to vaccine components and allows for doses to be smaller than they otherwise would be; adjuvants are tested for safety before they are used in vaccines. Two ingredients that strike fear in many people are aluminum and thimerosal, which contains a form of mercury. The Hib (*Haemophilus influenzae* type b) vaccine is an example of one that contains an aluminum-based adjuvant; in fact, aluminum-based adjuvants are the only type of adjuvant that is widely used in vaccines.[10] While the presence of these ingredients can be alarming at first thought, studies have shown that there is far more aluminum in a normal diet than there is in all the vaccines received in infancy combined and that even dietary aluminum is consumed in nowhere near the quantity required to be harmful. Though the presence of aluminum in any form or amount can sound concerning, studies have not linked aluminum-based adjuvants to any adverse health effects. As for mercury-containing thimerosal, which is used as a preservative, it does not contain any of the forms of mercury that are known to be neurotoxic.[11,12]

The Pfizer and Moderna Covid-19 vaccines contain viral mRNA, lipids to allow for delivery of the mRNA, sodium chloride, sucrose, dibasic sodium phosphate

[10] Peng He, Yening Zou, and Zhongyu Hu, "Advances in Aluminum Hydroxide-Based Adjuvant Research and Its Mechanism," *Human Vaccines & Immunotherapeutics* 11, no. 2 (February 18, 2015): 477–88, https://doi.org/10.1080/21645515.2014.1004026.

[11] Thimerosal contains ethylmercury, which differs from methylmercury, which is neurotoxic. Ethylmercury is cleared from human tissues quickly and does not accumulate the way methylmercury does.

[12] Sarah Geoghegan, Kevin P. O'Callaghan, and Paul A. Offit, "Vaccine Safety: Myths and Misinformation," *Frontiers in Microbiology* 11 (March 17, 2020): 372, https://doi.org/10.3389/fmicb.2020.00372.

dihydrate, monobasic potassium phosphate, cholesterol, and potassium chloride.[13] The Janssen (Johnson & Johnson) vaccine, which is not an mRNA vaccine, contains replication-incompetent adenovirus expressing the SARS-CoV-2 spike protein, citric acid monohydrate, trisodium citrate dihydrate, ethanol, 2-hydroxypropyl-beta-cyclodextrin, polysorbate-80, and sodium chloride.[14] All of the ingredients in these Covid-19 vaccines have been used in older vaccines except for mRNA, thus mRNA is the ingredient of greatest interest in this thesis. The mechanism of action of mRNA vaccines will be explained in detail in Chapter 5.

Notably, many vaccines, particularly those utilizing inactivated virus, contain formaldehyde or formalin. Formaldehyde is the ingredient used to inactivate the virus, making it necessary in the vaccines in which it is used. The Salk IPV, which will be discussed later, contains formalin for this purpose. Many vaccine-hesitant individuals have posted ingredient lists for common vaccines and drawn attention to the presence of formaldehyde, indicating that it is dangerous and is only used to preserve cadavers. While formaldehyde has not been found to be harmful in the quantity at which it is present in vaccines, the issue can be avoided altogether in discussion of mRNA vaccines because they do not require it; using mRNA as the active ingredient eliminates the need for inactivated virus, and therefore formaldehyde.[15]

---

[13] "Frequently Asked Questions About The Covid-19 Vaccine," Marshfield Clinic, 2022, https://www.marshfieldclinic.org/specialties/infectious-diseases/covid-19-vaccine-faq.

[14] "Frequently Asked Questions About The Covid-19 Vaccine."

[15] Center for Biologics Evaluation and Research, "Common Ingredients in U.S. Licensed Vaccines," *FDA*, February 2, 2021, https://www.fda.gov/vaccines-blood-biologics/safety-availability-biologics/common-ingredients-us-licensed-vaccines.

Also of note is the fact that development of the Johnson & Johnson (Janssen) Covid-19 vaccine involved the use of embryonic stem cells. While there are no stem cells present in the vaccine itself, their use in any capacity has been the source of much consternation. Many people, including Baylor University students (as will be demonstrated via survey data in Chapter 6), raise ethical objections to stem cell research. These objections, while noted in the study, do not mark anything immediately actionable; while stem cells are cited as a reason for vaccine refusal, they fall under a category of reasons that would be difficult to sway people from due to the moral/ethical nature of the objection. Furthermore, stem cells have been used in the development of many older vaccines, including in the production of the vaccines against rubella and varicella (chickenpox), and objections to their use have been cited ever since.[16]

Vaccine development and approval

Any discussion of vaccines must include an explanation of how they are approved; in the case of the Covid-19 vaccines referred to in this work, the relevant location is the United States, though Covid-19 vaccines were developed outside of the United States as well.

The typical timeline for vaccine development is as follows: First, preclinical trials are performed (usually in animal models) for between one and ten years. Second, Phase 1 clinical trials evaluating both safety and immunogenicity are

[16] The Children's Hospital of Philadelphia, "Vaccine Ingredients – Fetal Cells," Text (The Children's Hospital of Philadelphia, November 6, 2014), https://www.chop.edu/centers-programs/vaccine-education-center/vaccine-ingredients/fetal-tissues.

performed using human subjects for between one and ten years.[17] Third, Phase 2 clinical trials are performed, taking between two and three years. Phase 2 trials further evaluate safety and immunogenicity, introducing any necessary dosing changes. Next, Phase 3 clinical trials take between two and four years, determining how effective the vaccine is at preventing infection after exposure to the pathogen; after this the regulatory approval process takes place. In the United States, regulatory approval is given by the Food and Drug Administration (FDA), which makes licensing decisions for vaccines.[18]

After licensure, the Centers for Disease Control and Prevention (CDC) is charged with recommending licensed vaccines to populations within the U.S., which is typically done by its Advisory Committee on Immunization Practices (ACIP). CDC recommendations can make or break the success of a vaccine both from a medical and commercial perspective.[19] After FDA approval and CDC recommendation, vaccine manufacturing is scaled up and the vaccine is ready to be administered to the public. Following widespread administration, post-licensure safety monitoring takes place to ensure the vaccine does not need to be withdrawn for any reason, including unexpected adverse effects not found during pre-licensure testing.[20]

---

[17] Immunogenicity is the ability to invoke an immune response.

[18] "Vaccine Research & Development," Johns Hopkins Coronavirus Resource Center, accessed April 3, 2022, https://coronavirus.jhu.edu/vaccines/timeline.

[19] Jason L Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk," *The Milbank Quarterly* 90, no. 2 (June 2012): 278–310, https://doi.org/10.1111/j.1468-0009.2012.00664.x.

[20] "Vaccine Research & Development."

In the case of a pandemic, there is an accelerated timeline for vaccine development. Phase 1 clinical trials can be shortened to 2-3 months and Phase 2 trials can be completed in 3-4 months; in some cases, Phase 1 and Phase 2 trials can even be combined. Phase 3 trials can be completed in 6-9 months, given extended follow-up for at least two years to assess whether the vaccine is safe and efficacious long-term. The regulatory approval process can also differ in pandemic situations; the FDA can choose to issue EUA (Emergency Use Authorization) to a vaccine before definitive proof of efficacy has been determined if there is a good reason to believe the vaccine is safe and will prevent significant disease mortality.[21] Thus, where typical vaccine trials take between 6 and 27 years to complete, accelerated trials generally take only 11-16 months. These broad timetables do not take into account the time required for FDA approval or the length of post-licensure monitoring, though the FDA works to approve vaccines more quickly in emergency situations, as occurred in the case of Covid-19.

What is a pandemic?

Next, it is important to establish what exactly constitutes a pandemic; a pandemic occurs across multiple populations and can therefore be differentiated from an epidemic and an endemic disease. An epidemic can be defined as "an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area."[22] A pandemic, on the other hand, is much

[21] "Vaccine Research & Development."

[22] "Principles of Epidemiology | Lesson 1 - Section 11."

more widespread. The classic epidemiological definition of a pandemic is "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people."[23] Endemic diseases are prevalent either constantly or on some kind of "schedule" (i.e., the yearly flu season) in a certain area. Covid-19 may very well become an endemic disease in the future.

The first recorded pandemic was in 431 BC. To relay a story from Athens in 431 during an unidentified plague chronicled by Thucydides, a disease ravaged Athens to the extent that "people began holing up in their homes, afraid to visit friends, relatives, or neighbors…"[24] There have been 249 recorded pandemics in history leading up to the current SARS-CoV-2 pandemic.[25] With this in mind, it seems we were "due" for another pandemic around this time (though not necessarily of this kind); in fact, in October of 2019, the Johns Hopkins Center for Health Security ran a simulation of a pandemic based on epidemiological trends, *using a coronavirus as the fictional pathogen*, mere months before Covid-19 entered the world stage. This simulation, called Event 201, brought experts from a number of disciplines together to respond to the fictional pandemic. Hopkins did not do this in an attempt to predict the Covid-19 pandemic, nor were the similarities between the simulation and reality substantive enough to indicate any foreknowledge of

---

[23] Heath Kelly, "The Classical Definition of a Pandemic Is Not Elusive," *Bulletin of the World Health Organization* 89, no. 7 (July 1, 2011): 540–41, https://doi.org/10.2471/BLT.11.088815.

[24] Gina Bari Kolata, *Flu: The Story of the Great Influenza Pandemic of 1918 and the Search for the Virus That Caused It* (Simon & Schuster, 1999).

[25] Howie Baum, "A History of the World's Pandemics," University of Cincinnati, n.d., https://www.uc.edu/content/dam/refresh/cont-ed-62/olli/s21/history-of-pandemics.pdf.

what was to come; the temporal proximity of the simulation to the outbreak of SARS-CoV-2 should not be confused with conspiracy or suspicious prescience.

Anecdotally, however, it shows that the emergence of SARS-CoV-2 was not a major shock to epidemiologists; given the relatively recent history of similar pandemic diseases,[26] SARS-CoV-2 was well within the realm of plausible possibility.[27,28]

According to a joint report following investigation by the WHO into the possible pathways of emergence of SARS-CoV-2, Covid-19 disease first appeared in the Wuhan province of China around December 2019 (but possibly November for the earliest cases). Due to international travel, Covid-19 quickly spread to 114 countries, leading the World Health Organization to declare a pandemic on March 11th, 2020.[29,30]

---

[26] SARS (Severe Acute Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome) were first discovered in 2003 and 2012, respectively. Both are caused by coronaviruses. The last known case of SARS was in 2004. CDC, "Disease of the Week - SARS," Centers for Disease Control and Prevention, March 3, 2016, https://www.cdc.gov/dotw/sars/index.html. MERS is still classified as an emerging disease by the WHO. "WHO EMRO | Middle East Respiratory Syndrome (MERS) | MERS-CoV | Health Topics," accessed April 3, 2022, http://www.emro.who.int/health-topics/mers-cov/mers-cov.html.

[27] JHCHS website designer, "Public-Private Cooperation for Pandemic Preparedness and Response," Johns Hopkins Center for Health Security, accessed March 31, 2022, https://www.centerforhealthsecurity.org/event201/recommendations.html.

[28] "The Event 201 Scenario," Johns Hopkins Center for Health Security, n.d., https://www.centerforhealthsecurity.org/event201/scenario.html.

[29] "WHO-Convened Global Study of Origins of SARS-CoV-2: China Part" (World Health Organization, February 14, 2021).

[30] "WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020," March 11, 2020, https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

Different countries have responded to the pandemic in vastly different ways,[31] and with differing degrees of success.[32] New variants of the virus have arisen as mutations have accumulated; some of those variants have been labeled "variants of concern" (VOC) for their high virulence or transmissibility. At the time of this writing (February 2022) we are experiencing widespread prevalence of a VOC named "Omicron"; this variant generally leads to milder symptoms than other variants (such as "delta"). As alluded to above, these variants arose due to mutations in the virus's RNA; viruses replicate with great efficiency and quick replication begets quick mutation. That said, viral mutation is not necessarily detrimental to human survival; when a virus kills its host too quickly, it has less time to find a new host, and viruses absolutely need a host to replicate and spread. A virus cannot replicate on its own. Based on the above dynamics, the natural history of most respiratory viruses is a gradual increase in transmissibility with decrease in virulence. SARS-CoV-2 seems to be following this same natural course as it has now reached a less virulent, more "contagious" form in the Omicron variant.

Covid-19 specifically has changed the world in myriad ways. In the time since SARS-CoV-2 was discovered, societies have "locked down" by keeping citizens in

---

[31] Some countries used containment strategies (ex. China, South Korea, Singapore) while others used mitigation strategies (ex. The United States, France, The United Kingdom). Containment strategies, as posited in a September 2021 article comparing these six countries' responses to the pandemic, proved more effective than mitigation strategies at outbreak control. Haiqian Chen et al., "Response to the COVID-19 Pandemic: Comparison of Strategies in Six Countries," *Frontiers in Public Health* 9 (2021), https://www.frontiersin.org/article/10.3389/fpubh.2021.708496.

[32] In a study of 113 countries, it was concluded that lockdown/containment procedures, all implemented similarly, did not have the same level of effectiveness in lower-income countries as it did in high-income ones. Morgan Pincombe, Victoria Reese, and Carrie B Dolan, "The Effectiveness of National-Level Containment and Closure Policies across Income Levels during the COVID-19 Pandemic: An Analysis of 113 Countries," *Health Policy and Planning* 36, no. 7 (August 1, 2021): 1152–62, https://doi.org/10.1093/heapol/czab054.

their homes and forcing the closure of highly-patronized locations such as places of worship, concert venues, bars, and even grocery stores. Other measures have included mandated mask wear and "social distancing," and even mandated vaccination (or attempted mandates.) Millions of Americans have been forced to work from home, and economic disruptions have resulted in supply chain problems and product shortages. The pandemic has shown us that our "normal" is fragile, and that prevention is far superior to the reactive responses detailed above. Vaccination, now that it is available, is regarded to be the best way to reach herd immunity and effectively end the pandemic, given that the volume of natural infections required to expose 80-90% of the world's population to Covid-19 organically would cause a major death toll.[33,34]

Why discuss old vaccines?

In order to properly discuss vaccination against Covid-19 and its controversies, we must first look to the past; comparing the way older vaccines were received can shed light on present concerns. In the following chapters, seven vaccines will be discussed in order of development, focusing on what each disease is, how the vaccine came to be, its release to the public, and the subsequent public response to that vaccine. This review will provide much-needed historical context for the way Covid-19 has been handled today.

---

[33] While this was true at time of writing, the Omicron variant of SARS-CoV-2 likely did expose most people organically without the aforementioned death toll; this is in keeping with the characteristics of the Omicron variant described above.

[34] Fernando P. Polack et al., "Safety and Efficacy of the BNT162b2 MRNA Covid-19 Vaccine," *The New England Journal of Medicine*, December 10, 2020, NEJMoa2034577, https://doi.org/10.1056/NEJMoa2034577.

CHAPTER THREE

Pre-Modern Vaccines

Before there were vaccines, there was inoculation; inoculation was the first known immune modulation strategy. In the timeline of recorded history, vaccines are relatively new. The first vaccine, developed by Edward Jenner against smallpox, was released for public use around the year 1800, a little over 200 years ago. In this chapter, four "pre-modern" vaccines will be discussed, including the societal issues that surrounded them.

Smallpox (1798)

The first vaccine to be discussed is, fittingly, the *first vaccine.* Variola, colloquially called smallpox, is a prehistoric disease, making its eradication all the more historic. In fact, it was the first (and *only*) human infectious disease to be successfully eradicated worldwide.[1] Thought to have originated around 10,000 BC, humans have been afflicted with smallpox longer than history has been recorded. Allegedly, "the mummified head of the Egyptian pharaoh Ramses V (died 1156 BC) bears evidence of the disease."[2] Smallpox was introduced to Europe sometime between the fifth and seventh centuries and was frequently epidemic

[1] Kari A. Simonsen and Jessica Snowden, "Smallpox," in *StatPearls* (Treasure Island (FL): StatPearls Publishing, 2022), http://www.ncbi.nlm.nih.gov/books/NBK470418/.

[2] Stefan Riedel, "Edward Jenner and the History of Smallpox and Vaccination," *Proceedings (Baylor University. Medical Center)* 18, no. 1 (January 2005): 21–25.

during the Middle Ages.[3] Conquistadors brought smallpox to the New World. The indigenous tribes living in North America, who had never been exposed to the virus, were hit extremely hard by it with a large percentage of their populations wiped out. Smallpox has, in fact, been used in biological warfare since this period; the British army gave Native Americans blankets deliberately infected with smallpox in 1763 during the French and Indian War. Smallpox, prior to its eradication in 1980, had a mortality rate between 30 and 50%.[4]

Smallpox transmission occurs through airborne respiratory droplets or direct contact with lesions or contaminated fomites.[5] The effects of smallpox disease are devastating. Early symptoms include fever, chills, vomiting, backache, pharyngitis, and headache, which quickly give way to the "eruptive stage," the characteristic skin lesions (exanthem) that are most associated with the disease. Smallpox epidemics swept Europe throughout the 18th century, killing hundreds of thousands and disfiguring those who survived. However, it was well known at the time that survivors of smallpox were subsequently immune for life. For this reason, those who had survived the disease were often the ones to care for the smallpox ill.

[3] Riedel.

[4] Dan Liebowitz, "Smallpox Vaccination: An Early Start of Modern Medicine in America," *Journal of Community Hospital Internal Medicine Perspectives* 7, no. 1 (March 31, 2017): 61–63, https://doi.org/10.1080/20009666.2016.1273611.

[5] A fomite is an inanimate object that may be contaminated with an infectious agent and aid in its transmission. Simonsen and Snowden, "Smallpox."

Inoculation

Inoculation, the introduction of smallpox under the skin of individuals not immune to the virus, was the first effective method for inducing smallpox immunity; it could induce a milder form of the disease and immunize the patient in the process.[6] Inoculation was risky, leading to concerns about transmission of the virus to others and even death from smallpox in the inoculated individual: two to three percent of inoculated persons either died from smallpox, spread it and caused an outbreak, or were infected with other pathogens contaminating the inoculum itself.[7] Inoculation was also referred to as variolation, after the name "variola".

In 1721, a smallpox epidemic in Boston infected half of the population. Variolation/inoculation was performed in a widespread manner after it was discovered that the fatality rate for the Boston epidemic was fourteen percent if the disease was naturally acquired, while only two percent died from variolation.[8] Later, during the American Revolutionary War, smallpox was killing more soldiers than were dying in battle—disease, if left unchecked, would have ended the Revolution. General George Washington ordered for the entire Continental Army to be inoculated against smallpox in 1777. Consistent with inoculation, it was expected that Continental troops would still get sick from smallpox, but far fewer of them would die. Washington also implemented strict quarantine, placing both Boston

[6] Riedel, "Edward Jenner and the History of Smallpox and Vaccination."

[7] Riedel.

[8] Riedel. Variolation/inoculation was not foolproof and occasionally caused death on its own, but the risk of death from inoculation was not nearly as high as from natural infection.

civilians and smallpox-infected troops under quarantine in July 1775.[9] Washington is credited with minimizing smallpox deaths among the Continental Army and "bolstering the morale of the troops by offering them a defense against the pox."[10]

On the other hand, inoculation (and later vaccination) have always had their share of opponents. During the aforementioned Boston epidemic of 1721, Reverend Cotton Mather, the first proponent of inoculation against the pox in the Colonies, received the unwelcome gift of a bomb thrown into his home by an opponent of the practice.[11] Contemporary political cartoons demonstrated common misunderstandings of science and fear of the unknown.[12]

A key fact to note is that vaccination and its predecessor have been both politicized and viewed as moral quandaries since their inception. Despite opposition, inoculation became widely popular in the colonies and was oft-used before much time had passed since Mather's advocacy. Edward Jenner was one of many, many children in England who were inoculated against smallpox. Later in life, he became a surgeon and natural scientist.

Jenner was not the first to discover that those who were infected with cowpox were thereafter immune from infection with smallpox, but he was the first

---

[9] Dr. Walter M. Matthews, "Outflanking the Tiniest Enemy: Washington's Smallpox Inoculation of the Continental Army at Valley Forge, 1777-78" (National Defense University, 2013).

[10] Liebowitz, "Smallpox Vaccination."

[11] "The Fight Over Inoculation During the 1721 Boston Smallpox Epidemic," *Science in the News* (blog), December 31, 2014, https://sitn.hms.harvard.edu/flash/special-edition-on-infectious-disease/2014/the-fight-over-inoculation-during-the-1721-boston-smallpox-epidemic/.

[12] See *Figure 3* on page 30

to act on that knowledge in such a way as to develop a vaccine. Jenner completed a number of studies on myriad subjects before developing his smallpox vaccine. In fact, "antivaccinationists" used Jenner's old studies to try and discredit his vaccine after it was rolled out publicly.[13] Jenner was criticized to a great degree throughout the advent of his vaccine; where many saw it to be the beginning of a new medical era, others were staunchly opposed to his research. This demonstrates that opposition to vaccination has existed for one reason or another as long as vaccination itself; further discussion on this point can be found in the section on the public reception of smallpox vaccines.

Jenner, intrigued by the protective effects of cowpox on milkmaids, hypothesized that inoculating a person with cowpox would protect them against smallpox; cowpox causes only mild illness in humans. To prove his theory, Jenner subsequently inoculated a young boy with cowpox. The boy became ill, but not deathly so, and recovered; Jenner then exposed him to smallpox. The boy did not contract smallpox after exposure. Jenner continued experimenting and published a study on cowpox in 1798, but was met with skepticism. He then traveled to London to find individuals who would volunteer to be vaccinated, but initially found no one. Eventually, Jenner gave vaccine resources to physicians in the area and they popularized vaccination among their patients.

Jenner chose to name his procedure "vaccination" in reference to cowpox, otherwise known as "vaccinia."[14] Vaccinia, in point of fact, is derived from "vaca,"

[13] Riedel, "Edward Jenner and the History of Smallpox and Vaccination."

[14] Riedel.

meaning "cow" in Spanish (or "vacca" in Italian). As slowly as uptake began, vaccination took off around Europe with great speed afterward. Vaccination supplies made their way to New England, and eventually, vaccine proponents won the support of Thomas Jefferson; a National Vaccine Institute was set up shortly thereafter to spread vaccination to the masses in the newly-minted United States.

Jenner published an *Inquiry into the Causes and Effects of the Variolae Vaccinae* in 1796. Within his *Inquiry*, he "described his twenty-five years of investigation into the curious relationship between cowpox and smallpox."[15] The "Jennerian Method" of vaccination came to the United States via a doctor named Benjamin Waterhouse, who read Jenner's paper and decided to start vaccinating people in the United States near Harvard, where he was a professor. Allegedly, he wanted to profit from being the only American able to vaccinate; he hesitated to distribute cowpox vaccine material to others. Then, "finding himself bitterly denounced for this action, Waterhouse finally relented and sent the vaccine to Thomas Jefferson for transmission to the Southern States."[16]

Jenner was monetarily rewarded by Parliament in 1802 once the revolutionary vaccination was known to be effective, and he devoted most of his time to vaccine-related projects, even vaccinating the poor without cost. Vaccination eventually replaced inoculation, as can be seen when we look to modern medicine.[17]

---

[15] MARTIN KAUFMAN, "THE AMERICAN ANTI-VACCINATIONISTS AND THEIR ARGUMENTS," *Bulletin of the History of Medicine* 41, no. 5 (1967): 463–78.

[16] KAUFMAN.

[17] Riedel, "Edward Jenner and the History of Smallpox and Vaccination."

Jenner not only vaccinated against smallpox for the first time, but devoted his life to developing and promoting vaccines. Unfortunately, not even medical revolutionaries are immune to the human condition: Jenner's wife and eldest son both died of tuberculosis in the early 1800s. However, the father of vaccination helped save others from a similar fate—a vaccine against tuberculosis was put into use in 1921, made possible in large part by the first implementation of the concept of vaccination by Jenner.[18,19]

Initial Rollout & Mass Vaccination

Washington's inoculation of his troops led to the Jenner vaccine being accepted in the new nation; "When Edward Jenner's vaccine reached America it was more readily accepted by political and medical leaders due [to] the success of Washington's inoculation campaign."[20] Later, after Waterhouse's introduction of vaccination to the United States, the Institution for the Inoculation of the Kine Pox (another name for cowpox) was established in New York in 1802—making it the first organization of its kind—its goal being to vaccinate New York's poor against smallpox free of charge. Other cities followed suit shortly after. The United States Congress passed "An Act to Encourage Vaccination" in 1813, "which authorized the use of the postal service for transmission of the free vaccine."[21] Unfortunately, this

[18] "Tuberculosis | History of Vaccines," accessed January 20, 2022, https://www.historyofvaccines.org/index.php/content/articles/tuberculosis.

[19] Riedel, "Edward Jenner and the History of Smallpox and Vaccination."

[20] Liebowitz, "Smallpox Vaccination."

[21] KAUFMAN, "THE AMERICAN ANTI-VACCINATIONISTS AND THEIR ARGUMENTS."

led to the first relatively large vaccine incident. In 1822, "the accidental mailing of variolous matter to Dr. John F. Ward, of Tarborough, North Carolina, and the ensuing smallpox epidemic led to the repeal of the federal law." [22,23] Even with this incident, vaccination was widely regarded to be both safe and effective, nearly eliminating the risk of contracting smallpox in America. From 1802 to 1840, the smallpox vaccine was well-accepted. The remainder of the 1840s and the 1850s saw the rise of some detractors once the imminent threat of smallpox infection was gone.[24]

Because smallpox was (and is) such a deadly disease, the public seemed to have a vested interest in its eradication; this encouraged the acceptance of any preventive treatment, vaccination included. On the other hand, from the outset, the practice of vaccination has had its detractors. As briefly mentioned previously, "antivaccinationists" opposed the Jennerian method for a myriad of reasons. While we do not know the inner convictions of every antivaccinationist of the nineteenth century, there is considerable record of what angles they argued and reasons they gave, as demonstrated in *The American Anti-Vaccinationists and Their Arguments*, an article written by Martin Kaufman and published by Johns Hopkins University Press in 1967.[25]

---

[22] The term "variolous matter" is not technically correct, as the substance mailed was cowpox vaccine material. This is a misstatement on behalf of the author of the quoted article, but it was left as-is to ensure a faithful representation of source material.

[23] KAUFMAN, "THE AMERICAN ANTI-VACCINATIONISTS AND THEIR ARGUMENTS."

[24] KAUFMAN.

[25] KAUFMAN.

The first antivaccinationists gained some footing in the 1850s; many were "irregular physicians," a catch-all term for non-allopaths that included homeopaths, hydropaths, eclectics, naturopaths, and "botanical physicians.'' A Dr. C. C. Schiefferdecker, a hydropath, called vaccination "nonsense before reason" and "the greatest crime that has been committed in this last century."[26] Furthermore, he allegedly invoked the Bible to prove vaccination inadequate. The antivaccination movement, though, did not begin in earnest until a few years later. Certain conditions made this possible; after the 1840s, not many people were vaccinated, simply because smallpox was no longer an ever-present threat. Preventive measures were not largely considered after it had been seemingly wiped out, as it was "out of sight, out of mind." Because of the decrease in vaccination, smallpox epidemics broke out in the 1870s when most people were not vaccinated. Many U.S. states still had vaccination ordinances in place that had not been enforced in decades; those states began enforcing these extant ordinances. Other states passed new laws mandating vaccination. Opponents of vaccination began their movement on the backs of these new mandates; eventually, their movement drew sympathy from people who wanted the government to stay out of the sphere of "public health" (which was then a relatively novel concept in terms of governmental action) and their personal health decisions. Early on, when antivaccinationists were mostly individuals (as opposed to a cohesive group), they were making pamphlets, fighting

[26] KAUFMAN.

at state legislatures, and "occasionally instigating destructive riots' ' to stop compulsory vaccination."[27]

Antivaccinationists opposed vaccination for myriad other reasons, including, but not limited to: belief that vaccination was ineffective at preventing smallpox, belief that vaccination would give the recipient full-blown smallpox, concerns about infection with other pathogens in the process of vaccination (which was a reasonable concern at the time), anecdotes about vaccination causing death, belief that other treatments or preventive measures were superior to vaccination, and the sanitation movement, during which proponents pushed for improved public sanitation *instead* of vaccination to prevent the spread of smallpox.[28]

Some reasons reported by Kaufman are due further explanation. First, the basis for many of the "irregular physicians" opposing vaccination could be traced back to opposition to medical licensure—non-allopaths felt that their professions were being threatened by the movement toward physician licensure and saw vaccination as a part of that. Furthermore, "irregular physicians" often advocated for patent medicines, which were increasingly regulated as Pure Food and Drug laws came into effect. In fact, according to Kaufman, "anti-vaccination became a pawn in the hands of patent medicine interests." Related to the patent medicine issue was blanket opposition to the FDA (Food and Drug Administration) beginning from its establishment in 1906. Another point held by the irregular physicians was that the

[27] KAUFMAN.

[28] KAUFMAN.

allopaths only wanted to have everyone vaccinated, the poor in particular, because it lined their pockets.

Anti-vivisectionists were also often anti-vaccine due to the inhumane treatment of animals during vaccine production: "the 'barbarous and unnatural treatment to which animals are subjected' in the production of vaccine" was noted by these individuals. Perhaps the most popular objections to vaccination aside from those of the irregular physicians involved concerns over vaccine safety, the morality of vaccination, and the effects of vaccination on the whole of an individual; each will be illuminated below.

The vaguest argument against vaccine safety regarded so-called "accidents of vaccination," though there were indeed incidents and accidents that spanned from distribution to secondary infection upon injection. Many people, as alluded to previously, believed that vaccination "spread smallpox on an epidemic scale."[29] Henry Bergh discovered a correlation between tuberculosis death rates and smallpox vaccination; high tuberculosis death rates in specific locations coexisted with strongly enforced vaccination policies in those places. There were, then, fewer deaths from tuberculosis where vaccination programs were not enforced or not strictly so. However, where Bergh noted a correlation he implied causation, that smallpox vaccination caused increased tuberculosis deaths, which was in error. Tuberculosis was most common in urban centers, which were also "centers of pro-vaccination sentiment" most likely to have mandated vaccination. This is an

[29] KAUFMAN.

example of misinterpreted data due to conflated facts, which was reportedly "a common practice among the antivaccinationists."[30] To illustrate his point, Kaufman states:

> "The opponents of the Jennerian method of immunization produced statistics to prove that vaccination was ineffective in preventing smallpox, and that dreaded diseases were inoculated into the system by the cowpox vaccinators. Like many others who believe they are the saviors of society, the anti-vaccinationists were willing to falsify statistics in order to prove the destructive effects of vaccination."

However, it is wise to note that those opposed to vaccination held that the statistics used to advocate for vaccines were pointedly inaccurate due to the pro-vaccinationists' financial investment in vaccinating en masse. As is well established, statistics may be used out of context to advocate for almost anything.

Lastly, some passages of particular note, given the context of U.S. society in the present, can be found below:

> Quoting Henry Bergh, "In the period of less than one hundred years" since Jenner developed vaccination, he wrote, "millions upon millions of sound and healthy human beings have been inoculated with the most loathsome pestilence, doomed to carry to the grave bodies wasted by consumption or marred and deformed by scrofula, cancer, and innumerable other ills."
>
> "Anti-vaccinationist arguments ran the gamut from the sublime to the ridiculous, but like most specious claims, they often contained some elements of truth. The ridiculous was provided by Dr. J. F. Banton, who wrote that vaccination introduces into the bloodstream 'a bioplasm, death laden—carrying with it all the vices, passions and diseases of the cow,' and he rated vaccination with 'alcohol, tobacco, lust and sensual love' as the most destructive elements of society."

[30] KAUFMAN. All direct quotations for the remainder of the subsection on smallpox can be attributed to Kaufman unless otherwise noted.

"Comparing compulsory vaccination to King Herod's edict that all male children under two years of age shall be killed, the anti-vaccinationists demanded the repeal of compulsory vaccination laws. It was argued that syphilis, leprosy, polio, cancer, and a host of other diseases were inoculated into the bloodstream of innocent children…"

"Dr. H. Lindlahr, the editor of Nature Cure Magazine, added a new twist to the argument that vaccination brought disease, a twist intended to throw fear into the heart of every American woman. Vaccination dries up the mammary glands, he wrote, and the widespread use of vaccination explains the popularity of 'bust foods and developers.'"

Arguing that vaccination is opposed to the laws of nature: "if God wanted man vaccinated, He would have vaccinated him."

"…the anti-vaccinators were prepared to argue that smallpox was not a serious illness in any case, and that it could be easily treated. For example, J. F. Banton wrote that smallpox was a 'disease not so much to be dreaded as we are wont to believe, leaving the system in a much healthier condition than most other diseases…' Bernarr Macfadden wrote that the disease was possible only to those who 'clothe heavily, bathe infrequently, eat very heartily and exercise rarely.'"

"The antivaccinationists also argued that compulsory vaccination was an infringement of basic human rights. For this reason, some doctors who believed in the efficacy of the practice joined in its denunciation. 'In this free country,' wrote Dr. Walter Coles, 'there are certain 'inalienable rights' which no state or municipality can take away. Compulsory vaccination is certainly an infringement upon these rights, and involves a principle which, if carried out, would soon involve medical, religious, and social interests in a wild vortex of wreck and ruin.' J.W. Hodge, in his speech before the Western New York Homeopathic Medical Society, argued that vaccination 'ranks with human slavery and religious persecution as one of the most flagrant outrages upon the rights of the human race.' "[31]

[31] KAUFMAN.

Figure 3: A political cartoon depicting alleged effects of smallpox vaccination. Because smallpox vaccines were made using cowpox, some believed vaccination would turn people into cows. Published by the "Anti-Vaccine Society."

The first-ever anti-vaccination movement, in opposition to the first-ever vaccine, began to fall apart in the 1930s. Mandatory vaccination laws had been repealed in many states, on the one hand, and on the other, government involvement in public health had become well-established by that time, something that would not be easily changed (or, perhaps, ever). Furthermore, medical licensure became the standard, and secondary infections due to poor process and technique were drastically reduced, helping to establish a generally positive public opinion of smallpox vaccines and the practice of vaccination at large.[32]

[32] KAUFMAN.

Prior to its eradication, smallpox was endemic in more than 30 countries.[33] A WHO global vaccination campaign for eradication was carried out in the 1960s and 70s, which proved extremely effective.[34] Ultimately, naturally-occurring smallpox was eradicated, with the virus only present for study in the laboratory environment. In 1976, the WHO "requested that all laboratories with smallpox virus either destroy the virus or submit their stocks" to either the CDC in the United States or to the Soviet Union's Moscow Institute.[35] The last naturally-acquired case of smallpox was in 1977, while the last lab-acquired case was in 1978.[36] Smallpox was declared officially eradicated on May 8th, 1980, when it had been over two years since the last naturally-occurring case was reported in the world. Of note is that the Soviet Union is known to have weaponized smallpox; according to a 2003 article, following the September 11th, 2001 attack on the World Trade Center and the 2001 anthrax attacks, there was concern about smallpox as a bioweapon and thoughts of initiating another nationwide vaccination program.[37]

Figure 3: "Use This Image 146958001 | British Museum," The British Museum, accessed April 14, 2022, https://www.britishmuseum.org/collection/image/146958001.

[33] Marc A. Strassburg, "The Global Eradication of Smallpox," *American Journal of Infection Control* 10, no. 2 (May 1, 1982): 53–59, https://doi.org/10.1016/0196-6553(82)90003-7.

[34] "Smallpox | History of Vaccines," accessed February 15, 2022, https://www.historyofvaccines.org/content/articles/history-smallpox.

[35] Edward A. Belongia and Allison L. Naleway, "Smallpox Vaccine: The Good, the Bad, and the Ugly," *Clinical Medicine and Research* 1, no. 2 (April 2003): 87–92.

[36] "Laboratory-Acquired Vaccinia Exposures and Infections --- United States, 2005--2007," accessed April 11, 2022, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5715a3.htm.

[37] Belongia and Naleway, "Smallpox Vaccine."

Today, the smallpox vaccine is relatively less safe than more modern vaccines on the immunization schedule. In the 1960s, the smallpox vaccine had mild side effects including fever and muscle aches. Rarely, more serious side effects were seen, such as generalized vaccinia, progressive vaccinia, postvaccinal encephalitis, vaccine-associated blindness, vaccine-induced myocarditis, and eczema vaccinatum. These more serious sequelae resulted in an average of one death per million doses. Another relatively unique potential outcome of smallpox vaccination was transfer of the vaccinia infection from the vaccination site to another site on the vaccinated's body, or to another person. "Inadvertent inoculation" occurred "529 [times] per million vaccinations in a 1968 study."[38] In particular, the immunocompromised are at higher risk of adverse events following smallpox vaccination, as well as individuals with autoimmune diseases and those receiving chemotherapy or radiation therapy. At present, the general public is no longer vaccinated against smallpox. Mass vaccination promoted by the WHO halted in 1972 after the disease was effectively removed from circulation; when the threat of smallpox was eliminated, the benefits of vaccination were determined to no longer outweigh its risks. Some people do still receive the vaccine, including some hospital staff, researchers, and military personnel.[39] The World Health Organization maintains a stockpile of smallpox vaccines in case of a re-emergence of smallpox in the future.[40]

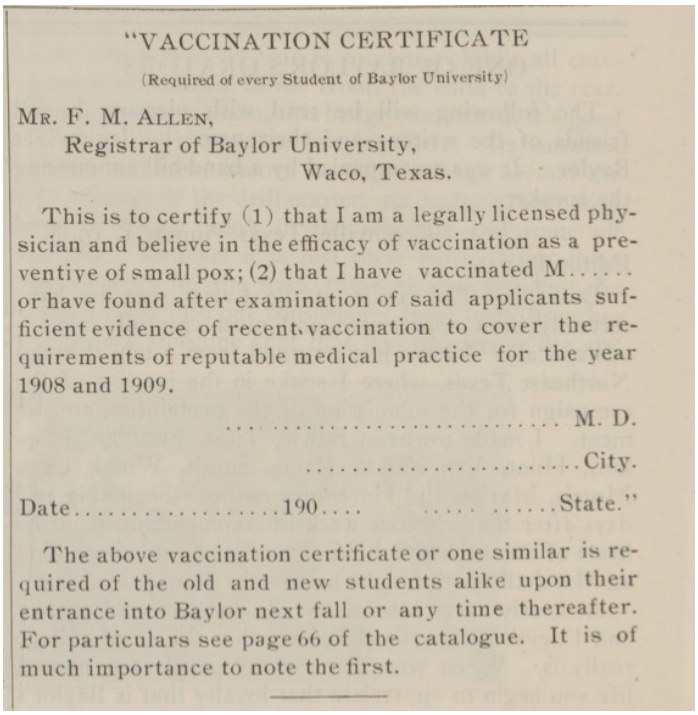
---

[38] Belongia and Naleway.

[39] Belongia and Naleway.

[40] "Smallpox Vaccines," World Health Organization, May 13, 2016, https://www.who.int/news-room/feature-stories/detail/smallpox-vaccines.

The first vaccine naturally generated the first objections to vaccination; these objections are paralleled in stunning detail in the present day. Smallpox vaccine dissenters had religious objections on the grounds of injecting evil substances, concerns about vaccines infecting recipients with the disease itself, fears for women's health and fertility, convictions about vaccines being unnecessary, the idea that smallpox was not serious and that only those with comorbidities need have been concerned,[41] and objections on the grounds of personal rights and freedoms. In 1914, Baylor students even mounted a protest against their treatment with regard to smallpox quarantines and vaccination.[42] All of these reasons have been cited to some degree for the declination of Covid-19 vaccines, which will be shown in explicit detail in Chapter 6.



"VACCINATION CERTIFICATE

(Required of every Student of Baylor University)

MR. F. M. ALLEN,
Registrar of Baylor University,
Waco, Texas.

This is to certify (1) that I am a legally licensed physician and believe in the efficacy of vaccination as a preventive of small pox; (2) that I have vaccinated M..... or have found after examination of said applicants sufficient evidence of recent vaccination to cover the requirements of reputable medical practice for the year 1908 and 1909.

..... M. D.

.....City.

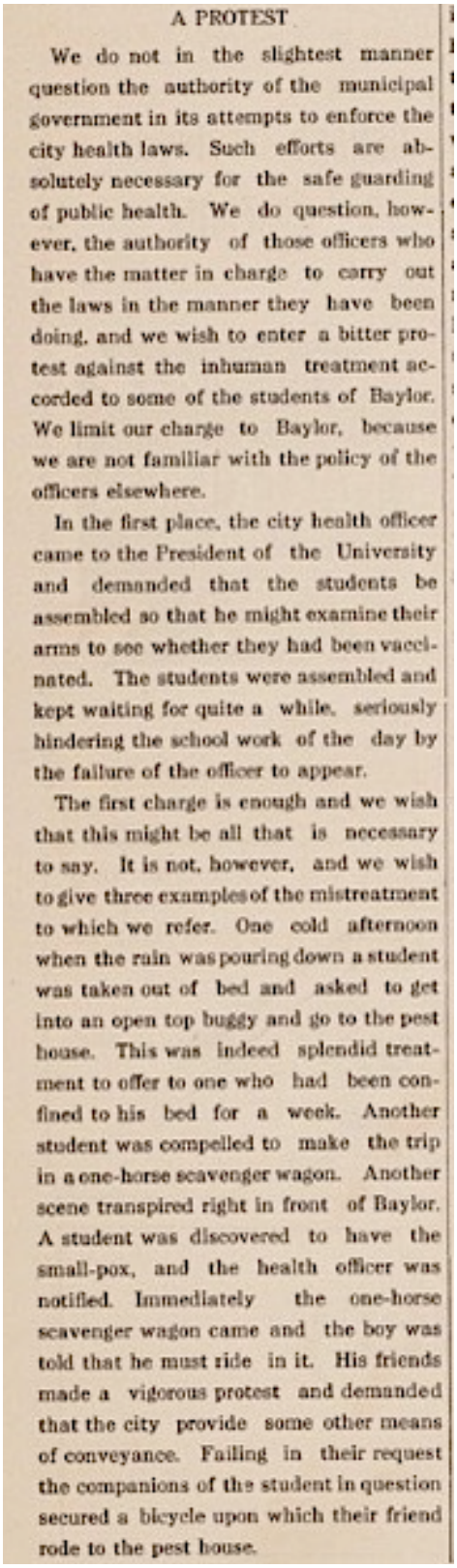
Date.....190.... ....State."

The above vaccination certificate or one similar is required of the old and new students alike upon their entrance into Baylor next fall or any time thereafter. For particulars see page 66 of the catalogue. It is of much importance to note the first.

Figure 4: An example of a smallpox vaccination certificate required to be obtained by all Baylor students in 1908, as posted in the Baylor Lariat. Not only are vaccine mandates not new, they are not new for Baylor students.

[41] Comorbidities refer to concurrent but unrelated health problems that can exacerbate the disease/pathology in question.

[42] *Figures 4 and 5:* A.T. Coleman, "Vaccination Certificate," *The Baylor Lariat*, August 8, 1908, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-8-no.-42-saturday-august-08-1908/54055. *And* Lariat Staff Writers, "A Protest," *The Baylor Lariat*, March 11, 1914, Vol. XIII edition, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-13-no.-21-wednesday-march-11-1914/55982.



A PROTEST

We do not in the slightest manner question the authority of the municipal government in its attempts to enforce the city health laws. Such efforts are absolutely necessary for the safe guarding of public health. We do question, however, the authority of those officers who have the matter in charge to carry out the laws in the manner they have been doing, and we wish to enter a bitter protest against the inhuman treatment accorded to some of the students of Baylor. We limit our charge to Baylor, because we are not familiar with the policy of the officers elsewhere.

In the first place, the city health officer came to the President of the University and demanded that the students be assembled so that he might examine their arms to see whether they had been vaccinated. The students were assembled and kept waiting for quite a while, seriously hindering the school work of the day by the failure of the officer to appear.

The first charge is enough and we wish that this might be all that is necessary to say. It is not, however, and we wish to give three examples of the mistreatment to which we refer. One cold afternoon when the rain was pouring down a student was taken out of bed and asked to get into an open top buggy and go to the pest house. This was indeed splendid treatment to offer to one who had been confined to his bed for a week. Another student was compelled to make the trip in a one-horse scavenger wagon. Another scene transpired right in front of Baylor. A student was discovered to have the small-pox, and the health officer was notified. Immediately the one-horse scavenger wagon came and the boy was told that he must ride in it. His friends made a vigorous protest and demanded that the city provide some other means of conveyance. Failing in their request the companions of the student in question secured a bicycle upon which their friend rode to the pest house.

Figure 5: Report of a protest in The Lariat as detailed on page 33.

Additionally, comparisons to King Herod's edict are echoed in modern-day objections to Covid-19 vaccination; today, vaccine mandates have been compared to both slavery and the wearing of the Star of David by Jewish people during the Holocaust. The difference in this case can likely be explained by the fact that in the mid-nineteenth century the Holocaust simply had not happened yet, thus King Herod was the historical aggressor who first came to mind for analogy.

Following Jenner's development of the smallpox vaccine, the technology was established for use against other dangerous diseases. Since smallpox, one of the first responses to any epidemic disease has been to begin research into the creation of a vaccine. Influenza, the disease to be discussed next, has been around since ancient times, though the pandemic of 1918 was the most devastating world-wide flu event in the post-Jenner age. A vaccine was eventually successfully created, decreasing flu mortality significantly. With that

said, people frequently forego modern flu vaccines, often due to indifference. Influenza is the next important topic of discussion for its pandemic past, severity, persistence in the present as an endemic disease, and its vaccine history.

Influenza (1930s)

Influenza, colloquially "the flu," is a disease most everyone is familiar with, either because they have had it at least once or because friends and family have. That said, while the flu kills up to 52,000 people in the United States yearly, it is largely regarded as an inconvenience by those without serious comorbidities.[43] It was not always this way—in fact, it was once quite the opposite—but Americans today have the gift of temporal distance from the most severe pandemics of late. Of greatest consequence is the Pandemic of 1918, of which the societal toll can hardly be overstated.

There is reliable documentation of influenza beginning from 1510, though the flu is thought to have existed much longer than that. In fact, "influenza" is a shortened version of "influenza di freddo," derived from Italian and meaning "influence of the cold." This is a distant echo to the Middle Ages and before, when some disease was thought to originate with "bad airs" and climatic changes. The first confirmed influenza pandemic occurred in 1580, spreading from Asia to Europe.[44]

---

[43] CDC, "Burden of Influenza," Centers for Disease Control and Prevention, January 7, 2022, https://www.cdc.gov/flu/about/burden/index.html.

[44] I. BARBERIS et al., "History and Evolution of Influenza Control through Vaccination: From the First Monovalent Vaccine to Universal Vaccines," *Journal of Preventive Medicine and Hygiene* 57, no. 3 (September 2016): E115–20.

Pandemics have continued throughout the time since, making influenza viruses the most deadly in history.[45]

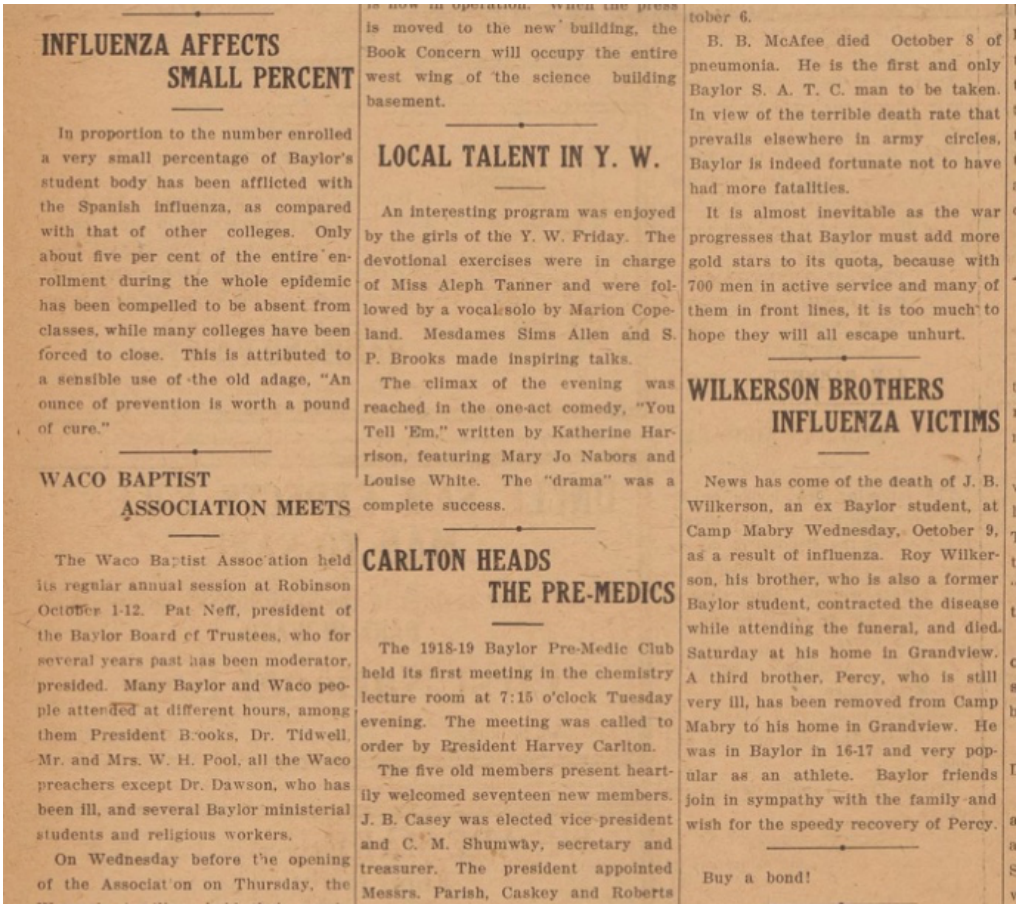
Speaking of the death toll of influenza viruses, the influenza pandemic of 1918, colloquially the "Spanish Flu," was the deadliest pandemic in human history. The pandemic was caused by an H1N1 flu virus and had avian (bird) origin.[46] In point of fact, the nickname "Spanish flu" was a misnomer—the 1918 pandemic did not originate in Spain. Spain was indeed hit by the flu in 1918, but it was the first wave that was much less deadly than the second, which would come to be known as the thick of the pandemic flu. Spain was "one of the first, if not *the* first, to report on the illness snaking through the country" and because it was the first to report, the pandemic was given the nickname that would haunt them forever after.[47] In reality, the 1918 pandemic likely originated in Haskell County, Kansas.[48]

[45] Gina Bari Kolata, *Flu*. Pages 18-53.

[46] "History of 1918 Flu Pandemic | Pandemic Influenza (Flu) | CDC," accessed January 30, 2022, https://www.cdc.gov/flu/pandemic-resources/1918-commemoration/1918-pandemic-history.htm.

[47] Johanna Mayer, "The Origin Of The Name 'Spanish Flu,'" *Science Friday* (blog), January 29, 2019, https://www.sciencefriday.com/articles/the-origin-of-the-spanish-flu/.

[48] John M Barry, "The Site of Origin of the 1918 Influenza Pandemic and Its Public Health Implications," *Journal of Translational Medicine* 2 (January 20, 2004): 3, https://doi.org/10.1186/1479-5876-2-3.



INFLUENZA AFFECTS SMALL PERCENT

In proportion to the number enrolled a very small percentage of Baylor's student body has been afflicted with the Spanish influenza, as compared with that of other colleges. Only about five per cent of the entire enrollment during the whole epidemic has been compelled to be absent from classes, while many colleges have been forced to close. This is attributed to a sensible use of the old adage, "An ounce of prevention is worth a pound of cure."

WACO BAPTIST ASSOCIATION MEETS

The Waco Baptist Association held its regular annual session at Robinson October 1-12. Pat Neff, president of the Baylor Board of Trustees, who for several years past has been moderator, presided. Many Baylor and Waco people attended at different hours, among them President Brooks, Dr. Tidwell, Mr. and Mrs. W. H. Pool, all the Waco preachers except Dr. Dawson, who has been ill, and several Baylor ministerial students and religious workers.

On Wednesday before the opening of the Association on Thursday, the

is moved to the new building, the Book Concern will occupy the entire west wing of the science building basement.

LOCAL TALENT IN Y. W.

An interesting program was enjoyed by the girls of the Y. W. Friday. The devotional exercises were in charge of Miss Aleph Tanner and were followed by a vocal solo by Marion Copeland. Mesdames Sims Allen and S. P. Brooks made inspiring talks.

The climax of the evening was reached in the one-act comedy, "You Tell 'Em," written by Katherine Harrison, featuring Mary Jo Nabors and Louise White. The "drama" was a complete success.

CARLTON HEADS THE PRE-MEDICS

The 1918-19 Baylor Pre-Medic Club held its first meeting in the chemistry lecture room at 7:15 o'clock Tuesday evening. The meeting was called to order by President Harvey Carlton.

The five old members present heartily welcomed seventeen new members. J. B. Casey was elected vice president and C. M. Shumway, secretary and treasurer. The president appointed Messrs. Parish, Caskey and Roberts

tober 6.

B. B. McAfee died October 8 of pneumonia. He is the first and only Baylor S. A. T. C. man to be taken. In view of the terrible death rate that prevails elsewhere in army circles, Baylor is indeed fortunate not to have had more fatalities.

It is almost inevitable as the war progresses that Baylor must add more gold stars to its quota, because with 700 men in active service and many of them in front lines, it is too much to hope they will all escape unhurt.

WILKERSON BROTHERS INFLUENZA VICTIMS

News has come of the death of J. B. Wilkerson, an ex Baylor student, at Camp Mabry Wednesday, October 9, as a result of influenza. Roy Wilkerson, his brother, who is also a former Baylor student, contracted the disease while attending the funeral, and died Saturday at his home in Grandview. A third brother, Percy, who is still very ill, has been removed from Camp Mabry to his home in Grandview. He was in Baylor in 16-17 and very popular as an athlete. Baylor friends join in sympathy with the family and wish for the speedy recovery of Percy.

Buy a bond!

Figure 6: Excerpts from the Baylor Lariat *student publication during the height of the 1918 influenza pandemic. Students reported only minor issues associated with the flu while reporting on the same page that recent alumni had died from it.*

A careful read-through of archived issues of the *Baylor Lariat* student publication reveals columns about student and professor deaths from influenza in 1918; contrary to the Covid-19 situation, there was little written about the influenza pandemic itself. The city of Waco was under quarantine for ten days in October 1918, during which public schools and movie theaters were closed and all public gatherings were prohibited in an effort to slow the spread of the flu. Baylor, on the other hand, was not forced to close due to its status as a private institution. Baylor President Samuel Palmer Brooks indicated that he would close Baylor if significantly more cases of influenza occurred or if the government told him to close

the university but barring those developments, he chose to keep classes and activities going.[49,50]

The 1918 flu has some remarkable parallels to our modern situation. To illustrate this point, here are some excerpts from the 1995 book *Flu: The Story of the Great Influenza Pandemic of 1918 and the Search for the Virus That Caused It* by science journalist Gina Kolata:[51]

> As the flu swept through the United States military and the Massachusetts public, Calvin Coolidge was the acting governor of the state. Coolidge "sent a telegram to President Woodrow Wilson, the mayor of Toronto, and the governors of Vermont, Maine, and Rhode Island, saying 'our doctors and nurses are being thoroughly mobilized and worked to the limit.'"
>
> "The *Journal of the American Medical Association* opined that medical authorities should not be alarmed by the flu's nickname, 'the Spanish flu.' That name, the journal wrote, 'should not cause any greater importance to be attached to it, nor arouse any greater fear than would influenza without the new name.' …Yet as the flu spread, [the city of Philadelphia] did take a few precautions. On September 18, its health officials began a public campaign against coughing, spitting, and sneezing. Three days later, the city made influenza a reportable disease, which meant that records had to be kept of numbers of cases."

The flu ravaged the Army in particular. In fact, army doctors inoculated troops against it with secretions from flu patients à la smallpox in a desperate attempt to curb the spread.

---

[49] Randy Fiedler, "Baylor's Response to Epidemics over the Years," Arts & Sciences Magazine | Baylor University, accessed March 20, 2022, https://www.baylor.edu/artsandsciences/magazine/index.php?id=973701.

[50] *Figure 6:* Lariat Staff Writers, "The Lariat: 'Influenza Affects Small Percent' & 'Wilkerson Brothers Influenza Victims,'" *The Baylor Lariat*, October 17, 1918, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-20-no.-03-thursday-october-17-1918/57732.

[51] Gina Bari Kolata, *Flu*. The remaining direct quotations in this subsection are exclusively derived from this source, pages 18-53.

> Additionally, they "made men spray their throats each day and gargle with antiseptics or alcohol. They hung sheets between beds, and at one camp they even hung sheets in the centers of tables at mess halls. At Walter Reed Hospital, soldiers chewed tobacco each day, believing that it would ward off the flu. Public health departments gave out gauze masks for people to wear in public. A New York doctor and collector of historical photographs, Dr. Stanley B. Burns, has a photograph in his archive of a minor league baseball game being played during the epidemic. It is a surreal image: The pitcher, the batter, every player, and every member of the crowd are wearing gauze masks. In Tucson, Arizona, the board of health issued a ruling that 'no person shall appear in any street, park, or place where any business is transacted, or in any other public place within the city of Tucson, without wearing a mask consisting of at least four thicknesses of butter cloth or at least seven thicknesses of ordinary gauze, covering both the nose and the mouth."

> "Public gatherings were prohibited in many cities and some places made it a crime to cough, sneeze, or spit in public. In Washington, D.C., even the Supreme Court adjourned so that, as Justice Oliver Wendell Holmes put it, they could spare lawyers from having to enter 'this crowded and infected place.'…No one could avoid knowing that a deadly epidemic was stalking the land. But the flu was expunged from newspapers, magazines, textbooks, and society's collective memory. Crosby calls the 1918 flu 'America's forgotten pandemic," noting: 'The important and almost incomprehensible fact about the Spanish flu is that it killed millions upon millions of people in a year or less. Nothing else—no infection, no war, no famine, --has ever killed so many in as short a period. And yet it has never inspired awe, not in 1918 and not since, not among the citizens of any particular land and not among the citizens of the United States."

In the thick of the 1918 pandemic, it was not yet known *what* exactly caused influenza, but quarantining, social distancing, masking and mask mandates, physical barriers in public spaces, and nearly religious use of antiseptics was the rule. While it may seem in the present day as if the measures implemented to slow the spread of Covid-19 were novel or extreme, it is quite telling that nearly the same things happened a century ago and many Americans have never heard about it.

First Vaccines

Toward the end of the 1800s, scientists had still not determined the cause of influenza. The first theory to really take hold was that it was of bacterial origin, specifically *Haemophilus influenzae*. "Pfeiffer's bacillus" or Bacillus influenzae was thought to be the cause of the flu during this period. French experiments did show that the flu could pass through extremely fine filters, making the bacterial hypothesis unlikely and suggesting another pathologic mechanism was at play, which we now understand to be a virus.

It became clear to scientists that influenza was not, in fact, caused by bacteria during the influenza pandemic of 1918. In 1932, three English scientists were able to isolate influenza A from nasal secretions of flu patients, proving that the flu was caused by a virus.[52] In the following half-decade, discoveries abounded, not the least of which was that formalin-inactivated influenza virus provided immunity in humans. Additionally, it was discovered that influenza grows well in chicken eggs; flu vaccines today are still manufactured this way. The 1930s saw flu vaccine trials, and the United States military was vaccinated in 1938 with the help of Jonas Salk, who would go on to make the first polio vaccine fourteen years later.[53]

In hopes of curbing flu epidemics, vaccination was encouraged in everyone who could receive it safely. Initially, the vaccine only protected against Influenza A. Proof that flu vaccines could prevent epidemics first came late in 1942, and safety

[52] BARBERIS et al., "History and Evolution of Influenza Control through Vaccination."

[53] BARBERIS et al.

and efficacy studies did not begin until 1942-1945. Influenza Type B was discovered around that time and was determined to be the main cause of seasonal epidemics. Additionally, there can be a phenomenon of "influenza mismatch" in which major and minor mutations of the virus circulate at the same time. Because of this, any given annual vaccine can fail to cover the correct strain of the virus, rendering it less effective in practical use.[54] This phenomenon is one that we can see happening today with both the flu and with variants of SARS-CoV-2. There is evidence to show that the two-dose vaccines against Covid-19 (developed by Pfizer-BioNTech and Moderna) are less effective against the Omicron variant of SARS-CoV-2, so a booster has been developed to combat this.[55]

Flu vaccines today

Today, two subtypes of influenza A and two lineages of influenza B circulate among humans.[56] It is well-accepted that the best way to prevent serious illness and infection with influenza is to be vaccinated against it. Influenza viruses are RNA viruses, and there are three types that can cause human epidemics: A, B, and C. Influenza A is generally the most dangerous of the three in terms of pandemic potential.[57] H1N1, the "swine flu," is a strain of influenza A.

---

[54] BARBERIS et al.

[55] Talha Khan Burki, "Omicron Variant and Booster COVID-19 Vaccines," *The Lancet. Respiratory Medicine* 10, no. 2 (February 2022): e17, https://doi.org/10.1016/S2213-2600(21)00559-2.

[56] Katherine Houser and Kanta Subbarao, "Influenza Vaccines: Challenges and Solutions," *Cell Host & Microbe* 17, no. 3 (March 11, 2015): 295–300, https://doi.org/10.1016/j.chom.2015.02.012.

[57] BARBERIS et al., "History and Evolution of Influenza Control through Vaccination."

The flu vaccines of today are meant to lead our immune systems to produce antibodies against influenza's viral surface glycoproteins; these glycoproteins are what bind to receptors on host cells (in this case, human) in order to infect them. Antibodies against the specific strain of influenza infecting a person can neutralize the virus upon natural infection. Note the emphasis on strain: because the flu virus mutates regularly, causing antigenic drift, it is not the same from year to year; seasonal flu vaccines must be reformulated semiannually to make sure they are immunizing us against the predominant circulating strains.[58] However, this reformulation is not foolproof. While flu vaccines can immunize against both influenza A and B broadly, specific components are chosen to protect against the strains predicted to circulate the following flu season.

Three types of annual flu vaccines are licensed and available to the public. The first is an inactivated vaccine (known as IIV) that contains the aforementioned viral surface glycoproteins, which alert the adaptive immune system to recognize the flu virion as bad and enable the body to deal with the virion efficiently the next time it is encountered. There are also trivalent and quadrivalent inactivated flu vaccines, which immunize against three and four strains, respectively. In particular, these versions of inactivated vaccine immunize against H1N1 and H3N2.[59]

The second type of licensed annual flu vaccine is live attenuated (known as LAIV.) A live attenuated vaccine is one that contains live virus but is artificially

[58] Houser and Subbarao, "Influenza Vaccines."

[59] Houser and Subbarao.

mutated such that it can only replicate in the nasal cavity and not the lower respiratory tract.[60] The live attenuated vaccine immunizes against the same four strains as the quadrivalent inactivated vaccine. The difference lies with its administration: LAIV is administered as an intranasal spray.

The third class of flu vaccine is called FluBlok, a recombinant vaccine made with viral surface glycoproteins "expressed in insect cells from baculovirus vectors."[61] FluBlok can be manufactured more quickly than the other two classes of vaccine, making it potentially very useful given a modern pandemic flu.

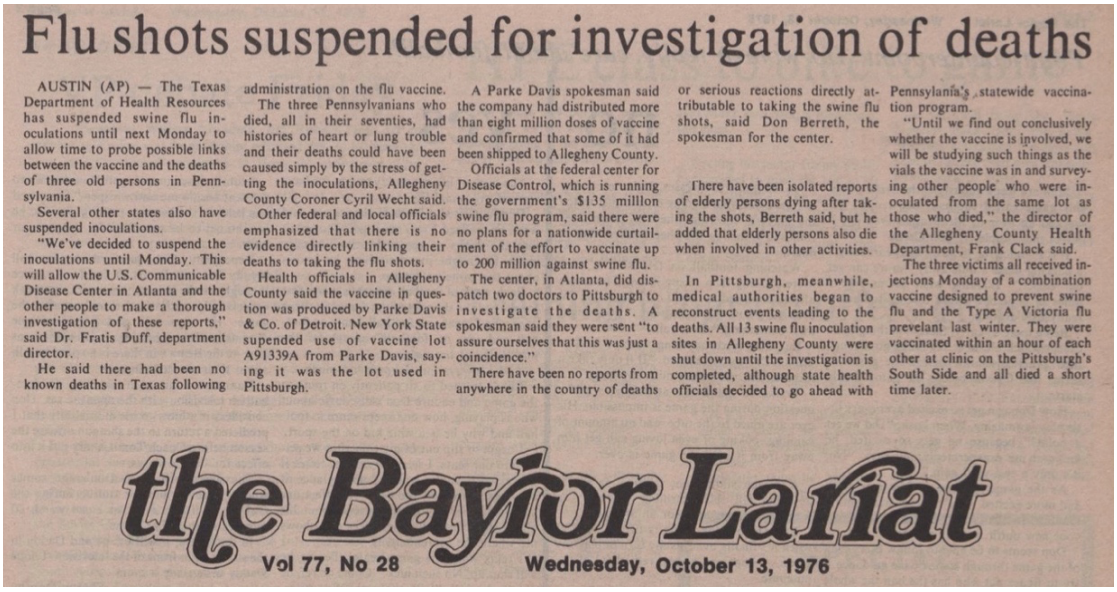
The inactivated vaccine is licensed for ages six months and older, the live attenuated for the ages between two and forty-nine years, and the recombinant for adults between eighteen and forty-nine years old. Additionally, the inactivated vaccine can be administered in a higher dose to individuals over sixty-five, given that our immune systems become less able to fight off infection as we age.

Flu vaccines, though long licensed, present their share of challenges. For one, both the inactivated and live attenuated vaccines require embryonated chicken eggs for manufacturing, which could be problematic due to supply issues in the event of a pandemic. However, FluBlok does not require eggs for manufacturing. Additionally, two new vaccine strategies are in consideration: virus-like particles, which are used

[60] Houser and Subbarao.

[61] Houser and Subbarao.

in current HPV vaccines,[62] and DNA vaccines, which are similar to Covid-19 mRNA vaccines.[63]



Flu shots suspended for investigation of deaths

AUSTIN (AP) — The Texas Department of Health Resources has suspended swine flu inoculations until next Monday to allow time to probe possible links between the vaccine and the deaths of three old persons in Pennsylvania.

Several other states also have suspended inoculations.

"We've decided to suspend the inoculations until Monday. This will allow the U.S. Communicable Disease Center in Atlanta and the other people to make a thorough investigation of these reports," said Dr. Fratis Duff, department director.

He said there had been no known deaths in Texas following administration on the flu vaccine.

The three Pennsylvanians who died, all in their seventies, had histories of heart or lung trouble and their deaths could have been caused simply by the stress of getting the inoculations, Allegheny County Coroner Cyril Wecht said.

Other federal and local officials emphasized that there is no evidence directly linking their deaths to taking the flu shots.

Health officials in Allegheny County said the vaccine in question was produced by Parke Davis & Co. of Detroit. New York State supended use of vaccine lot A91339A from Parke Davis, saying it was the lot used in Pittsburgh.

A Parke Davis spokesman said the company had distributed more than eight million doses of vaccine and confirmed that some of it had been shipped to Allegheny County.

Officials at the federal center for Disease Control, which is running the government's $135 milllon swine flu program, said there were no plans for a nationwide curtailment of the effort to vaccinate up to 200 million against swine flu.

The center, in Atlanta, did dispatch two doctors to Pittsburgh to investigate the deaths. A spokesman said they were sent "to assure ourselves that this was just a coincidence."

There have been no reports from anywhere in the country of deaths or serious reactions directly attributable to taking the swine flu shots, said Don Berreth, the spokesman for the center.

There have been isolated reports of elderly persons dying after taking the shots, Berreth said, but he added that elderly persons also die when involved in other activities.

In Pittsburgh, meanwhile, medical authorities began to reconstruct events leading to the deaths. All 13 swine flu inoculation sites in Allegheny County were shut down until the investigation is completed, although state health officials decided to go ahead with Pennsylania's statewide vaccination program.

"Until we find out conclusively whether the vaccine is involved, we will be studying such things as the vials the vaccine was in and surveying other people who were inoculated from the same lot as those who died," the director of the Allegheny County Health Department, Frank Clack said.

The three victims all received injections Monday of a combination vaccine designed to prevent swine flu and the Type A Victoria flu prevelant last winter. They were vaccinated within an hour of each other at clinic on the Pittsburgh's South Side and all died a short time later.

the Baylor Lariat
Vol 77, No 28 Wednesday, October 13, 1976

Figure 7: An excerpt from the Baylor Lariat about the suspension of the use of swine flu vaccines in 1976 after reported deaths. This is an example of students reporting on vaccine issues, with the excerpt placed prominently above the headline. Discussion of these issues is paralleled by talks about Johnson & Johnson's Covid-19 vaccine being investigated after reports of blood clots in 2021.

Seasonal flu vaccines have been documented over many years to be safe, with injection site pain, runny nose, and nasal congestion being the most commonly reported side effects. In the United States, everyone at least six months old is recommended to receive an annual flu vaccine. Efficacy has reportedly decreased in recent years, so new methods of vaccination are in the works, but the vaccines we have now are much better than nothing. Influenza is a prime example of an endemic

62 Ian H. Frazer, "The HPV Vaccine Story," *ACS Pharmacology & Translational Science* 2, no. 3 (May 29, 2019): 210–12, https://doi.org/10.1021/acsptsci.9b00032.

63 Leo Yi Yang Lee, Leonard Izzard, and Aeron C. Hurt, "A Review of DNA Vaccines Against Influenza," *Frontiers in Immunology* 9 (July 9, 2018): 1568, https://doi.org/10.3389/fimmu.2018.01568.

disease, meaning it is ever-present, and annual vaccination aims to combat it the best we can.

Flu vaccines are intriguing in the sense that many people never receive them, whether by conscious choice or indifference. From a study on the reasons people were not vaccinated during the 2011-2012 flu season in the United States, the most frequently cited reason was that those surveyed believed themselves "unlikely to get very sick from the flu." Likewise, there was concern from parents about their children contracting the flu *from the vaccine.*[64]

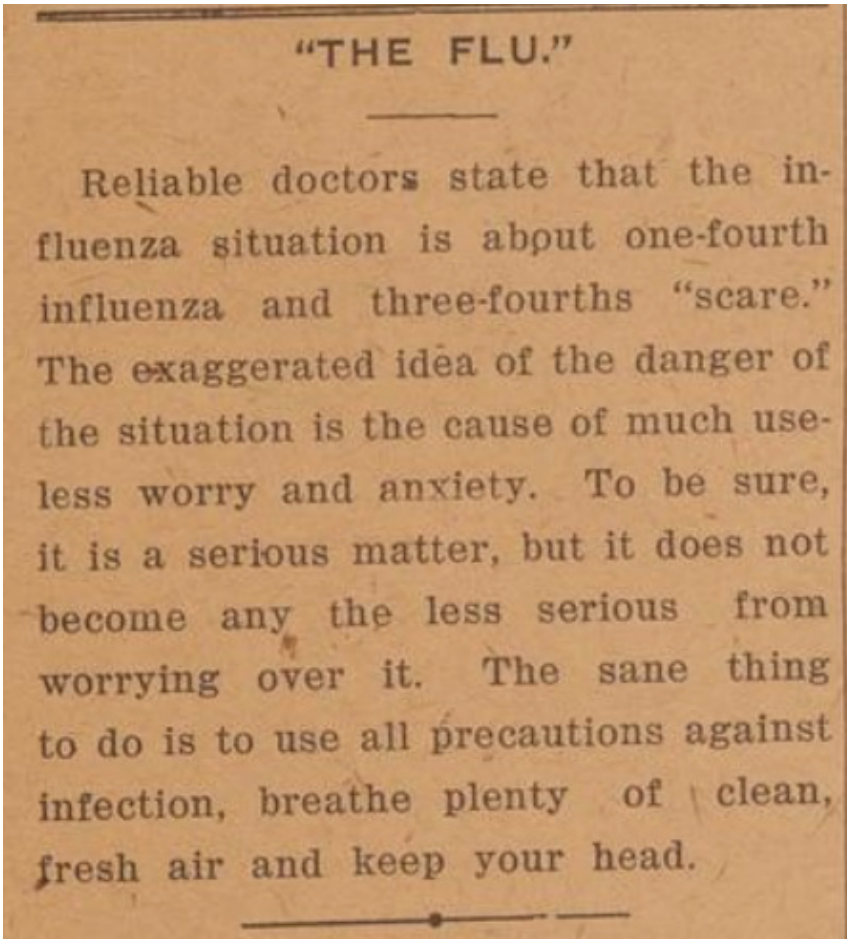
While figurative distance from pandemic influenza is a blessing, it can also be a curse; it is certainly a positive of modern medicine that most people do not need to mortally fear influenza, but that lack of fear has led vaccination rates to drop and remain relatively low in the modern era. In fact, the flu has become so commonplace and considered so mundane that when people have called Covid-19 "just another flu," they do not mean it in a consequential way, but rather that Covid-19 has never been anything to worry about.

---

[64] Tammy A. Santibanez and Erin D. Kennedy, "Reasons given for Not Receiving an Influenza Vaccination, 2011–12 Influenza Season, United States," *Vaccine* 34, no. 24 (May 23, 2016): 2671–78, https://doi.org/10.1016/j.vaccine.2016.04.039.

Figure 7: Lariat Staff Writers, "Flu Shots Suspended for Investigation of Deaths," *The Baylor Lariat*, October 13, 1976, Vol. 77 No. 28 edition, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-baylor-lariat-waco-texas-vol.-77-no.-28-wednesday-october-13-1976/103418.

Though the comparison may be understandable in some ways for the modern crowd, its implications run contrary to the statement's aim; if Covid-19 were anything like the Pandemic of 1918, the analogy is a frightening one.[65]



"THE FLU."

Reliable doctors state that the influenza situation is about one-fourth influenza and three-fourths "scare." The exaggerated idea of the danger of the situation is the cause of much useless worry and anxiety. To be sure, it is a serious matter, but it does not become any the less serious from worrying over it. The sane thing to do is to use all precautions against infection, breathe plenty of clean, fresh air and keep your head.

Figure 8: Another excerpt from the Baylor Lariat, October 1918. Students reported that the 1918 Flu, now known to have been the deadliest pandemic in human history, was exaggerated.

After influenza, the next major disease to receive a vaccine was poliovirus. Polio, like influenza, was terrifying in its morbidity and mortality at its height, though in some ways polio inspired more fear. The next section begins with a

[65] *Figure 8:* Lariat Staff Writers, "The Flu," *The Baylor Lariat*, October 17, 1918, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-20-no.-03-thursday-october-17-1918/57732.

background on poliovirus and polio vaccines, then shifts to public opinion regarding polio vaccination. The context surrounding polio is in many ways unique, though historically significant reasoning and themes are evident even in its differences.

Polio (1950s)

Poliovirus, an enterovirus, causes poliomyelitis, an acute paralytic disease that ravaged American society in the 1940s and 50s; tens of thousands of people were disabled by it every year. Parents' fear of polio kept children locked down in their homes during the summers. Calls for a vaccine, or really any preventive measure, were urgent.

Early vaccine development against polio went poorly. During testing, vaccines were administered to monkeys and then to human children, with some children being paralyzed shortly after vaccination. Then, in 1953, the first IPV (inactivated polio vaccine) was developed by Dr. Jonas Salk. This vaccine was produced by growing the virus on kidney cells from monkeys and inactivating it with formalin.[66] The Salk vaccine was adopted nationwide in 1955. After IPV rollout, the incidence of paralytic polio decreased significantly.

Unfortunately, there were also some drawbacks to the Salk IPV. A decrease in antibodies against the poliovirus was seen a few years after vaccination, wild poliovirus continued to circulate, and a large number of monkeys had to be

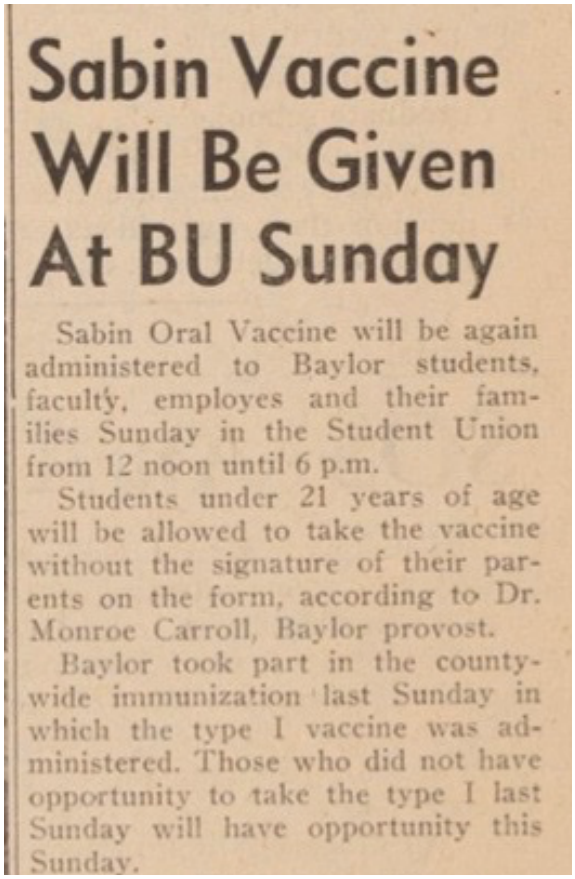
[66] Anda Baicus, "History of Polio Vaccination," *World Journal of Virology* 1, no. 4 (August 12, 2012): 108–14, https://doi.org/10.5501/wjv.v1.i4.108.

sacrificed to produce the vaccine. Ultimately, in 1987, an IPV with greater potency was licensed in the United States.

In 1956, Albert Sabin began developing a live-attenuated vaccine against polio. This vaccine was orally administered, thus it was designated the OPV (oral polio vaccine). The Sabin vaccine was tested on over 26,000 children in South America.[67]

Sabin's orally administered vaccine "had a herd effect" and induced long-lasting cellular and humoral immunity against polio. In 1972, Sabin donated his vaccine strains to the World Health Organization to make it more available in developing countries.

The OPV did come with risks as well. One in every 750,000 first doses and one in every 6.9 million subsequent doses of OPV caused VAPP, vaccine-associated paralytic poliomyelitis.[68] To combat this,



Sabin Vaccine Will Be Given At BU Sunday

Sabin Oral Vaccine will be again administered to Baylor students, faculty, employes and their families Sunday in the Student Union from 12 noon until 6 p.m.

Students under 21 years of age will be allowed to take the vaccine without the signature of their parents on the form, according to Dr. Monroe Carroll, Baylor provost.

Baylor took part in the county-wide immunization last Sunday in which the type I vaccine was administered. Those who did not have opportunity to take the type I last Sunday will have opportunity this Sunday.

Figure 9: An excerpt from the Baylor Lariat letting students know the Sabin OPV would be distributed at the University. Baylor has been a vaccine distributor for over sixty years, setting a precedent for its distribution of Covid-19 vaccines beginning in 2021.

[67] Baicus.

[68] VAPP occurs when the attenuated virus in the vaccine proliferates normally in the body, but mutates back to wild-type; this reversion means the virus can spread and cause poliomyelitis in the same way a naturally-acquired infection would.

sequential IPV/OPV was used in an attempt to eliminate VAPP in OPV recipients. Additionally, the OPV resulted in the emergence of VDPV, vaccine-derived poliovirus strains, that did not exist prior.[69]

"Cutter Incident"

> "In April 1955 more than 200,000 children in five Western and mid-Western USA states received a polio vaccine in which the process of inactivating the live virus proved to be defective. Within days there were reports of paralysis and within a month the first mass vaccination programme against polio had to be abandoned. Subsequent investigations revealed that the vaccine, manufactured by the California-based family firm of Cutter Laboratories, had caused 40,000 cases of polio, leaving 200 children with varying degrees of paralysis and killing 10."[70]

The Cutter Incident is one of the most notable "accidents of vaccination," yet after it was dealt with, there does not seem to have been significant pushback that prevented mass polio vaccination moving forward. It will be noted in the following section that members of the public were aware of the Cutter Incident and some expressed doubts or concerns about the polio vaccine because of it, but most of those concerns were related, in fact, to the perceived *delay* in vaccine release as opposed to speedy development in Covid-19.

Figure 9: Lariat Staff Writers, "Sabin Vaccine Will Be Given At BU Sunday," *The Baylor Lariat*, September 12, 1962, Vol. 64 No. 2 edition, https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/baylor-lariat-waco-texas-vol.-64-no.-2-wednesday-september-12-1962/156615.

[69] Baicus.

[70] Michael Fitzpatrick, "The Cutter Incident: How America's First Polio Vaccine Led to a Growing Vaccine Crisis," *Journal of the Royal Society of Medicine* 99, no. 3 (March 2006): 156.

Regarding polio vaccine reception among the public, the 1956 article *Public Attitudes Toward Polio Vaccine—Its Development and Distribution*, based on a nationwide survey conducted in 1955, is particularly illustrative.[71] The survey also had an interview component. The first part of the survey centered around the basics—the most telling aspect of Part I is that many people did not know who/what entity developed the polio vaccine when asked—they cited "scientists" or "the Foundation," which had a factual basis, but were not specific enough to indicate a working knowledge of the mechanics of vaccine development. Furthermore, public opinion on the polio vaccine was not really solid nor particularly polarized according to the study data:

> "A multitude of reasons, causes, groups, individuals, motivations, and events were referred to in the replies [to the survey], and none of them was mentioned by more than a small minority of the public."
>
> According to the authors of the study, "In part, too, the variability probably reflects the wide range of judgments conveyed by the mass media during that period. But whatever the reasons, it is clear that no consensus existed on the matter and that the public was somewhat less indignant and aroused than was often believed at the time."

Notable Responses and Excerpts from the 1956 article:

> "It seems like the Foundation had everything going good and then the government came in and there's not too much cooperation between the govt (sic) and the foundation. I feel it was the government health service messing it up."
>
> "They hurried the marketing of the vaccine after discovery. I think it should have been developed more before the publicity. I think they jumped the gun before they were ready."

---

[71] National Opinion Research Center, "Public Attitudes Toward Polio Vaccine--Its Development and Distribution" (University of Chicago, July 1956), https://www.norc.org/PDFs/publications/NORCRpt_57.pdf.

"…I think they gave the wrong amount of publicity to it. Too much publicity."

"Public opinion. They just cry because a few kids get polio."

"Newspapers. I think they caused a lot of hysteria among us because of a few [people] getting [polio] after they were vaccinated."

"The public. No two people can get the same idea. They are too ready to blame someone else."

"Politics. Politicians took over when it should be worked out by doctors and scientists."

"According to the papers it's been politics but you can't believe all you read."

"The doctors are trying to get it and charge a high fee for it. Poor people are the ones that need the shots too."

"Drug companies were unwilling to take the gamble until it was proven. Our Secretary of Health was lax and did not think it was important."

"Manufacturers were responsible. They were trying to put out as much as possible as fast as possible to make money."

"The specific group mentioned most frequently as not having played its proper role in the vaccine situation was the Federal government."

"Mrs. Hobby didn't handle it right."—in reference to Oveta Culp Hobby

"[A] frequent neutral response concerned the lack of public confidence in the vaccine. These replies were usually simple descriptions of public reaction to the faulty batch of vaccine, with no explicit blame attached either to the producers of the vaccine or to the public. Six percent of the public stated only that the delay was inevitable, and these usually stressed the recency of the discovery and the short time available to shift from laboratory to mass production."

'Thus, in their attempts to say who or what was responsible for the delay, one-third of the public (and half of those who gave any opinion at all) referred explicitly to the fact that some of the vaccine had proved faulty: "It isn't safe yet, " "The Cutter Incident," "The live virus was left in," "It didn't work too good," "They weren't making it right," etc. Another 10% of the public implied such awareness when they said the vaccine was still experimental, was being held up for further testing, etc. In answering our

> question, therefore, 44% of the total public, and two-thirds of those with opinions, referred in one way or another to the possible danger in the use of the vaccine at the time and to the need for further testing."
>
> "Other responses with vague referents were fairly explicit as to what was done improperly, but were not clear as to who was responsible for the situation. Thus "They got it out in too much of a hurry," "Whoever was in charge should have seen that it was properly tested," "They are letting the doctors make too much money on it," "They gave it too much publicity," etc. But in spite of persistent probing by the interviewers, these respondents too were unable to specify just who "they" actually were."
>
> "One example might be cited to illustrate how individuals with more education tended to give explanations of specific relevance to the situation, while people with less education were more likely to fall back on stereotyped explanations applicable to any situation."

Excerpts from Part III—In which parents' expectations about their children being vaccinated were evaluated:

> "About one parent in six (17%) expressed doubts or fears about the vaccine, while another 2% took the position that it was unnecessary. About one parent in five, therefore, seemed to be undesiring of the vaccine at that time."
>
> "While people were generally aware that an early batch of the vaccine had proved unsafe and that the program had been held up pending further testing, the great majority of parents and public alike appear to have accepted the developments calmly and with forbearance. Only about half of the parents who did mention fear or doubts about the vaccine's safety seemed to express a fundamental lack of faith in it, and these represented only 8% of the nation's parents of children under 18. The other doubtful responses referred either to the present safety of the vaccine, or to its probable effectiveness."

As demonstrated by the abundant survey data from 1955, the American public's opinions on polio vaccination have echoes in the present day. While the circumstances differ in that polio was almost universally considered to be very harmful and the vaccine was perceived to have been delayed more so than rushed,

the essential thought processes/motivations behind the answers reflect many similarities. Notably, the assignment of blame for vaccine issues on a vague source can be seen among those who decline Covid-19 vaccination. Some claimed polio was not a very big deal, as echoed in the current refrain, "Covid is just the flu!" Others indicated perceived low vaccine effectiveness. Still others cited the Cutter Incident, paralleling individuals today who have concerns about some vaccines causing unintended side effects or, more aptly, causing the spread of Covid-19 (though there is no risk of viral shedding in the case of Covid-19 vaccines).

Furthermore, members of the public often mentioned that polio vaccines were experimental, which is an oft-heard reason for declining Covid-19 vaccines. References to Oveta Culp Hobby, the first U.S. Secretary of Health, Education, and Welfare, may also have connections to the present; she was blamed by some survey respondents for vaccine problems because she was a major policy maker in that arena and thus the public face of the intersection between vaccination and government. Differences in ideals, titles, and perceived credibility aside, these answers seem to lightly correspond with complaints about Dr. Anthony Fauci, advisor to the White House and the U.S. Department of Health and Human Services on Covid-19.

In contrast to the Covid-19 pandemic, there were frequent responses to the 1955 survey indicating that the United States government had failed, but not by pushing the vaccine to the public too early. Rather, they were seen to have held back its development and distribution. Even this stark contrast is in keeping with a theme

to be addressed later, however: the same reasons are often cited by different people to mean opposite things.

The next disease (and its vaccine) to be examined is anthrax. Anthrax disease was never widespread in the way polio was and is not transmissible between humans, but it bears consideration as an example of strict vaccine mandates and their repercussions. While polio vaccines were mainly a concern of the American population at large, anthrax vaccines were more a concern of U.S. military members.

Anthrax (1950s-1970, 2001)

Bacillus anthracis, the gram-positive bacterium that causes anthrax, produces dormant spores that can be found in soil. Once a host organism comes in contact with the spores, they become active and produce an exotoxin, which is the actual disease-causing agent.[72] Anthrax can occur in three forms: cutaneous, gastrointestinal, and inhalational. Cutaneous anthrax causes characteristic skin ulceration, while gastrointestinal anthrax causes bloody diarrhea and severe abdominal pain. Inhalational anthrax is characterized by severe respiratory distress, cough, dyspnea, sweating, and cyanosis. Inhalational anthrax infection can lead to shock and meningitis and typically causes death within days of exposure. Once spores infiltrate the body, macrophages engulf them; the spores germinate and multiply, secreting exotoxin that causes systemic toxic effects leading to edema and

[72] "What Is Anthrax? | CDC," February 16, 2022, https://www.cdc.gov/anthrax/basics/index.html.

necrosis.[73] Anthrax is not transmitted person-to-person, but its high mortality warranted the development of a vaccine against it, especially due to the threat of weaponized anthrax used in war.[74]

Anthrax, despite its reputation as a horror to humans, is primarily a disease of animals. Before biological warfare it was just that, and humans only acquired it by contacting infected animals or animal products.[75] In fact, the first anthrax vaccine was developed by Louis Pasteur in 1881—a vaccine for animals. It was not until the 1940s that concerns began to arise about anthrax as a biological weapon. In the 1950s the U.S. Army commissioned the development of an anthrax vaccine, which was modified and licensed in 1970 and called Anthrax Vaccine Adsorbed (AVA) under the brand name Biothrax. AVA contains aluminum hydroxide as an adjuvant. As noted in Chapter One, aluminum-based adjuvants have not been found to cause harm in the minute quantities present in vaccines. AVA has an intensive dosing schedule: six doses with varying frequency, then a yearly booster.[76]

The 1970 formulation is the vaccine that is currently in use for people at risk of occupational exposure to anthrax, such as laboratory scientists and veterinarians. In 1990, due to concerns about Iraq potentially having weaponized anthrax, the vaccine was administered to over 150,000 service members deployed for the Gulf

---

[73] *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program* (Washington, D.C.: National Academies Press (US), 2002).

[74] "What Is Anthrax? | CDC," February 16, 2022, https://www.cdc.gov/anthrax/basics/index.html.

[75] *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program*.

[76] *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program*.

War. Iraq was later confirmed to have biological weapons and the U.S. Department of Defense initiated an Anthrax Vaccine Immunization Program to vaccinate all U.S. military personnel. This vaccination program was controversial; many military personnel left the service due to mandated anthrax vaccination. Air Force Reserve personnel in particular were faced with vaccination or resignation, with many choosing the latter.[77]

As it turns out, concerns about weaponized anthrax were still relevant after the turn of the century, as anthrax spores were indeed used for terrorism in the 2001 "Amerithrax" incident; anthrax spores were intentionally spread via the U.S. Postal Service, killing 5 people and exposing up to 30,000. Vaccines were offered to over 10,000 people who may have been exposed during the incident, but fewer than 200 people chose to be vaccinated—AVA was not officially approved by the FDA yet and was made available in an "investigational" capacity.[78]

The enforcement of anthrax vaccination is notable in that it was the impetus for many U.S. service members' resignation from the military. In the present day, many healthcare workers have resigned from their positions in the face of mandated vaccination, often in the name of personal liberties and freedoms. This is not limited to healthcare workers, though their departure is typically of greatest note to the media. Some Baylor University students, as will be discussed in Chapter 6, have also declined to be vaccinated on account of personal freedom and a

[77] *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program.*

[78] *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program.*

conviction to not comply with perceived infringements upon their Constitutionally granted liberties.

In this chapter, four pre-modern diseases and their vaccines were considered: smallpox, influenza, polio, and anthrax, though influenza and anthrax spill into the "modern" category as well on account of their contemporary uses. Each of these vaccines had its detractors and many of those detractors held strikingly similar views to people who decline vaccination against Covid-19 today. An investigation into three modern vaccines in the next chapter will demonstrate a similar dynamic. Public response to these modern vaccines is of high value in the deliberation on Covid-19; more recent public rollouts of these vaccines capture a more modern American population that overlaps more with the present day. Documenting similarities in responses between pre-modern, modern, and post-modern (Covid-19) vaccines is vital in proving that contemporary reasons to decline vaccination have historical roots that have been carried over despite profound contextual and societal changes.

CHAPTER FOUR

Modern Vaccines

The discussion of modern vaccines, as opposed to "pre-modern," begins with the Measles, Mumps, and Rubella vaccine developed in 1971 and extends through the vaccines against Human Papillomavirus (HPV) first developed in 2006. While there are certainly more than three such vaccines, each of the three selected have a particular relevance to the topic of vaccine hesitancy or acceptance, the reasoning behind it, or responses to vaccine hesitancy. Vaccines against all three of the diseases to be discussed in this section are on the CDC's recommended childhood immunization schedule, though not necessarily in the form in which they were first developed. Lastly, the modern vaccines to be discussed will lay the groundwork for the claim that even the more contemporary-sounding reasons in opposition to Covid-19 vaccination have been heard before in some capacity.

MMR (1971)

The first written account of measles is from 9th century Persia.[1] When measles was first nationally reportable in the United States starting in 1912, there were about 6,000 deaths from it reported per year. An individual with measles can

[1] CDC, "History of Measles," Centers for Disease Control and Prevention, November 5, 2020, https://www.cdc.gov/measles/about/history.html.

infect up to 90 percent of people close to them.[2] This makes measles, officially named "rubeola," one of the most infectious pathogens currently known; before there was a vaccine, almost everyone contracted measles at some point in childhood. Measles is a respiratory virus that is characterized by a distinctive red rash; it can be serious in early childhood and in the immunocompromised when it results in bronchopneumonia, but prognosis is generally favorable with supportive treatment. Contrary to polio, there was not much public fear of measles before the vaccine, and parents and physicians alike considered measles an inevitable stage of a child's development. Measles was killing between one and two million children annually in developing countries but in the United States it was seen as more of a nuisance than a threat.[3]

Though the development of vaccines for epidemic diseases is typically driven by high mortality associated with a disease, vaccines are also made for pathogens that are particularly infectious; measles, more than almost any other disease, falls into this category. This reason for development places the measles vaccine firmly in the "modern" category, as the vaccines for smallpox, influenza, polio, and anthrax were developed in response to extremely high disease morbidity and mortality. Measles can certainly kill, but it is not nearly as deadly as the aforementioned pathogens—in essence, the measles vaccine was developed because the opportunity was there, rendering measles (and its uncommon but devastating deaths) obsolete.

---

[2] "A History of Measles in the United States | Online Public Health," *GW-UMT* (blog), March 19, 2019, https://onlinepublichealth.gwu.edu/resources/measles-history-in-the-united-states/.
[3] Jan Hendriks and Stuart Blume, "Measles Vaccination Before the Measles-Mumps-Rubella Vaccine," *American Journal of Public Health* 103, no. 8 (August 2013): 1393–1401, https://doi.org/10.2105/AJPH.2012.301075.

At present, the measles vaccine is typically combined with vaccines against mumps and rubella, forming the acronymously-named "MMR" vaccine. Mumps (viral parotitis) is an infection characterized by swelling of the parotid glands and associated pain. Mumps is treatable with supportive care and typically does not cause lasting sequelae, though it can rarely lead to meningitis or encephalitis. Rubella, also known as "German measles," presents very similarly to measles (rubeola) and typically causes an even milder illness, also associated with a red rash. Though generally mild on their own, together, measles, mumps, and rubella have great potential to cause harm. The MMR vaccine is recommended by the CDC at age 12-15 months because measles is most harmful in early childhood.[4]

Vaccine development for measles began in 1954 but it was not licensed until 1963. Two vaccines were approved in 1963: one live attenuated and the other formalin-inactivated; the former was produced by Merck and the latter by Pfizer. An improved version was released in 1968, and that vaccine is the one we still use today.[5] After the CDC set out to eliminate measles in 1978, reported cases dropped 80% by 1981. In 1989, there were outbreaks despite children being vaccinated, which led to the recommendation that everyone who had received the 1968 measles vaccine receive a second dose. This development is similar to the Covid-19 situation; one vaccine was made, and then breakthrough infections led to the booster being released.

[4] "Birth-18 Years Immunization Schedule | CDC," June 16, 2021, https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html.

[5] CDC, "History of Measles."

Measles was declared eliminated in the United States in 2000 after an effective vaccination program was implemented. However, measles has recently undergone a resurgence, as decreased childhood vaccination rates for measles have allowed it to worm its way back into American society.[6]

In 1998, disgraced former physician Andrew Wakefield published a now-retracted article in *The Lancet* linking the MMR vaccine to "gastrointestinal disease and developmental regression."[7] The sample set in the study was only twelve children, eleven of whom were boys. According to the article, nine of the twelve children demonstrated the onset of autism, one experienced psychosis, and one had postviral/vaccinal encephalitis. However, the "previously normal" status of the children, and the onset of behavioral symptoms as being associated with the MMR vaccine, were self-reported by the parents; we have no way of knowing whether the reported temporal association is accurate. Four of the twelve children (33% of the sample size) were not evaluated by the same psychiatrist as the others—they had been "assessed professionally elsewhere" and the reports from those assessments were used. Furthermore, behavioral symptoms were not all the same, and not even all similar or according to the same course, though Wakefield named them broadly to be disintegrative encephalitis; equipped with this characterization, he mentions a previously established connection between disintegrative psychosis and measles encephalitis.

---

[6] CDC.

[7] A. J. Wakefield et al., "RETRACTED: Ileal-Lymphoid-Nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children," *The Lancet* 351, no. 9103 (February 28, 1998): 637–41, https://doi.org/10.1016/S0140-6736(97)11096-0.

Having made a connection between viral encephalitis and disintegrative psychosis, Wakefield then connected viral encephalitis to autistic disorders, venturing to state that "rubella virus is associated with autism" and that the MMR vaccine may be as well. Wakefield and his associates did not prove any association between the MMR vaccine and autism, but they used anecdotal statements to imply one. Ultimately, the study connects intestinal issues with autism-spectrum disorders, seemingly tacking on "plus vaccines!" as an afterthought—in reality, it turns out, Wakefield was paid to report the results he did.

The study's incredibly small sample size, uncontrolled study design,[8] and speculative claims did not deter the public from taking hold of the article and running with it; the article gained significant traction before it was retracted and continued to gain ground even afterward. Celebrities and celebrity doctors touted its claims, leading many parents to fear vaccination and opt not to let their children receive not only the MMR vaccine but any vaccine on the childhood immunization schedule. Vaccination rates against measles, mumps, and rubella declined. Anecdotally, some individuals on social media still believe the claims made by Wakefield et al. and hold that the retraction was an instance of censorship.

Studies performed shortly after the Wakefield article amply refuted its claims. Furthermore, "the logic that the MMR vaccine may trigger autism was also questioned because a temporal link between the two is almost predestined: both

[8] T. S. Sathyanarayana Rao and Chittaranjan Andrade, "The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud," *Indian Journal of Psychiatry* 53, no. 2 (2011): 95–96, https://doi.org/10.4103/0019-5545.82529.

events, by design (MMR vaccine) or definition (autism), occur in early childhood."[9] The article, published in 1998, was fully retracted by the *Lancet* in 2010; the investigations performed on children were found to be unethical, sampling methods were misrepresented, and the article at large was written fraudulently for financial gain. Not only was the initial sampling selective, but the authors also actually chose which data they used to make their predetermined point and blatantly falsified other data.[10]

Today, Andrew Wakefield is banned from practicing medicine in Britain for his part in the falsified article and the resultant public distrust in measles vaccination. His pursuits over the last decade have been centered around anti-vaccine advocacy. As of 2021, Wakefield was frequently speaking at anti-vaccine events during the Covid-19 pandemic.

Measles Now

The Wakefield article has had lasting repercussions. As vaccination rates have declined, measles has enjoyed a resurgence. Furthermore, the public has had its faith shaken in the scientific community. On one hand, the fact that the Wakefield article made it into the *Lancet* and that it was not retracted for twelve years calls into question the quality assurance measures and reliability of researchers and even major medical journals. On the other hand, the retraction has not changed the minds of many who believed the article's claims, but rather led them to believe that

[9] Rao and Andrade.

[10] Rao and Andrade.

"science" and "Big Vaccine" are corrupt and censoring anyone who tries to go against them. In fact, many prevalent opinions on the MMR crisis parallel the nationwide survey on polio vaccination discussed previously: there appears to be a general trend toward blaming government writ large or science in general for any failings in vaccine creation and distribution.

Looking to the present, some people who decline vaccination against Covid-19 have done so because of a general distaste for vaccines of all kinds while others have declined due to a belief that vaccines cause autism. Both of these reasons, most definitively the latter, are tied to the MMR vaccine and its surrounding controversies. The Wakefield article and subsequent vaccine hysteria are demonstrative of the fact that a small amount of unqualified misinformation from the right source has the power to set public opinion back significantly.

The next vaccine on the list is RotaShield, developed to protect against rotavirus. MMR and RotaShield have enough notable differences in context to potentially call the situations opposite; where MMR was attacked for unverified claims of severe side effects, RotaShield was investigated for verified reports and was quickly withdrawn, making it a prime example of conscientious post-market surveillance.

Rotavirus (1990s)

Rotavirus, a double-stranded RNA virus, and its associated vaccines are relatively new in terms of disease discovery and vaccine history. Rotavirus was first

discovered to be a cause of diarrhea in children in 1973.[11] 1980 saw rotavirus classified as the "most common cause of severe gastroenteritis in infants and young children in the United States." In fact, before there was a vaccine against rotavirus, about 500,000 children died annually throughout the world from the disease. Rotavirus was yet another disease that nearly every child contracted before adolescence. In the United States, "95% of children" were infected by age five and there were approximately 2.7 million cases per year before the vaccine.[12] With that said, the number of deaths in the United States was extremely low as compared to developing countries due to good access to supportive care. Furthermore, rotavirus only seriously affects children, not adolescents or adults.[13] Rotavirus is transmitted via the fecal-oral route, and it then travels to the small intestine and replicates there, leading to the characteristic gastrointestinal symptoms. The virus is shed in the stool of infected individuals and can live for months on fomites. Rotavirus can either cause severe diarrhea or be asymptomatic and usually resolves within a week, though immunocompromised children are at risk of longer-lasting infection and metabolic and electrolytic imbalance.[14]

The first vaccine for rotavirus was developed in the 1990s under the name RotaShield. It was clinically tested in a number of places, including Europe and South America, but was not tested in areas "where the impact of rotavirus-related

---

[11] "Rotavirus Vaccination | CDC," October 27, 2020, https://www.cdc.gov/vaccines/vpd/rotavirus/index.html.
[12] "Rotavirus Vaccination | CDC."

[13] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

[14] "Rotavirus Vaccination | CDC."

disease was greatest" because the manufacturer was more interested in rolling out the vaccine to the United States right away. It is stated that the plan was to create a market for the vaccine in the United States, then use the money to send the vaccine to more profoundly affected countries.[15]

It took over twenty years for Wyeth Pharmaceuticals to develop and test RotaShield, and it was finally presented to the FDA's Vaccines and Related Biological Products Advisory Committee at the end of 1997. At this time, the vaccine appeared to be highly efficacious; "at its final dosage, the vaccine was 49 to 68 percent efficacious against all rotavirus-related disease and 69 to 91 percent efficacious against severe diarrhea, the cases most likely to result in hospitalization or death."[16] There were no major safety concerns cited by the Wyeth presenters.

During the presentation, the FDA's director of the Office of Vaccines Research and Review asked about five reported cases of intestinal intussusception, "an uncommon condition in which a portion of the intestine descends, or telescopes, into a distal segment," reported during clinical testing of the vaccine. Intussusception is serious if not detected early and can require surgery or even result in death.[17] In response, the Wyeth presenters confirmed that these cases of intussusception did occur and that they were among vaccinated patients (as opposed to recipients of a placebo, though one control patient was found to have

---

[15] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

[16] Schwartz. quoting Margaret Cortese and Umesh D. Parashar, "Prevention of Rotavirus Gastroenteritis Among Infants and Children Recommendations of the Advisory Committee on Immunization Practices (ACIP)</FONT>," Centers for Disease Control and Prevention, February 6, 2009, https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5802a1.htm.

[17] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

intussusception later.) However, they stated that the number of cases was not statistically significant. One researcher stated her initial concern with these cases but explained that a review of the available literature quelled her fears. After the presentation, the Committee unanimously voted that RotaShield was safe and effective and it was licensed for use by the FDA in August 1998, with a comment about intussusception included within a lengthy insert in the vaccine's packaging. Intussusception was not listed as one of the possible adverse reactions to RotaShield, nor was Wyeth Pharmaceuticals directed by the FDA to study its possible connection to the vaccine long-term. During the FDA's review of RotaShield, the CDC was "developing draft recommendations" for it, as they wanted to have these recommendations out very shortly after approval because the vaccine was so many years in the making.[18] The CDC, concluding that intussusception was not associated with vaccination, recommended that all children receive three doses of RotaShield, one dose every two years starting at age two, in March 1999.[19]

After the CDC's official recommendation, Wyeth touted RotaShield's safety and necessity as their crowning achievement. The public began to trust RotaShield. On the other hand, the CDC worried as VAERS reports started coming in.[20] There were sixty-two reports in VAERS regarding RotaShield when the CDC began to take notice, three of which were reports of intussusception. At this point, the CDC began

---

[18] Schwartz. quoting a transcript of the CDC's Advisory Committee on Immunization Practices' Meeting, February 11-12, 1998.

[19] Schwartz.

[20] The VAERS program has been in use since 1990 and serves as a reporting system for the side effects of vaccines. VAERS will be discussed in greater depth later in the section on rotavirus.

to investigate a possible association between RotaShield and intussusception. For all the missed cues by the FDA and CDC leading up to this point, this was an incredibly swift response.[21] Based on the timeline of general anti-vaccination sentiment in the United States, this fast response made a lot of sense—the sensational Wakefield article linking MMR and autism was released in 1998 and was not retracted until 2010—and there was no time to lose. Additionally, around the same time "the safety of thimerosal, a mercury-containing preservative used in many vaccines, was under scrutiny by groups including the CDC."[22] Thimerosal was later removed or the quantity was decreased in CDC-recommended vaccines "as a precautionary measure" though low doses have not been shown to cause harm save for injection site redness.[23] In July 1999, during the CDC's investigation, their recommendation of RotaShield was suspended. This suspension came approximately a year after the initial recommendation, and by that time 1.5 million doses had been administered to 900,000 children. The government had planned to purchase millions of doses of the vaccine but had not yet reached an agreement with Wyeth Pharmaceuticals, so the doses that were given out were not federally distributed.[24]

---

[21] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

[22] Schwartz.

[23] "Thimerosal and Vaccines | Vaccine Safety | CDC," August 25, 2020, https://www.cdc.gov/vaccinesafety/concerns/thimerosal/index.html.

[24] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk." quoting a transcript of the CDC's Advisory Committee on Immunization Practices' Meeting, June 17, 1999.

After the suspension of the CDC's recommendation, new reports of intussusception flooded in.[25] Properly evaluating the connection between intussusception and RotaShield was of utmost importance to the CDC at this time. After extensive study, it was determined that there was a statistically significant risk of intussusception associated with rotavirus vaccination; one group of researchers "estimated one additional case of intussusception attributable to the vaccine for every 4670 to 9474 infants vaccinated."[26]

In October 1999, the CDC's recommendation of RotaShield was officially withdrawn. Before this was formally announced, Wyeth Pharmaceuticals withdrew the vaccine from the market. The fate of RotaShield in the United States was a strongly supported one. On the other hand, the lack of a mass market in the United States meant that RotaShield would not make it to developing countries, where the risk of death in children from rotavirus was significantly higher and the intussusception concern may have been of secondary importance. However, the CDC issued a very clear statement on RotaShield that left no room for exceptions, and even after further deliberations on its international use by the World Health Organization, "the meeting's participants from the United States left Geneva with little doubt that the vaccine would never be used again" because other countries did not want a vaccine that was considered unsafe for Americans.[27] Interestingly, the

---

[25] L. R. Zanardi et al., "Intussusception among Recipients of Rotavirus Vaccine: Reports to the Vaccine Adverse Event Reporting System," *Pediatrics* 107, no. 6 (June 2001): E97, https://doi.org/10.1542/peds.107.6.e97.

[26] Trudy V. Murphy et al., "Intussusception among Infants Given an Oral Rotavirus Vaccine," *New England Journal of Medicine*, August 20, 2009, https://doi.org/10.1056/NEJM200102223440804.

[27] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

director of the CDC stated in an interview on the subject of RotaShield, "I certainly didn't want a, 'on the one hand, on the other hand, you can do this, you can't do that.' The public doesn't like that garbage. They want a clear direction, much like you want from your own doctor."[28]

Shortly after it became clear that RotaShield would never again be used in the United States, Wyeth Pharmaceuticals effectively gave up on it, and Wyeth itself was acquired by Pfizer Pharmaceuticals in 2009. Today, there are two rotavirus vaccines licensed for use in infants in the United States. The first, known as RV1 or Rotarix, was developed by GSK pharmaceuticals and is given in two doses. The second, RV5 or RotaTeq, developed by Merck & Co., is given in three doses. Both vaccines are administered as oral drops rather than by injection.[29] The CDC recommends administration of one of these vaccines to all infants beginning at 2 months of age.[30]

While the MMR vaccine faced backlash for unconfirmed concerns, RotaShield was an example of a vaccine that really did have empirically demonstrated problems. RotaShield is also the most high-profile modern vaccine to have been withdrawn in such a way as it was, indicating anecdotally that when there was evidence of vaccine risk in the past, that evidence was addressed full force, even to the chagrin of the pharmaceutical company developing it. The RotaShield issue was

---

[28] Schwartz. quoting an interview with Dr. Jeffrey P. Koplan, 16 November 2009)

[29] "Rotavirus Vaccination | What You Should Know | CDC," August 8, 2019, https://www.cdc.gov/vaccines/vpd/rotavirus/public/index.html.

[30] "Birth-18 Years Immunization Schedule | CDC."

one that perhaps could have been nipped in the bud before any doses were administered but was still addressed effectively within a year of public rollout, making it an example of a vaccine problem dealt with in a prompt and decided way.

RotaShield's withdrawal is very similar to the temporary withdrawal of the Johnson & Johnson Covid-19 vaccine after reports of blood clots were deemed concerning. Heavy use of VAERS is also notable, as many people who are suspicious of Covid-19 vaccines look to VAERS for definitive data on vaccine side effects.

VAERS (the Vaccine Adverse Event Reporting System) is a passive surveillance system jointly operated by the FDA and the CDC that was created in 1990 in response to the National Childhood Vaccine Injury Act of 1986, which was passed as a result of an increasing number of lawsuits for alleged vaccine injuries. The DPT (diphtheria, tetanus, and pertussis) vaccine was frequently cited as a cause of vaccine injury and damages were often awarded to plaintiffs without proof of the alleged injury.[31] VAERS "allows anyone—patients, physicians, or third parties—to report adverse events that could be associated with a vaccine" but "the reporting is incomplete, requires follow-up investigation, and cannot directly distinguish temporal associations from causal associations. Consequently, VAERS functions as a hypothesis-generating mechanism, an early-warning signal of potential problems regarding vaccine safety."[32] In other words, VAERS reports are made to initiate investigation and therefore do not constitute confirmed correlation nor causation

[31] "National Childhood Vaccine Injury Act" (Texas Department of State Health Services, n.d.), https://www.dshs.texas.gov/immunize/forms/11-11246/.

[32] Schwartz, "The First Rotavirus Vaccine and the Politics of Acceptable Risk."

between vaccination and reported adverse events, but much of the public seems to believe they do.

VAERS' proper use was realized with RotaShield. In contrast, many complaints of censorship of Covid-19 vaccine side effects are derived from a misinterpretation of VAERS' functionality. A similar incorrect connection between correlation and causation can be found in Chapter 3 regarding the incidence of tuberculosis and smallpox; the misinterpretation of data is a theme woven consistently through vaccine history.

The last modern vaccines to be discussed protect against HPV; recommendations for HPV vaccines, more than any others discussed thus far, are commonly seen as an affront to parental rights and values. Before Covid-19, HPV was the most recent controversial vaccination, making it distinctly relevant as the last historical vaccine to be examined in this thesis.

HPV (2006)

HPV (human papillomavirus) is actually a group of over 200 viruses that cause roughly the same disease, though some human papillomaviruses cause more serious disease than others. Many human papillomaviruses are sexually transmitted and those that are can be classified as either high-risk or low-risk. HPV infection is extremely common and high-risk HPVs have the potential to cause cancer; the only known cause of cervical cancer is HPV infection. Even low-risk HPVs can cause genital warts.[33]

[33] "HPV and Cancer - National Cancer Institute," cgvArticle, March 1, 2019, nciglobal,ncienterprise, https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer.

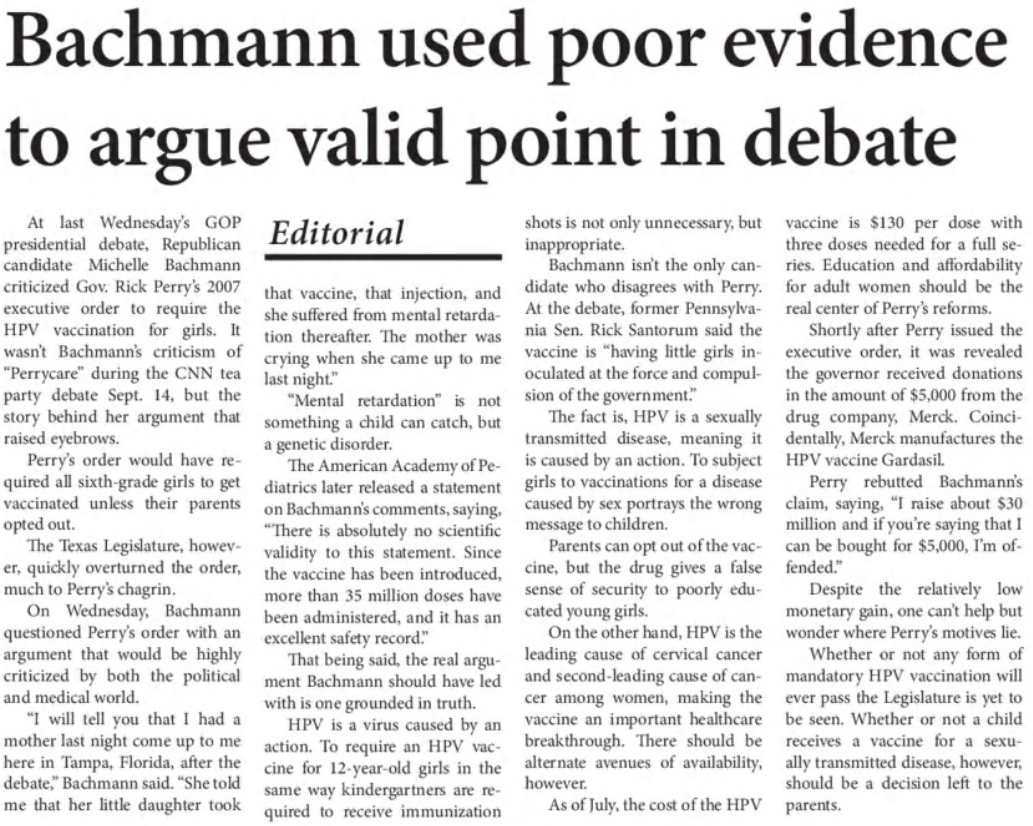
A highly effective vaccine against HPV (Gardasil) has been continuously available to the public since it was introduced in 2006, but uptake is relatively low and vaccination is shrouded in controversy even sixteen years later. It is authorized for use in males and females aged 9 to 26, which is a point of concern for many parents who are asked to vaccinate their children in adolescence. Due to the controversial nature of HPV vaccination and the amount of time that has passed since its development and release, an abundance of studies have been performed on the reasons why parents refuse HPV vaccines for their children and how to best increase vaccine uptake. These studies are enlightening in relation to Covid-19 in some ways because they address some of the basic concerns associated with all vaccines, while the major concerns are indeed HPV-specific.

The perennial point of contention is that because HPV is a sexually transmitted disease and vaccination protects against it, some parents believe that vaccination encourages or tacitly condones sexual promiscuity in the adolescents who receive it.[34] Similarly, other parents believe that a

Figure 10: A political cartoon from the Baylor Lariat student publication about HPV vaccination.

[34] "Understanding the Reasons Why Mothers Do or Do Not Have Their Adolescent Daughters Vaccinated Against Human Papillomavirus | Elsevier Enhanced Reader," accessed March 23, 2022, https://doi.org/10.1016/j.annepidem.2009.03.011.

teenager who is not sexually active has no need to be vaccinated against HPV. Unfortunately, the HPV vaccine is not effective once a person has been exposed to a given strain of HPV; vaccination must happen in adolescence *because* it is before the recipient is sexually active. Lastly, HPV vaccines have been erroneously linked to cognitive impairment, scaring parents away from having their children vaccinated.[35]



Bachmann used poor evidence to argue valid point in debate

Editorial

At last Wednesday's GOP presidential debate, Republican candidate Michelle Bachmann criticized Gov. Rick Perry's 2007 executive order to require the HPV vaccination for girls. It wasn't Bachmann's criticism of "Perrycare" during the CNN tea party debate Sept. 14, but the story behind her argument that raised eyebrows.

Perry's order would have required all sixth-grade girls to get vaccinated unless their parents opted out.

The Texas Legislature, however, quickly overturned the order, much to Perry's chagrin.

On Wednesday, Bachmann questioned Perry's order with an argument that would be highly criticized by both the political and medical world.

"I will tell you that I had a mother last night come up to me here in Tampa, Florida, after the debate," Bachmann said. "She told me that her little daughter took that vaccine, that injection, and she suffered from mental retardation thereafter. The mother was crying when she came up to me last night."

"Mental retardation" is not something a child can catch, but a genetic disorder.

The American Academy of Pediatrics later released a statement on Bachmann's comments, saying, "There is absolutely no scientific validity to this statement. Since the vaccine has been introduced, more than 35 million doses have been administered, and it has an excellent safety record."

That being said, the real argument Bachmann should have led with is one grounded in truth.

HPV is a virus caused by an action. To require an HPV vaccine for 12-year-old girls in the same way kindergartners are required to receive immunization shots is not only unnecessary, but inappropriate.

Bachmann isn't the only candidate who disagrees with Perry. At the debate, former Pennsylvania Sen. Rick Santorum said the vaccine is "having little girls inoculated at the force and compulsion of the government."

The fact is, HPV is a sexually transmitted disease, meaning it is caused by an action. To subject girls to vaccinations for a disease caused by sex portrays the wrong message to children.

Parents can opt out of the vaccine, but the drug gives a false sense of security to poorly educated young girls.

On the other hand, HPV is the leading cause of cervical cancer and second-leading cause of cancer among women, making the vaccine an important healthcare breakthrough. There should be alternate avenues of availability, however.

As of July, the cost of the HPV vaccine is $130 per dose with three doses needed for a full series. Education and affordability for adult women should be the real center of Perry's reforms.

Shortly after Perry issued the executive order, it was revealed the governor received donations in the amount of $5,000 from the drug company, Merck. Coincidentally, Merck manufactures the HPV vaccine Gardasil.

Perry rebutted Bachmann's claim, saying, "I raise about $30 million and if you're saying that I can be bought for $5,000, I'm offended."

Despite the relatively low monetary gain, one can't help but wonder where Perry's motives lie.

Whether or not any form of mandatory HPV vaccination will ever pass the Legislature is yet to be seen. Whether or not a child receives a vaccine for a sexually transmitted disease, however, should be a decision left to the parents.

Figure 11: An opinion editorial from the Baylor Lariat student publication about HPV vaccination, specifically referencing politician Michele Bachmann's 2011 claim that HPV vaccines cause cognitive impairment.

[35] Karlie A. Intlekofer, Michael J. Cunningham, and Arthur L. Caplan, "The HPV Vaccine Controversy," *AMA Journal of Ethics* 14, no. 1 (January 1, 2012): 39–49, https://doi.org/10.1001/virtualmentor.2012.14.1.msoc1-1201.

Figures 10 and 11: Esteban Diaz and Lariat Staff Writers, "Baylor Lariat Editorial," *The Baylor Lariat*, September 20, 2011, Vol. 112 No. 12 edition.

HPV vaccines were perhaps the quintessential controversial modern vaccines before Covid-19, and their difficulties have not abated with the rise and decline of the pandemic. As compared with Covid-19, HPV controversies have a unique spin, but they are ethical and religious nonetheless. Religious objections to Covid-19 vaccines due to fears that it will change the recipient's DNA, will mark them as irredeemable by God, or will inoculate them with cells derived from immoral sources have basic similarities to the HPV issue.

"Modern" vaccines, including contemporary applications of older influenza and anthrax vaccines, are the basis for most Americans' experiences with immunization. With this in mind, they are eminently important in understanding the Baylor microcosm's experiences with vaccines to date and thereby the fundamental basis for their opinions on Covid-19 vaccination. Where pre-modern vaccines provide the context for basic human hesitancy toward vaccination in its earliest forms, modern vaccines contextualize newer reasons for hesitancy and can be compared and contrasted with the one and only "post-modern" vaccine created so far.

CHAPTER FIVE

Covid-19: The First Post-Modern Vaccines

Covid-19 vaccines are post-modern in the sense that they mark a departure from what was until recently considered modern vaccine technology. The Pfizer-BioNTech and Moderna Covid-19 vaccines make use of synthesized viral messenger RNA (mRNA), which can be produced very efficiently.[1] The third widely-distributed Covid-19 vaccine in the United States, developed by Johnson & Johnson/Janssen, is an adenovirus vaccine that does not utilize mRNA.[2] The brand names for the Pfizer and Moderna vaccines are Comirnaty and Spikevax, respectively, but these vaccines will be referred to by the name of their developing pharmaceutical companies because the brand names are relatively new while the company names have become colloquially well-known. At the time of this writing, the Janssen vaccine is still under Emergency Use Authorization and not fully FDA-approved, so it does not have a brand name.

mRNA vaccines for Covid-19, broadly, employ mRNA in targeting a specific protein on SARS-CoV-2. This protein is called the "spike" or S protein and it is present on the surface of the virion, as shown in Figures 1 and 2 in Chapter Two.

---

[1] Nidhi Subbaraman, "This COVID-Vaccine Designer Is Tackling Vaccine Hesitancy — in Churches and on Twitter," *Nature* 590, no. 7846 (February 11, 2021): 377–377, https://doi.org/10.1038/d41586-021-00338-y.

[2] Edward H. Livingston, Preeti N. Malani, and C. Buddy Creech, "The Johnson & Johnson Vaccine for COVID-19," *JAMA* 325, no. 15 (April 20, 2021): 1575, https://doi.org/10.1001/jama.2021.2927.

More specifically, mRNA is a single-stranded form of genetic material that is transcribed from DNA. In the case of Covid-19 vaccines, the mRNA is synthesized *in vitro* from viral RNA that encodes for the spike protein on the virus' surface.[3] An important tenet of biology is the "central dogma" that explains the pathway by which genetic information is transmitted: DNA is transcribed to RNA, then that RNA is translated to make specific proteins. Proteins, once synthesized, perform most of our cells' functions and make up their structure. The mRNA in Covid-19 vaccines is translated in normal host cells, leading those host cells to produce the viral spike protein without the rest of the SARS-CoV-2 virion. The host's immune system produces an immune response against the foreign spike protein, preparing the host to mount an effective response to natural infection with SARS-CoV-2 upon exposure; host antibodies will recognize the spike protein on the surface of the virion and attach to it, preventing the virus from infecting host cells.

The indicated pathway (DNA, RNA, protein) does not act in reverse without a specific enzyme called reverse transcriptase, which can synthesize DNA from RNA, but few RNA viruses have reverse transcriptase. One such virus is the Human Immunodeficiency Virus (HIV). SARS-CoV-2, on the other hand, does not have reverse transcriptase, which is relevant to particular vaccination opinions regarding Covid-19. Due to mRNA's association with genetic coding, some individuals worry that receiving a Covid-19 vaccine will allow the injected mRNA to integrate with or change their DNA.

[3] Kizzmekia S. Corbett et al., "SARS-CoV-2 MRNA Vaccine Design Enabled by Prototype Pathogen Preparedness," *Nature* 586, no. 7830 (October 2020): 567–71, https://doi.org/10.1038/s41586-020-2622-0.

The mRNA in the Pfizer and Moderna Covid-19 vaccines, by encoding for the spike protein of SARS-CoV-2, enables the immune system to create antibodies against the virus so it can fight off infection. Essentially, viral mRNA is used to tell our cells how to make antigens identical to viral proteins. From a January 2018 published peer-reviewed manuscript, "as mRNA is a non-infectious, non-integrating platform, there is no potential risk of infection or insertional mutagenesis. Additionally, mRNA is degraded by normal cellular processes, and its *in vivo* half-life can be regulated through the use of various modifications and delivery methods."[4] In other words, mRNA cannot integrate into/alter our DNA and is naturally broken down by our bodies once it has served its purpose.

It was known long prior to the Covid-19 pandemic that vaccines utilizing mRNA as a viral vector could induce immunity.[5] However, much development still had to take place to make a safe and effective Covid-19 mRNA vaccine. What sets Covid-19 vaccine development apart from older vaccines is the speed and urgency with which it was performed. Clinical trials were allowed to overlap temporally, and production of the vaccine began before trials were completed.[6] That said, speedy development was possible because of the amount of funding provided by the United States government for research as part of Operation: WARP SPEED, and not necessarily because corners were being cut. Ultimately, mRNA Covid-19 vaccines

[4] Norbert Pardi et al., "MRNA Vaccines — a New Era in Vaccinology," *Nature Reviews. Drug Discovery* 17, no. 4 (April 2018): 261–79, https://doi.org/10.1038/nrd.2017.243.

[5] "Frequently Asked Questions About The Covid-19 Vaccine."

[6] "Frequently Asked Questions About The Covid-19 Vaccine."

were developed and released very quickly because the FDA determined that their benefits outweighed any risks they posed.

The two mRNA Covid-19 vaccines—developed by Moderna and Pfizer/BioNTech—received emergency use authorization not even a year after Covid-19 was declared a pandemic.[7] Recalling the previously discussed premodern and modern vaccines, it is clear that Covid-19 vaccines stand apart; other vaccines took multiple years, and sometimes decades, to be developed, tested, and released to the masses.

Covid-19 vaccines are not your grandparents' polio or chickenpox vaccines; the design of Covid-19 vaccines has led to a shift in the way immunization is perceived. The new and unknown have strong ties to vaccine hesitancy. While this is not a fundamentally new concept, some of the intricacies and minutiae are new and must be considered as such before they are categorized with the "old" reasoning against older vaccines. With that said, the following chapter details the results of the study on Baylor students' responses to Covid-19 vaccines, and even with context in mind, the results still bear striking resemblance to the past.

[7] Prabhu S. Arunachalam et al., "Systems Vaccinology of the BNT162b2 MRNA Vaccine in Humans," *Nature* 596, no. 7872 (August 19, 2021): 410–16, https://doi.org/10.1038/s41586-021-03791-x.

CHAPTER SIX

Baylor University Students' Covid-19 Vaccination Opinions—Study

College students, and freshmen in particular, are in a strange social spot; they have been given almost ultimate freedom during school months, but most live with their parents on breaks and (in the case of freshmen) have just recently left home for the first time. There can sometimes be dissonance between parental opinions and what the student thinks is right or desirable, leading to conflict between following the wishes of one's parents (because they still have much power over decision-making) or doing what one believes to be right in the case of a disagreement.

The majority of university students in the United States have received a host of vaccines since they were babies, with very little to no say in the matter. In fact, most vaccines on the schedule for childhood are required for a child to attend public school.[1] With this in mind, college students are an interesting subset of the population to study because this may be the first time they have had to willfully make the decision to be vaccinated against a disease or not—save for annual influenza shots, which tend to be far less controversial.

[1] 44 U.S. states allow religious exemptions, philosophical exemptions, or both to vaccinations required to attend public school. All 50 states allow medical exemptions. "States With Religious and Philosophical Exemptions From School Immunization Requirements," accessed April 10, 2022, https://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.

Knowing the reasons why Baylor students have decided for or against vaccination against Covid-19 can inform future public health decisions on a university level and beyond. Universities draw students from a variety of backgrounds and with a variety of interests, making them a potentially meaningful gauge of the opinions of the young, although as a cohort they do not include those who do not seek collegiate education.

Research design and methods

Using the Qualtrics survey system, current Baylor University students from a variety of majors and programs were surveyed regarding their personal Covid-19 vaccine decisions and opinions. This study was considered and determined to be exempt from review by Baylor University's Institutional Review Board for the Protection of Human Subjects in Research on October 8th, 2021.

Initially, an anonymous pilot study was performed, in which Baylor students responded to fill-in-the-blank questions asking them to detail their own reasons in favor of or in opposition to Covid-19 vaccination and the reasons they have heard others cite for their decisions. The pilot study was open for four weeks and yielded responses from 60 individuals, which in turn yielded around 150 discrete opinions in approximately 30 categories. Numbers are approximate because the pilot study was qualitative in nature; responses were sorted into broad categories, with some individual opinions differing only slightly from each other. Any perceived difference in meaning was included as a separate opinion in an effort to ensure comprehensive results. Responses from the pilot study were used to create multiple-choice style

questions in the opinion section of the primary survey. Each opinion deemed different enough so as to denote different principles or apprehensions was made into a selectable choice. Though the pilot was performed as a means to generate accurate multiple-choice reasons for participants to choose from in the full-length survey, pilot responses proved both thorough and enlightening enough to address in their own section.

After the pilot study was completed, the primary full-length survey was distributed. This survey utilized the opinions detailed in the pilot study with the goal of having every major reason behind participants' vaccination decisions be represented in a quantifiable format. At the end of each list of reasons, there was a free-text box for "other" to ensure any unrepresented opinions could be shared if a participant desired. Participants were asked demographic questions such as age, major area of study, and political affiliation. Next, they responded to a series of questions about their vaccination status and the reasons behind their decision-making leading them to that point.

Last, a secondary (follow-up) survey was sent to participants of the primary survey after some time had passed; most participants who completed the primary survey received the secondary survey about three months later. The delay between the primary and secondary surveys allowed for a longitudinal study design; an important question the study sought to answer was whether participants would demonstrate a change in opinion on Covid-19 vaccination over time. The last participants to receive the primary survey before it closed received the secondary survey after only a month due to time constraints, but receipt of the surveys by this

group was settled temporally around a major change in Baylor's Covid-19 policies. This time frame presented a unique view: these individuals completed the primary survey while Baylor still required masks to be worn in classrooms, and when they completed the secondary survey, the campus mask mandate had been rescinded. The rescinding of the classroom mask mandate signified the end of the last of the Covid-19 restrictions at Baylor University; Covid-19 was essentially "over" for students at this point.

Survey Data, Pilot Study

From the qualitative pilot study data, the following categories of opinions were derived in favor of Covid-19 vaccination (in alphabetical order):

Abiding others' wishes
Avoiding inconvenience
Belief that vaccination is an unquestionable thing to do
Civic duty/civil responsibility
Desire for life to return to normal
Ending the pandemic
Mandate-based
Moral or ethical duty/responsibility
Protection from long-haul Covid-19 disease
Protection of loved ones from Covid-19
Personal health and protection from Covid-19
Political
Trust in science/scientists/doctors

The following opinion categories were derived as opposed to vaccination:

Abiding others' wishes
Anecdote of acquaintance with bad outcome/side effect
Belief that the vaccine is unnecessary
Covid-19-specific fears/uncertainties
Disbelief in the reality of the pandemic
Distrust of institutions
Distrust of science/scientists/doctors
Efficacy concerns

Fear of institutional/government ill-intent
Fear of long-term side effects of vaccination
Fear of short-term or immediate side effects following vaccination
Fear of vaccine-induced infertility
General distaste
General fears/uncertainties, avoidance of all vaccines
Lack of motivation or priority placed on getting vaccinated
Mandate-based
Moral, ethical, and religious objections
No reason/simple refusal
Personal health
Personal freedom
Political
Prioritization of natural immunity
Specific medical concerns (ex. myocarditis, seizures, blood clots)
Speed of vaccine development and/or testing concerns
Vaccine inaccessibility

In a broader sense, most of the categories boil down to fear-based objections, ideological objections, contrarianism or apathy, objections based on lack of perceived necessity, and political objections. A major subset of fear-based objections was based upon the fear of medical side effects. These concerns are not entirely unreasonable; there is data to suggest that the risk of myocarditis is increased in adolescent males following the second dose of the Pfizer vaccine,[2] and the Janssen vaccine was briefly withdrawn from distribution following concerns about an increased risk of blood clots following vaccination, though the withdrawal was made out of an abundance of caution.[3] Additionally, for people concerned about feeling sick or missing a day of work for side effects, there is abundant evidence to show

[2] Matthew E. Oster et al., "Myocarditis Cases Reported After MRNA-Based COVID-19 Vaccination in the US From December 2020 to August 2021," *JAMA* 327, no. 4 (January 25, 2022): 331–40, https://doi.org/10.1001/jama.2021.24110.

[3] David K. Shay et al., "Safety Monitoring of the Janssen (Johnson & Johnson) COVID-19 Vaccine - United States, March-April 2021," *MMWR. Morbidity and Mortality Weekly Report* 70, no. 18 (May 7, 2021): 680–84, https://doi.org/10.15585/mmwr.mm7018e2.

that is not an unreasonable fear. Reasons such as this, based on effects known to be short-term, ultimately reflect personal priorities.

Notable verbatim excerpts from pilot study responses are as follows:

(Some responses have been lightly edited for clarity.)

In favor of vaccination, firsthand:

> "I work in healthcare and am exposed to Covid."
>
> "[To] protect myself, my family, and others."
>
> "The risks of the virus seemed to outweigh the risks of the vaccine. Since I never got the virus I wanted to be protected from it."
>
> "I don't want to get Covid again."
>
> "[I was] worried about the long-term effects of Covid."
>
> "Being able to participate in normal activities and go places without restrictions…"
>
> "To do my part for public health."
>
> "So I don't die or kill my loved ones."
>
> "Preventing serious health effects from the Covid-19 virus for myself and making me less likely to get infected/infect others."
>
> "I didn't want Baylor to Covid test me twice a week."
>
> "My family wanted me to get vaccinated."
>
> "I wanted to be like Christ, accepting possible danger to myself for the benefit of others."
>
> "...It felt obvious that everyone would get vaccinated after the amount of death and suffering of the past year."

"I've lost someone from Covid and if she had the opportunity, she would have been vaccinated. No one should take that opportunity to save lives for granted."

"Don't want to lose tastebuds."

"So that I don't have to worry about getting quarantined or wearing a mask when I don't need to."

"It's my civic duty."

"To take care of others and love them like Christ."

"[I] feel a social responsibility to others [and] an "all in it together" mentality. Also, the people who developed this vaccine have years upon years of education and training, and I, a college sophomore, am not one to question them."

In favor of vaccination, secondhand:

"So that they won't get tested as often at Baylor, or if they are old."

"I believe in science."

"It's how we can love our neighbors."

"Mainly [the] reasons [of] travel, family, and fear of contracting Covid-19."

"Freedom."

"It's the morally right thing to do. It's a responsibility as someone working in healthcare. If scientists and healthcare professionals around the world trust it I should as well."

"To keep others safe. You already get other vaccines so just get this one."

"Their health and the safety of others around them. So they can travel outside of the country. [Vaccination is] required by their workplace. So they can be around elderly family members and friends. To help the country build immunity and so that they can get back to a sense of normalcy."

"To protect loved ones. It's the right thing to do. Because they were told to."

"[They] need it to keep a job."

"It's FDA approved. It's the right thing to do. You have to have one to travel and go anywhere. As protection for family members or themselves."

"Some are genuinely concerned about getting Covid themselves or giving it to someone they love, others just want to get out of the testing/quarantine requirements for unvaccinated people."

"Fears surrounding long term effects of COVID–loss of taste and smell."

"Herd immunity."

"All the science shows it is effective against the spread of coronavirus."

In opposition to vaccination, firsthand:

"I didn't want the Biden prick."

"I didn't react well to vaccines in the past and when I got Covid, I was almost asymptomatic. The only symptom was congestion, which I thought was my normal allergy flare-up until my friend called me and told me she had tested positive."

"I have natural immunity from Covid-19 which has been proven incredibly effective against the virus. Additionally, some of the vaccine's side effects are troubling along with unknown long-term effects. I believe people should evaluate their own health before making medical decisions, whether those evaluations lead them to get the COVID-19 vaccine or not."

"I am not comfortable with receiving it. I am uncomfortable with how much it is being forced onto people with bribes and free shots left and right and up and down streets. I would need to see the long-term effects, not just over 6 months or a year, of how it affects people. I have heard too many horror stories about people who received it. I have built immunity from contracting COVID. Based on different opinions given by different physicians, there is too much uncertainty for me to get it."

"My initial reasons for waiting to get the vaccine were based on health concerns. It was a bad idea to put the ingredients in my specific body because my body has a history of reacting negatively to foreign ingredients. I was planning on waiting on getting the vaccine until there

was more information on how people with a similar bodily constitution to me reacted to it. As such, my first basis was not political. However, as the months have progressed, I've seen increased mandates and a use of emergency executive power in a way I feel is unethical. The paternalism of forcing people to make a health decision (even if it's in the name of public good) is an invasion of personal autonomy in my opinion. I despised anti-vaxxers early on for being petty and attention-seeking, but I've come to realize that this process is not playing out in a just manner. The levels of coercion ethically outweigh the benefits. The ends do not justify the means."

"The unknown, I guess."

"I was nervous to get a vaccine which was so new– we could not possibly know the full extent of its potential medical ramifications at the time it was released. I was also [hesitant] to take a vaccine that was so politicized and promoted without question by the Left."

"Just the newness of it."

"I was only hesitant because I felt like there was a lot of political controversy surrounding what I thought to be a health issue, and all of the misinformation made it hard to know whether or not the vaccine was genuinely safe."

"People often say that it's what the scientists say should happen, and I believe that trusting the expertise sample size of just general pandemic researchers and specific immunization experts ignores healthcare physicians that know how to contextualize health changes in the body's overall ecosystem. Our bodies are incredibly complicated, and we cannot look at any health issue in isolation without knowledge of how it effects every body system and balance. Mandating vaccination on that basis of immunization knowledge alone, without existing research or even consultation on its holistic effects (e.g., effects on the microbiome, effects on thyroid, etc.) is an irresponsible use of political power. Politicians should not be doing the work of doctors without fully established a priori medical knowledge."

One individual stated that their parents would stop supporting them financially if they were to be vaccinated.

In opposition to vaccination, secondhand:

“They [source of secondhand information] want to ‘do their own research’.”

“They think it’s a form of government control.”

“They don’t believe the pandemic is real.”

“They were concerned about embryonic stem cells in the Johnson & Johnson vaccine.”

“[They] don’t trust the vaccine yet because it’s too early to tell the side effects in future years.”

“For lack of a convincing reason to do otherwise.”

“I don’t like medicine.”

“Vaccines cause autism.”

Indicated that those who object do so because they “don’t want to be sheep.”

“There have been numerous reasons that I have heard others decline to take the vaccine. I have heard people say it will "magnetize" you. I have heard that it contains a chip that will control you. I have heard that it has not been tested properly and will severely alter our genetic code. I have heard that the vaccine will result in more death and population control from world governments.”

“The long-term effects are unknown, [the vaccine] resembles the Mark of the Beast since states are banning unvaccinated people to go places they were once able to…they would rather build natural immunity, [and] they don't know what they are being injected with.”

“They know that they are healthy and would rather not put something in their body that they don't need.”

“There are legitimate concerns about the unknown and long-term effects, especially in females, that, despite our best testing, simply cannot be known for several years.”

“One friend told me he was not going to get vaccinated because he did not want his child to have three arms. Another told me they don't need it because COVID is just the flu. Many have told me that it violates their freedom. Many say they don't even know why not.”

> "Heart inflammation, seizures, the embryos used in its development, censorship around any side effects, the rush for FDA approval, the profit for pharmaceutical companies, how it wasn't as effective as expected."
>
> "They care for no one else's life."
>
> "It's experimental. It alters your DNA. It makes you magnetic. They want to take the wait-and-see approach. It makes you infertile."

Survey Data, Primary

The primary survey garnered 352 complete responses. This sample size of 352 comprises approximately 1.7% of the 20,626 reported Baylor University students in the Fall of 2021. While the survey was open to all undergraduate and graduate students at Baylor, all but five responses were from undergraduates. The primary survey was distributed by e-mail to program directors and department heads for all major undergraduate areas of study with the request to send it to the students in their departments. Graduate program directors were not as accessible by email, so the survey's exposure was mostly to undergraduates. The 347 undergraduate responses to the primary survey make up 2.3% of the undergraduate student population of 15,191.[4]

Of the 352 complete responses to the initial full-length survey, 278 respondents (78.98%) were fully vaccinated against Covid-19, 62 respondents (17.61%) were unvaccinated, and 12 respondents (3.41%) chose not to answer the question about their vaccination status. At the time of this writing, 80.4% of Baylor

[4] "Profile of Undergraduate Students: Fall 2020 and Fall 2021," IR Series (Baylor University Office of Institutional Research, Waco, Texas: Baylor University, September 13, 2021), https://www.baylor.edu/ir/doc.php/382061.pdf.

University students are vaccinated and 19.6% are unvaccinated.[5] The marginally lower percentage of unvaccinated survey respondents compared to the Baylor student population at large may be attributed to a number of factors, not the least of which is a possible nonresponse bias due to fear of sharing vaccination status. Further illustrating this point, most respondents who chose not to disclose their vaccination status selected only "reasons opposed to vaccination" and no "reasons in favor of vaccination" when asked what considerations have factored into their decision to be vaccinated or not; it is possible that many of the "choose not to answer" respondents were unvaccinated students not counted in the final percentage. If all the respondents who did not disclose their vaccination status were indeed unvaccinated, the percentage of unvaccinated respondents would be 20.7%, but this figure is mere speculation.

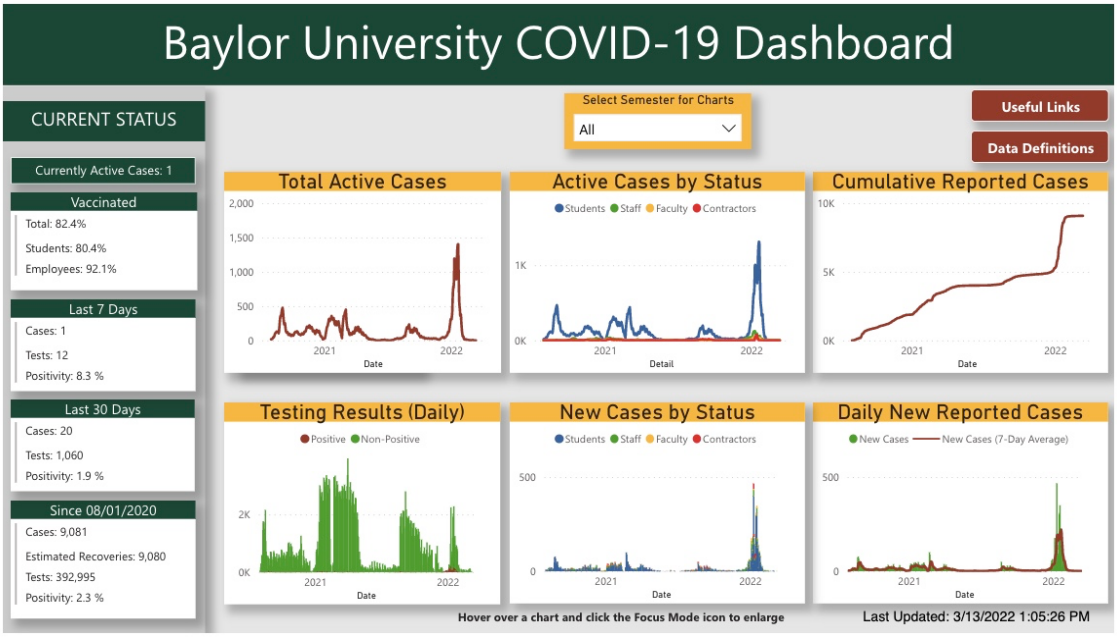


Figure 12: Baylor's Covid-19 Dashboard depicting case numbers and vaccination percentages.

[5] *Figure 12:* "Baylor Coronavirus Dashboard," Baylor University, March 13, 2022, https://www.baylor.edu/coronavirus/index.php?id=972342.

The most common reason cited in favor of vaccination was protecting oneself from Covid-19 disease; 78.8% of vaccinated respondents selected this reason. The second most cited reason was the protection of loved ones (71.7%), and the third was the protection of vulnerable and immunocompromised individuals (66%). Each vaccinated respondent, as well as those who indicated intent to be vaccinated, was asked what their primary reason(s) were for getting vaccinated and were able to select all reasons that applied to them. Most individuals selected multiple reasons, and many selected all of them; 97.12% of respondents (all but 8) selected more than one reason, indicating multifactorial decision-making.

For the majority of respondents who selected only one reason, that reason was based on University pressures toward vaccination. These included avoiding mandated testing, feeling Baylor was pushing them to be vaccinated in general, and protecting other Baylor students.

The least commonly cited reason to get vaccinated was "public figures encouraged vaccination"; only 34 respondents (12%) selected this choice. The second least-commonly cited reason was "government officials encouraged vaccination," with 19.8% selecting that choice. Interestingly, some of the answers to the pilot survey opposing vaccination involved not wanting to behave "like sheep" or follow government orders for their own sake, insinuating (and sometimes outright stating) that those who willingly receive a Covid-19 vaccine are weak-minded or "brainwashed" by Dr. Anthony Fauci or the government at large. The survey data says otherwise; less than 20% said that government officials or public figures played any role in their decision to be vaccinated and *no one* chose either of

those things as their only reason. This marks a potentially major difference between the vaccinated and unvaccinated points of view, explaining some of the miscommunication and misunderstanding between the two populations.

Of the 62 unvaccinated respondents, 46 (74.19%) indicated that they had no intent to ever be vaccinated. 8 were undecided about whether they would be, and 8 indicated that they intended to be vaccinated. In the same way the vaccinated respondents were asked about their reasons for getting vaccinated, the unvaccinated respondents who indicated no intent to be vaccinated (the "Hard Nos"/refusals) were asked for their reasons why not. The most commonly reported reason for not receiving a Covid-19 vaccine was "I am worried about unknown or long-term side effects." Second, third, fourth, and fifth were "I feel the vaccine is being forced on me," "I have concerns about the newness of mRNA vaccines or the speed with which they were developed," "I believe there has been an abuse of presidential power to mandate vaccination," and "I would rather build natural immunity to the virus than get vaccinated," respectively. Of the five most common reasons cited in opposition to vaccination, two can be categorized as fear-based, but particularly within the subset of medical concerns. One was political, one was in defense of personal medical freedom, and one was science-based.

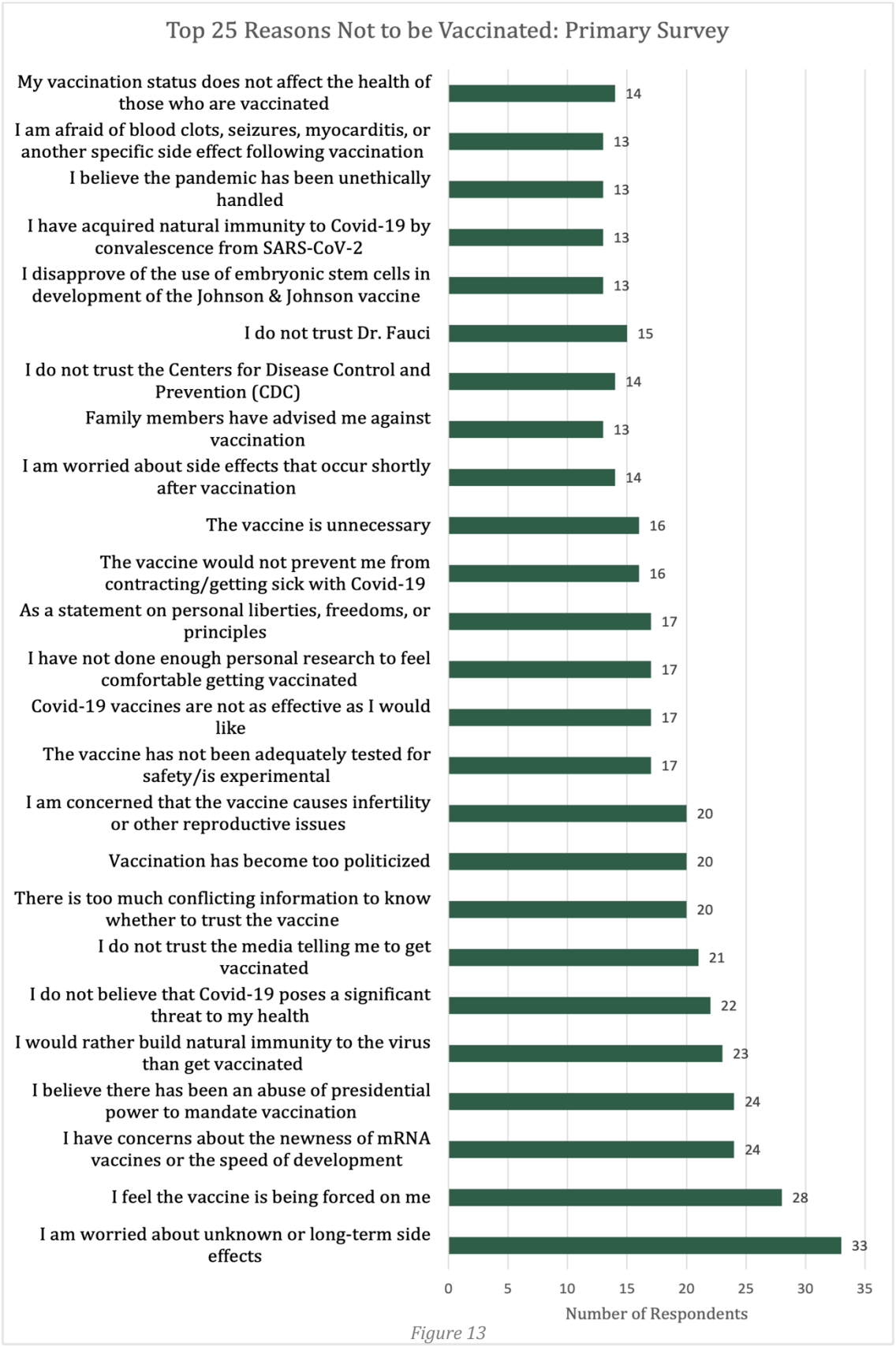

Top 25 Reasons Not to be Vaccinated: Primary Survey
My vaccination status does not affect the health of those who are vaccinated
14
I am afraid of blood clots, seizures, myocarditis, or another specific side effect following vaccination
13
I believe the pandemic has been unethically handled
13
I have acquired natural immunity to Covid-19 by convalescence from SARS-CoV-2
13
I disapprove of the use of embryonic stem cells in development of the Johnson & Johnson vaccine
13
I do not trust Dr. Fauci
15
I do not trust the Centers for Disease Control and Prevention (CDC)
14
Family members have advised me against vaccination
13
I am worried about side effects that occur shortly after vaccination
14
The vaccine is unnecessary
16
The vaccine would not prevent me from contracting/getting sick with Covid-19
16
As a statement on personal liberties, freedoms, or principles
17
I have not done enough personal research to feel comfortable getting vaccinated
17
Covid-19 vaccines are not as effective as I would like
17
The vaccine has not been adequately tested for safety/is experimental
17
I am concerned that the vaccine causes infertility or other reproductive issues
20
Vaccination has become too politicized
20
There is too much conflicting information to know whether to trust the vaccine
20
I do not trust the media telling me to get vaccinated
21
I do not believe that Covid-19 poses a significant threat to my health
22
I would rather build natural immunity to the virus than get vaccinated
23
I believe there has been an abuse of presidential power to mandate vaccination
24
I have concerns about the newness of mRNA vaccines or the speed of development
24
I feel the vaccine is being forced on me
28
I am worried about unknown or long-term side effects
33
0
5
10
15
20
25
30
35
Number of Respondents

Figure 13

The least-cited reasons of the 58 possible choices were "I do not have access to Covid-19 vaccination" and "the vaccine is inconvenient to obtain." Only one respondent selected the latter and no one selected the former. This is likely due to the ease with which Baylor students can get vaccinated free of charge on campus; in this way, Baylor student responses may differ from other populations who may not have the ease of access that students do. On the other hand, vaccination has been free in many drugstores and clinics in most areas for some time, so the difference may be less significant than theorized. It is a matter of great interest that some individuals stated that they would not be vaccinated because it was *too easy* to obtain the vaccine—as demonstrated in the excerpts pulled from the pilot study, some respondents indicated unease about vaccination for this very reason.

Those who indicated they were unvaccinated and undecided about whether they should seek vaccination were presented with all of the reasons for and against vaccination in their survey. Of the 8 unvaccinated respondents who were undecided, 7 stated they were worried about unknown or long-term side effects of vaccination; this was their most-picked reason opposing vaccination and their most-picked reason overall. The most-picked reason in favor of vaccination was for "the pursuit of herd immunity/to end the pandemic."

The undecided are a particularly relevant demographic because they, by their own admission, can be swayed one way or the other and do not hold dead-set opinions. It is telling that the undecided respondents' number one reason opposing vaccination was the same as their refusing counterparts: being worried about unknown or long-term side effects.

Of the 357 respondents, 148 indicated a Republican or Lean Republican political affiliation, 102 indicated Democrat or Lean Democrat, and 107 indicated No Lean. 94% of Democrat-leaning respondents and 85% of respondents indicating no political lean were vaccinated. On the other hand, only 64% of Republican-leaning respondents were vaccinated, and Republicans made up the majority of refusals/"Hard Nos" who indicated no intent to be vaccinated.

Survey respondents were overwhelmingly female, with 234 women (65.7%) responding as compared to 122 men (34.2%). However, the Baylor student population at large is about 60% female and 40% male, so the disparity in survey responses may be attributed in part to the population that was sampled.[6] Despite the disparity in responses, 79.5% of both women and men were vaccinated, so there was no significant difference between vaccination rates among men and women demonstrated in this study.

The mean age of vaccinated respondents was 20 years while the mean age of unvaccinated respondents was 19. However, four outliers (two students aged 24, one aged 29, and one aged 48) were vaccinated, driving the average age of vaccinated respondents up. With outliers excluded, the mean age of vaccinated respondents was 19.35 with unvaccinated being 19.28, specifically. With this in mind, there was no substantive difference in mean age between vaccinated and unvaccinated respondents.

[6] "Profile of Undergraduate Students: Fall 2020 and Fall 2021."

Students who responded to the primary survey self-reported their major area of study. In total, there were 70 reported majors among respondents.[7] The most common major for vaccinated respondents was biology, with health science studies, psychology, nursing, and medical humanities close behind. The most common major for unvaccinated respondents was nursing; nursing students made up 16% of the unvaccinated participants.

281 of 352 primary survey respondents (79.83%) identified themselves religiously as some form of Christian. 55 of the 62 unvaccinated respondents (88.71%) identified themselves as Christians. Of the 46 refusals (those who indicated no intent to be vaccinated), 42 were Christians (91.30%). Not enough data was obtained to be able to confidently ascertain why such a high percentage of unvaccinated respondents were Christians, but some likely contributing factors are Baylor's high proportion of Christian students,[8] the fact that religious reasons opposing vaccination were predominantly based upon Christian beliefs, and the correlation between Christian faith and conservative political affiliation in the United States.[9] Covid-19 vaccination has become highly politicized, as supported by the political demographic data from the primary survey, and Republican

[7] Baylor University offers around 115 undergraduate majors. "Majors & Minors," Undergraduate Admissions | Baylor University, 2022, https://www.baylor.edu/admissions/index.php?id=871985.

[8] "Profile of Undergraduate Students: Fall 2020 and Fall 2021."

[9] Michael Lipka, "U.S. Religious Groups and Their Political Leanings | Pew Research Center," Pew Research Center, February 23, 2016, https://www.pewresearch.org/fact-tank/2016/02/23/u-s-religious-groups-and-their-political-leanings/.

respondents were considerably more likely to be unvaccinated than self-reported Democrats.

270 of 352 primary survey respondents reported that they were White (63.35%)[10] with 47 of those respondents indicating they were of Hispanic, Latino, or Spanish descent. 10 more respondents fell under this category but did not select White as their primary racial identification; in total, Hispanic, Latino, or Spanish students made up 16.19% of respondents. 47 students were of Asian descent (13.35%), 13 were Black/African American (3.69%), 3 were American Indian/Alaskan Native (0.85%), 2 were Native Hawaiian or Pacific Islander (0.57%), and 17 indicated more than one race (4.83%). 203 White respondents were vaccinated (75.19%), 53 were unvaccinated (19.62%), and 14 chose not to answer (5.19%). 46 Asian respondents (all but one) were vaccinated. 9 of the 13 Black/African American respondents were vaccinated and 4 were not.

Some student majors were reported more often than others. While this likely reflects the unequal distribution of majors in undergraduate programs at Baylor to an extent, it may also reflect a degree of bias in distribution or response. As noted, the primary survey was distributed to undergraduate program directors and heads of University departments. It can be assumed that not all program directors who

[10] Demographic reports separated White from Hispanic/Latino students, so this figure represents White respondents with no Hispanic, Latino, or Spanish heritage so as to be comparable to the available information for analysis.

were contacted distributed the survey, thus those who did distribute it had their subject of study more strongly represented in the sample population.

Annual household income was requested in the demographic questions in the primary survey, but results did not prove valuable due to wide differences in what students reported as their main source of financial support; some included their parents' income while others did not, making it unclear how to approach this data, thus it will not be discussed further. While students undoubtedly come from a variety of socioeconomic backgrounds (and future research would do well to focus on this fact), their presence on Baylor's campus serves as a sort of equalizer in terms of vaccination, in large part due to the availability of Covid-19 vaccines free of charge at the University Health Center.

The sample of students surveyed is believed to be representative of the Baylor undergraduate student population. Though the sample size was relatively small, the vaccinated to unvaccinated respondent ratio as well as the gender breakdown were very similar to demographic and Covid-19 information posted by the University. Participants were from a wide variety of majors and classifications, and the most strongly represented majors in the survey data (biology being number one) are the most highly populated undergraduate majors at Baylor. In terms of racial demographics, Baylor University reported in the Fall of 2021 that 38.4% of students were of minority descent.[11] According to study data, 36.65% of respondents were minority students. With all these things considered, the data

[11] "Profile of Undergraduate Students: Fall 2020 and Fall 2021."

gathered from this survey seems to be a fair representation of the Baylor student body at large.

Survey Data, Secondary

Of 99 responses to the secondary/follow-up survey, 81 were vaccinated (81.81%), 18 were unvaccinated (18.18%), and none chose not to answer. Only one of the 8 unvaccinated respondents from the primary survey who indicated intent to be vaccinated responded to the follow-up, but that one person did, in fact, get vaccinated. One originally undecided respondent who completed both surveys also got vaccinated.

Of the 18 unvaccinated respondents to the follow-up, 17 indicated that they do not intend to ever be vaccinated. The one remaining unvaccinated respondent had indicated no intent to be vaccinated on the primary survey but stated she was undecided on the secondary survey. She is the only participant to have changed her mind away from "no" between the two surveys. Because not all unvaccinated respondents to the primary survey completed the follow-up, there can be no confirmation that those who were initially unvaccinated and indicated intent to become vaccinated followed through. With that said, the fact that there was no demonstrated shift from "yes" to "no" could be expected, given that once a person is vaccinated, they can no longer change their mind to become unvaccinated.

While conclusions drawn from the secondary survey are of limited scope and generalizability due to small sample size, the trends demonstrated by the longitudinal data that was collected are not without value. 94.44% of unvaccinated

respondents to the secondary survey showed no sign of changing their minds about vaccination, as opposed to the 74.19% from the primary survey. While further research would be required to truly determine this trend's validity, it appears that those opposed to vaccination are holding strong in their opinions and are unlikely to be swayed. They have maintained their positions over the course of this longitudinal study. This is supported by the fact that only one person who originally had no intent to be vaccinated changed their mind, and it was only a slight change at that—from "no" to "undecided."

With the numbers in mind, there is much to consider regarding the survey data as a whole. The implications of students' answers are expansive and need to be considered on their own, then considered with all seven pre-modern and modern vaccines in mind. First, trends discovered in the data will be discussed, then those trends will be considered in context and compared with a similar study. To conclude, everything will be tied together to form one cohesive picture of vaccine hesitancy and refusal throughout time.

CHAPTER SEVEN

Discussion of Survey Results

Astute readers may have noticed that many of the reasons given for and against vaccination were essentially the same, just seen from a different perspective. For example, "personal freedom" was cited by both sides—the vaccinated for their freedom to attend events and travel, and the unvaccinated for the freedom to control one's own medical care—so is it any wonder we struggle to communicate well with one another? For another example, moral and ethical reasoning was used by both sides in this study. The vaccinated believed vaccination to be the morally or ethically right thing to do to protect other people from disease, while the unvaccinated believed refusal to be morally or ethically right because one or more aspects of vaccination or the pandemic were distinctly unethical. Both sides cited politics. Both sides cited "abiding others' wishes." Some dissenters said it is too easy to obtain the vaccine while others implied that it required too much effort. Some of those in favor of vaccination appreciated the ease of access while others saw value in having to make appointments to receive a vaccine. Perhaps most pervasive on both sides is fear; many of the vaccinated feared Covid-19, while many of the unvaccinated feared injected mRNA. It is clear that fear manifests itself in many very different ways in different people, leading to misunderstandings and difficulty in figuring out what the truth is.

One of the most comprehensive responses to the pilot survey has not yet been mentioned. This student (quoted below) did and said many things that are of note. First, they differentiated themselves from others who decline vaccination, calling some reasons irrational and implying others are not. Next, they cited ethics and gave concrete bases for refusal. Last, they declared personal liberty to be the rational reason to encompass all of these ethical issues. Their submission is as follows:

> "I've heard many people in support of the vaccine say that there are people who believe Facebook conspiracy theories about the vaccine causing magnetism, autism, or even [containing] the presence of the devil. However, I have never personally seen nor heard any of those irrational beliefs first-hand (though I'm sure there are people out there who believe such stories). I've also heard people refuse the vaccine on ethical grounds less related to partisanship or political practice. Modern medical research that we are currently using to develop vaccines is reliant on stem cells. The stem cells first used in immunology, which have since been replicated, were taken from a woman named Henrietta Lacks — without her consent. That is a medically unethical legacy. I've also heard that the stem cells used in beginning research (which have also since been replicated) were taken from fetuses (i.e., aborted babies). If these legacies are true (which I believe there is some basis for both), then choosing not to partake in receiving a vaccine is a totally acceptable and permissible exercise of personal liberty and principle."

It bears discussing that while this student, in mentioning Henrietta Lacks, was wrong about what type of cells were taken from her—they mentioned stem cells rather than cancer cells—their fundamental point about a medically unethical legacy is true. In 1951, a 31-year-old African American mother with cervical cancer had a biopsy performed at Johns Hopkins Hospital in Baltimore after presenting with severe abdominal pain. Her tumor cells became the first immortal cell line, replicating indefinitely and opening up a world of research possibilities. Henrietta Lacks was never told that her cells lived on, nor was her family told after her

untimely death to the cervical cancer she went to Johns Hopkins for help with, though the cell line was named HeLa after her initials.[1]

Mrs. Lacks' cells are not only worth mentioning for the unethical legacy they carry; they also carry a legacy of incredible discovery. The HeLa cell line has been used millions of times since the first cells were taken from Henrietta, but their first published use was in research on poliovirus.[2] Soon after, Jonas Salk used HeLa cells to test his inactivated polio vaccine. More recently, HeLa cells were used in the first study to characterize SARS-CoV-2's infectivity, which has now been cited over 9,500 times.[3]

Henrietta Lacks links pre-modern, modern, and post-modern vaccination together. In 1954, HeLa cells were used to develop the first vaccine against polio, only three years after Henrietta's death. In 1985, HeLa cells were used to figure out how HPV infection can cause cancer, making it possible to develop a vaccine against HPV, protecting the women of today from the cancer Mrs. Lacks suffered from herself.[4] In February 2020, HeLa cells were used to determine that SARS-CoV-2 invades cells using a spike protein recognized by ACE2 receptors on the cell's

[1] Rebecca Skloot, *The Immortal Life of Henrietta Lacks* (Broadway Books, 2010).

[2] William F. Scherer, Jerome T. Syverton, and George O. Gey, "STUDIES ON THE PROPAGATION IN VITRO OF POLIOMYELITIS VIRUSES," *The Journal of Experimental Medicine* 97, no. 5 (May 1, 1953): 695–710.

[3] Peng Zhou et al., "A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin," *Nature* 579, no. 7798 (March 2020): 270–73, https://doi.org/10.1038/s41586-020-2012-7.

[4] "Significant Research Advances Enabled by HeLa Cells," Office of Science Policy, National Institutes of Health, accessed April 11, 2022, https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/.

surface, paving the way toward the mRNA vaccines whose rejection is presently being discussed.[5]

HeLa cells are a stark reminder that medical history is not without its share of ethical missteps, and the student who wrote about Henrietta Lacks in their response to the pilot survey provided a reminder that many individuals who decline vaccination do so out of a sense of righteous indignation. That indignation, while not always accurately based, is not always wrong, and regardless of accuracy it is nearly impossible to *reason* someone away from a belief.

Putting survey results in context

As alluded to previously, data gathered from University students in a University setting is bound to be distinct from data collected from the general public. For one thing, those who do not attend college are not represented in this study. Furthermore, Baylor University students represent a particular University culture and demographic that cannot be generalized to all universities, especially given Baylor's Christian affiliation.

While it would be a major stretch to say that pre-modern and modern vaccine hesitancy was unconcerned with American politics, the Covid-19 pandemic and subsequent rollout of vaccines has perhaps been the most politicized of those discussed in this paper, and perhaps the most politicized ever. The state of American politics is combative and highly polarized, and this was true before the Covid-19

[5] Zhou et al., "A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin."

pandemic. It would prove enlightening to research vaccine hesitancy and refusal regarding Covid-19 in countries other than the United States—a comparison between vaccination rates and public health programs in the U.S. and in other countries could demonstrate either the profound effect of American politics on the American epidemic specifically or provide evidence to the contrary.

Survey data in this study did not indicate many typical "anti-vaxxers" (as they are colloquially called). Very few respondents selected the "I desire to avoid all vaccines/vaccines in general" option as a reason for Covid-19 vaccine refusal; only 5 of 62 unvaccinated respondents selected it (8%). This suggests that most unvaccinated respondents are not entirely anti-vaccination, but anti-Covid-vaccination.

Furthermore, individuals who are against *mandated* vaccination may have been convinced not to be vaccinated in the absence of any health concerns; the choice to remain unvaccinated "as a statement on personal liberties, freedoms, or principles" was selected by 27% of vaccine-refusing respondents to the primary survey and 35% on the secondary survey. This is not to say all respondents who cited personal liberties did so in opposition to mandates, as some may have done so for reasons related to broader medical ethics; there is no way to know for certain from the data acquired in this study what exact percentage of respondents remained unvaccinated for reason of mandates alone.

Ultimately, the reasons why some Baylor students have chosen not to be vaccinated against Covid-19 are tied strongly to context. With that said, even in as unique a context as the high-technology world of the twenty-first century, their

reasons followed certain themes that can be traced back through history. Next steps involving this research should be tied to vaccine education strategies that can be implemented to target students' concerns specifically.

A number of vaccine education strategies and interventions have been attempted in the past. These include the teaching of adolescents about the dangers of vaccine-preventable diseases, the teaching of medical students about vaccine safety, better enabling them to counsel patients, and publishing information in traditional print media and online. Additionally, college student-based educational interventions are of note. In studies from 2020 and 2022, the adolescent and medical student interventions proved effective—students' communication skills about vaccines improved in both medical and grade-school students. The noted interventions were focused on education about the HPV and MMR vaccines. The study on adolescents was performed in Ontario, Canada, while the medical student study was performed in the United States.[6,7]

In the study on education of pre-clinical medical students, students completed a self-study module and then an interactive lesson. After both interventions, "significant improvements" were reported in the students' ability to counsel patients on vaccines and their comfort level with doing so. However, when these students were tested on their knowledge a year after the intervention by

---

[6] Arati Kelekar et al., "Vaccine Hesitancy Counseling-an Educational Intervention to Teach a Critical Skill to Preclinical Medical Students," *Medical Science Educator* 32, no. 1 (February 2022): 141–47, https://doi.org/10.1007/s40670-021-01495-5.

[7] Jaymie-Lynn Blanchard et al., "A Pre and Post Intervention Study Measuring the Effect of Interactive Education on Adolescent Perceptions of Vaccines, Vaccine Safety and Disease Risk," *Journal of Public Health (Oxford, England)* 42, no. 3 (August 18, 2020): e272–77, https://doi.org/10.1093/pubmed/fdz089.

obtaining a patient history, 72.6% asked about vaccinations but only 36.3% were able to appropriately counsel the patient on vaccine hesitancy, and 63.7% provided no counseling at all.[8] This suggests that while there is an immediate benefit to interventional vaccine education for medical students, it may not translate well into clinical practice, suggesting a need for an official curriculum on vaccine counseling. According to a 2020 study published by the Oxford University Press, medical students who were asked about their opinions on Covid-19 vaccination replied generally favorably, but 23% were unwilling to be vaccinated against Covid-19 immediately after FDA approval. Of those who were willing to be vaccinated immediately, "[they] were more likely to trust public health experts, had fewer concerns about side effects and agreed with vaccine mandates."[9]

In January 2022, a statewide study on Nevada college students' Covid-19 vaccine opinions was published.[10] This study is particularly enlightening regarding the topic of this study on Baylor University students because the questions the Nevada students were asked were extremely similar and a large sample was obtained. Researchers sent an electronic survey using the Qualtrics system by email to all active students at six major universities in Nevada in February and March 2021. 3.9% of students who received recruitment emails responded and the

---

[8] Kelekar et al., "Vaccine Hesitancy Counseling-an Educational Intervention to Teach a Critical Skill to Preclinical Medical Students."

[9] Victoria C. Lucia, Arati Kelekar, and Nelia M. Afonso, "COVID-19 Vaccine Hesitancy among Medical Students," *Journal of Public Health (Oxford, England)* 43, no. 3 (September 22, 2021): 445–49, https://doi.org/10.1093/pubmed/fdaa230.

[10] Leslie Elliott and Kanyeemengtiang Yang, "Vaccine Acceptance and Hesitancy among College Students in Nevada: A State-Wide Cross-Sectional Study," *Vaccines* 10, no. 1 (January 11, 2022): 105, https://doi.org/10.3390/vaccines10010105.

majority of responses were from undergraduates (82.3%). Being that the Nevada survey was distributed early in 2021, only 18.9% of student respondents were vaccinated.

23.5% of respondents to the Nevada survey indicated hesitancy to receive a Covid-19 vaccine. 60% of hesitant respondents indicated they were "very reluctant" to be vaccinated. The following excerpts from the published article on the Nevada study are of great relevance:[11]

> "Students who were reluctant to be vaccinated expressed concerns about vaccine side effects (67.3%), the need for more COVID-19 vaccine research (74.3%), and being suspicious of vaccines in general (25%)...At the same time, these students reported a desire to protect themselves (15.4%), their friends and family members (16.8%), and to "help get things back to normal" (16.2%)."
>
> "The more popular sources for obtaining information about health or COVID-19 were the CDC or other public health agency (34.3%) and social media (20.7%), followed by television and family or friends. Compared with non-hesitant respondents, vaccine hesitant respondents were less likely to rely on public health agencies and the newspaper for health information and were more likely to rely on employers and clinics or doctors' offices. Vaccine hesitant respondents were over four times more likely to report that they relied on "no one" and nearly three times more likely to rely on "other" sources."
>
> "The investigators received numerous responses from the recruitment emails complaining about COVID in general and stating displeasure at receiving a survey about it, reflecting the overall fatigue most universities are observing among their students. During the previous fall semester, institutions sent numerous surveys to students about their experiences with online education after the mode of delivery had pivoted for all on-campus students. These surveys also had low response proportions, and we hoped that sending the survey early in the spring semester would yield a higher response since it was separated from the previous surveys. Because all surveys to the students had low responses, it is unlikely that the results of this survey reflect non-response bias related to the outcomes being measured. Despite the apparent low

[11] Elliott and Yang.

> response proportion, however, the large sample size allowed meaningful comparisons among groups."
>
> "Although our study did not ask about trust in government, high confidence in government and ongoing awareness efforts were reasons cited for a high level of acceptance in Saudi Arabian students, while recommendation by government was identified as a reason for vaccine refusal and hesitancy in American students."

Responses by Nevada college students in February and March 2021 strongly parallel responses by Baylor students in late 2021 and early 2022, sometimes to the word. This may lend credence to the data obtained from Baylor students and indicate its generalizability to other American college students. As for the section in the Nevada study on students' sources for health and Covid-19 information, while the Baylor study did not contain a quantifiable question on the subject in the primary or secondary surveys, respondents to the pilot study did occasionally indicate sources of information; these responses are also in line with the Nevada data, though Nevada's is more illustrative and can provide strong insight into educational strategies that should be implemented for college-aged students in particular.[12]

Based on the discussion portion of the Nevada study, vaccine mandates for Covid-19 were only considered after incentivization did not prove effective enough. In the pilot study of Baylor students, some indicated that they were uncomfortable with the high availability of vaccines and the number of incentives offered for vaccination, finding these practices suspicious and stating that if the vaccine were safe enough, incentives would be unnecessary. On the other hand, other

[12] Elliott and Yang.

respondents to the pilot indicated dislike for the mandates implemented when incentives did not work. Nevada researchers concluded that the most effective educational interventions for college students would be based on specific groups and specific concerns; a simple one-off strategy was not recommended due to the variety of reasons for vaccine hesitancy. While this strategy would prove much higher-effort than a universal vaccine education program, it would seemingly prove much more effective.

CHAPTER EIGHT

Conclusion

The reasons cited by Baylor University students for choosing not to be vaccinated against Covid-19 can be paralleled (almost verbatim in some cases) by the opinions of those who have denied vaccines in the past all the way back to the 1850s. The main reasons, if placed into very broad categories, are as follows: fear-based, ideological, politics-based, based on lack of perceived necessity, and apathy or contrarianism-based. As demonstrated in prior chapters, all five of these categories of objections can be traced back to smallpox. In the same way vaccines are not all the same, there has not simply been one unified anti-vaccination movement since smallpox. Rather, objections to individual vaccines reflect the concerns of their time. Even so, vaccine hesitancy is not something that has sprung up overnight, nor exclusively in the decades since vaccines were erroneously linked to autism; the phenomenon is strongly rooted in American history. This makes addressing it at best an uphill battle and at worst an unwinnable chess match.

Because reasons for hesitancy are extremely varied, there is no one answer to every concern—there are many concerns based upon misconceptions that can be corrected with education from a trustworthy source, but many others that are not refutable, either because they are rooted in fact or because they are rooted in belief. One thing that can be said for certain is that addressing every "anti-vaxxer" the same way is at best ineffective and at worst detrimental to public health at large. As

demonstrated in the pilot study, individuals who avoid vaccination based on health concerns do not want to be lumped in with those who are politically motivated, and vice versa. Those who oppose Covid-19 vaccination specifically do not want to be associated with the "vaccines cause autism" crowd. Because there is little to no unity among modern "antivaccinationists" themselves, and in fact many do not think of themselves as "anti-vaccine", it would be unwise for governing bodies and health authorities to consider them all jointly. Speaking to all unvaccinated individuals in the same superficial way breeds resentment and sets these people at odds with those promoting vaccination; we must keep in mind that when people do not feel heard, they do not feel inclined to listen.

Though the vaccine-hesitant cannot be rightly placed into one group and addressed the same way, there *are* common threads of motivation and analogy that unify most of them. One important unifying theme throughout the history of vaccines is that people fear change and new technology. Most stated reasons to avoid vaccines can be boiled down to this fear. Another theme is that of resistance to authority, which in some (but not all) ways can be linked to fear. This is not to say that fear is a bad thing—fear is a protector. For this reason, a major key to reaching people could be to differentiate between which fears can be addressed and which cannot and focus on the former.

Of note is the fact that many opponents to Covid-19 vaccination approach the discussion with an assumption that the situation we, and they, are in is entirely new and novel—the one thing it is not. mRNA vaccine technology is indeed new, as is access to the full breadth of information (good and bad) that can be found on the

internet about the pandemic, as is the technological capacity for corporate and educational life to continue isolated behind closed doors. But the facets of Covid-19 listed by Baylor students as reasons to decline vaccination, namely vaccine and mask mandates, quarantining, government involvement in vaccine development and rollouts, pharmaceutical companies' funding concerns, rushed development, widely disseminated misinformation, ethical dilemmas, and healthcare inequalities are *not new at all.*

Vaccine mandates have been around since smallpox, as have lawsuits against them. In fact, the U.S. Supreme Court upheld the constitutionality of smallpox vaccine mandates for the general population in 1905.[1] For the United States military, anthrax vaccination was mandated in the 1990s. Mask mandates and enforced quarantines have existed since the 1918 flu and smallpox, respectively. The U.S. government was heavily involved in the rollout of polio vaccination and was even cited by some citizens as an unwelcome addition to the vaccine development team. Funding for pharmaceutical companies and drug manufacturing have been a point of debate, again, since smallpox, when the "irregular physicians" advocated for patent medicines and opposed the formation of the FDA. On the other side of the pharmaceutical coin, RotaShield was abandoned when its safety was questioned, playing a part in its developing company's consolidation with Pfizer in 2009. Polio vaccines were perceived to have been rushed in their development. The MMR vaccine has been steeped in controversy since 1998 not due to inherent flaws,

[1] "Jacobson v. Massachusetts, 197 U.S. 11 (1905)," Justia Law, accessed April 11, 2022, https://supreme.justia.com/cases/federal/us/197/11/.

but due to a purposely misleading study once published in *The Lancet* connecting it to autism. In terms of ethical dilemmas, smallpox inoculation was not 100% safe, but it was performed anyway for its life-saving capabilities. Flu vaccines require the use of fertilized chicken eggs and manufacturing of the smallpox and inactivated polio vaccines involved the mistreatment of animals. The smallpox vaccine and the concept of vaccination at large has had religious opponents from its advent. The HPV vaccine has almost exclusively ethics-based dissenters citing concerns about the age at which vaccination is recommended. Lastly, Henrietta Lacks went to Johns Hopkins Hospital because it was the only one in Baltimore that would treat Black patients, with her family never being compensated for the profits made from her cells; this is a glaring example of inequality in healthcare that is connected to polio, HPV, and Covid-19 vaccination. With these examples from vaccine history in mind, the reasons why Baylor students decline Covid-19 vaccination have all been seen before. While some distinctly modern factors come into play, at their heart these reasons are long-established. SARS-CoV-2 may have been a novel coronavirus, but responses to its vaccines have been anything *but* novel.

Many objections, as demonstrated in the survey data, have tinges of "but we've never seen anything like this before!" and "this is all going to snowball." References to "these unprecedented times" are a dime-a-dozen. What if these times are, in fact, "precedented", just with a new paint job? If most of the perception of novelty were removed from the scenario, would vaccine acceptance be higher? Perhaps. On the other hand, there is an element of willful forgetting that takes place after a pandemic that is of historical difficulty to overcome; the 1918 flu is known as

"America's forgotten pandemic" for a reason.[2] Will Covid-19 be yet another mysteriously forgotten pandemic that leaves the public mind, never again to return but in the history books? Will citizens be arguing amongst themselves about whether the vaccine for the next pandemic will turn them into Wookiees, only the space smuggler they're indebted to is Big Pharma? Perhaps some of the present situation boils down to a desire to be the most unique generation in history, disguised as a fear of just that. Unfortunately, history is cyclic—can we ever *use* the knowledge that this is so? Future pandemic response and subsequent vaccine rollouts will require perspective, and perspective cannot be attained without memory of the past.

Next steps

The Covid-19 pandemic has been marked by an extreme volume of information, changing recommendations, and differing perspectives from various reputable sources of information in addition to sources more dubious. The simplest solution would be for public health authorities to all agree on what is true, believe that truth to be static and unchanging, and participate in a public press release detailing that information. Unfortunately, no facet of that plan is realistic—different authorities put forth different claims and recommendations, scientific conclusions are neither static nor unchanging, and even if everyone agreed, there would still be dissenters. After all, those who distrust government may even find it *suspicious* if every public health organization were in agreement. Scientific innovation requires

[2] Gina Bari Kolata, *Flu*. See page 39 for the full quote.

first offering, then rejecting hypotheses. The flexibility to accept that conclusions change seems to be a forgotten principle among many.

Perhaps the most indefinite part of public health is the "public" part, though it is clear that the "health" side has been somewhat irresolute as of late; perhaps it is in the nature of people to disagree with (and be suspicious of) one another. What is key is understanding. We must understand that the instinct toward self-preservation and protection of others does not present itself in the same way in every person. While there are individuals who make their Covid-19 vaccine decisions for reasons other than the preservation of life or integrity, the vast majority of reasons can be categorized under those two goals. On the primary survey, the answer choices generated from pilot study data were diverse and numerous, but even within that great variety the motivations reflected were essentially similar. There were 19 answer choices to choose from in favor of vaccination and 58 in opposition to it, and 44 of those choices can be reasonably linked to the preservation of life or integrity (whether the respondents' or someone else's.) This includes most fear-based reasons. These answer choices, reflecting very similar motivations, made up about 57% of reasons combined between pro-vaccination and anti-vaccination answers. In short, while the personal reasoning behind vaccination decisions varies wildly, the motivations behind that reasoning do not, and those motivations have been nearly the same since the dawn of the "Vaccine Age." While every vaccine has its own unique context surrounding it, at their heart they are *all* "new technology" in a "new age" at time of release, and in that way, they *are* all the same.

With the breadth of misinformation and conjecture that presents itself so prominently on social media and elsewhere on the internet, it can prove exceedingly difficult for individuals without a science background to arrive at the truth. For those who know the basics of how vaccines work and how disease spreads, the misinformation appears as just that, but the people it is most convincing to are the ones who end up sharing that misinformation and passing it on until it is several degrees removed from the actual truth, or sometimes does not even resemble it. It has been said that we are experiencing an "infodemic"—too much information from too many people, especially those completely uneducated on the topic at hand, making it difficult to know who to trust if one does not have a science background.

It has been suggested that primary care physicians, nurses, and other frontline healthcare workers need to be on the same page regarding information on vaccines and their use; of late this has seemingly not been the case. According to the article *Identifying and Addressing Vaccine Hesitancy* from April 2015, people most trust their personal physicians to direct their decisions on vaccination and healthcare providers are the most important predictor of vaccine acceptance.[3] Despite the fact that many cited reasons in this study to refuse vaccination were not directly tied to concerns about vaccine safety, the most common one was. Furthermore, many of the seemingly unrelated reasons *were* related to trust—not knowing who to trust, not trusting large institutions, or not trusting the intentions behind vaccination, to name a few—and the trust inherently placed in a personal

[3] Lori A. Kestenbaum and Kristen A. Feemster, "Identifying and Addressing Vaccine Hesitancy," *Pediatric Annals* 44, no. 4 (April 2015): e71-75, https://doi.org/10.3928/00904481-20150410-07.

physician is one that may be leveraged. That said, the information given to physicians must be accurate and these physicians must be open and honest with their patients, lest the entire medical profession be sidelined by hesitant individuals as yet another untrustworthy, censored institution.

Survey data suggests that an emphasis should be placed upon disseminating correct information from a variety of sources rather than heavily censoring misinformation. Telling people that they cannot publicly ask questions about vaccines and simultaneously suppressing misguided posts on social media platforms leads to the oft-heard cries of censorship and consequent refusal to abide by guidelines that have become so characteristic of Covid-19. Telling people they cannot share their ideas often only makes them want to believe those things more staunchly and share them via other avenues that cannot be monitored so closely. In essence, perhaps the "good" should be piled on among the "bad," taking a proactive stance rather than a reactive one. Though not everyone can be expected to correctly differentiate between factual and incorrect information all of the time, ready availability of information and right guidance may soften some of the hesitant toward vaccination, perhaps particularly those who are wary of being "duped" or coerced into something they have not been given sufficient context to understand.

For Baylor University students in particular, educational resources on vaccines should be directed toward addressing prominent concerns individually rather than issuing a blanket statement to "get vaccinated!" As a society, we need to look back on the vaccines of old, adjust our public health agendas to the current age, and utilize hindsight to develop a plan for today and for the next pandemic.

APPENDIX 1-1

Pilot Study Survey Instrument

Each of the three surveys included a consent form to be read prior to the display of any questions, as required by Baylor University's Institutional Review Board.

Q1 At this time, have you been fully vaccinated against SARS-CoV-2, the virus that causes Covid-19 disease? ("Fully vaccinated" indicates you have received both doses of the Pfizer/Moderna vaccine or the single-dose Johnson & Johnson vaccine at least two weeks ago.)

- Yes
- No
- Partially vaccinated, with intent to complete vaccination
- Partially vaccinated, without intent to complete vaccination
- No, but I want to get vaccinated

Q2 What were/are your primary reasons for getting vaccinated?
(Displayed to those who answered "Yes," "Partially vaccinated with intent to complete vaccination," or "No, but I want to get vaccinated" to Question 1.)

_____

_____

Q3 What were/are your primary reasons **not** to be vaccinated/complete vaccination?
(Displayed to those who answered "No," or "Partially vaccinated, without intent to complete vaccination" to Question 1.)

_____

_____

Q10 Do you/did you have any hesitancy regarding vaccination?
(Displayed to those who answered "Yes," "Partially vaccinated with intent to complete vaccination," or "No, but I want to get vaccinated" to Question 1.)

- Yes
- No

Q11 What were/are your apprehensions?
(Displayed to those who answered "Yes" to Question 10.)

_____

_____

Q4 What reasons have you heard **others** give to get vaccinated? Include as many as you would like.

_____

_____

Q5 What reasons have you heard **others** give to **decline** the vaccine? Include as many as you would like.

_____

_____

You have reached the end of this survey. If you would like to edit your responses, use the back button to navigate through the questions again before continuing.

- I understand and wish to submit

APPENDIX 1-2

Primary/Initial Survey Instrument

Q1 This is a longitudinal study, meaning you will be re-contacted during the Spring 2022 semester for a brief follow-up. Your Baylor email is requested for re-contacting purposes only.

What is your Baylor email address?

_____

Q2 What gender (sex) do you identify as?

- Male
- Female
- Choose Not To Answer

Q4 What is your primary racial identification?

- White (including Europe, the Middle East, or North Africa)
- Black/African American
- American Indian or Alaskan Native
- Asian
- Native Hawaiian or Other Pacific Islander
- More than one race (please specify) _____

Q5 Do you identify as Hispanic, Latino, or of Spanish origin?

- Yes

- No

Q6 What is your age (in years)?

_____

Q7 What is your annual household income? For students, answer based on where you receive most of your financial support.

- Less than $10,000
- $10,000 - $19,999
- $20,000 - $29,999
- $30,000 - $39,999
- $40,000 - $49,999
- $50,000 - $59,999
- $60,000 - $69,999
- $70,000 - $79,999
- $80,000 - $89,999
- $90,000 - $99,999
- $100,000 - $149,999
- More than $150,000

Q8 How many semesters have you been studying on the Baylor campus (including this semester)?

_____

Q9 Are you an undergraduate or graduate student?

- Undergraduate

- Graduate

Q10 What is/are your major(s)?

_____

Q11 What is/are your minor(s)?

_____

Q12 Do you have a pre-health concentration?

- Yes
- No

Q13 Select your pre-health designation:
(Displayed if the respondent answered "Yes" to Question 12.)

- Pre-Medicine
- Pre-Veterinary Medicine
- Pre-Nursing
- Pre-Physician Assistant
- Pre-Dentistry
- Pre-Optometry
- Pre-Pharmacy
- Pre-Physical Therapy
- Pre-Occupational Therapy

Q14 What is your political affiliation?

- Republican or Lean Republican
- No Lean

- Democrat or Lean Democrat

Q15 What is your religious affiliation?

- Jewish
- Buddhist
- Christian - Protestant
- Christian - Catholic
- Christian - Baptist
- Mormon
- Muslim
- Agnostic
- Atheist
- Hindu
- Other (Please Specify) _____

Q16 Have you ever been diagnosed as having had Covid-19 disease (or a positive test for the SARS-CoV-2 virus)?

- Yes
- No

Q17 Do you have a medical condition that would prevent you from being vaccinated against the SARS-CoV-2 virus?

- Yes
- No

Q18 What is the condition? You may choose not to answer.
(Displayed if the respondent answered "Yes" to Question 17.)

_____

Q19 Have you been vaccinated against the SARS-CoV-2 virus (Covid-19)?

- Yes
- No
- Choose not to answer

Q20 Which vaccine did you receive?
(Displayed if the respondent answered "Yes" to Question 19.)

- Pfizer-BioNTech
- Moderna
- Johnson & Johnson/Janssen

Q21 On what date(s) did you receive your vaccine? Response should be in mm/dd/yyyy format. You may skip this question if you do not feel comfortable answering.
(Displayed if the respondent answered "Yes" to Question 19.)

- First Dose _____
- Second Dose (if applicable) _____

Q22 Do you intend to get vaccinated against the SARS-CoV-2 virus (Covid-19)?
(Displayed if the respondent answered "No" to Question 19.)

- Yes
- No
- Undecided

Q23 If you have already been vaccinated or intend to be, what were/are your primary reasons why? Mark all that apply.
(Displayed if the respondent answered "Yes" to Question 19 OR answered "Yes" to Question 22.)

- [ ] Vaccine mandates for work or school
- [ ] Avoiding mandated testing
- [ ] To stop masking or quarantining
- [ ] To be able to travel domestically or internationally
- [ ] Freedom to go to restaurants, events, and other public spaces
- [ ] Pursuit of herd immunity/to end the pandemic
- [ ] A sense of civic duty or social responsibility
- [ ] A sense of religious or moral responsibility
- [ ] Trust in vaccine safety and efficacy
- [ ] To protect my loved ones
- [ ] To protect other students at Baylor
- [ ] To protect myself from Covid-19 disease
- [ ] To protect the vulnerable and immunocompromised in public spaces
- [ ] Family or friends wanted me to get vaccinated
- [ ] It seemed like the obvious or unquestionable thing to do

☐ The vaccine is FDA approve

☐ Health authorities encouraged vaccination

☐ Government authorities encouraged vaccination

☐ Public figures encouraged vaccination

☐ Other (Please specify) _____

Q24 If you do not intend to be vaccinated, what are your primary reasons why? Mark all that apply.
(Displayed if the respondent answered "No" to Question 19 AND answered "No" to Question 22.)

☐ I desire to avoid all vaccines/vaccines in general

☐ I have concerns about the newness of mRNA vaccines or the speed with which they were developed

☐ Covid-19 vaccines are not as effective as I would like

☐ I don't know what's in the vaccine

☐ Certain vaccine ingredients concern me

☐ I have not done enough personal research to feel comfortable getting vaccinated

☐ There is too much conflicting information to know whether to trust the vaccine

- [ ] I am worried about side effects that occur shortly after vaccination
- [ ] I am worried about unknown or long-term side effects
- [ ] I have heard stories of others having bad vaccine experiences
- [ ] The vaccine has not been adequately tested for safety/is experimental
- [ ] I have a medical contraindication/The vaccine would be dangerous for my body in particular
- [ ] I disapprove of the use of embryonic stem cells in development of the Johnson & Johnson vaccine
- [ ] My personal physician advised me against vaccination
- [ ] Family members have advised me against vaccination
- [ ] I do not believe that Covid-19 poses a significant threat to my health
- [ ] I feel the vaccine is being forced on me
- [ ] The vaccine would not prevent me from spreading Covid-19 to others
- [ ] I do not trust the United States government
- [ ] I do not trust the Centers for Disease Control and Prevention (CDC)
- [ ] I believe mRNA vaccines are not real vaccines

- [ ] I do not trust Dr. Fauci
- [ ] I do not trust the World Health Organization (WHO)
- [ ] I do not trust the Food & Drug Administration (FDA)
- [ ] I do not trust the pharmaceutical companies that developed the vaccines
- [ ] Covid-19 vaccines are not FDA approved
- [ ] The vaccine does not work
- [ ] I do not believe the vaccine is safe in general
- [ ] The vaccine would not prevent me from contracting/getting sick with Covid-19
- [ ] I believe the pandemic is a hoax
- [ ] As a statement on personal liberties, freedoms, or principles
- [ ] My vaccination status does not affect the health of those who are vaccinated
- [ ] I am concerned that the vaccine causes infertility or other reproductive issues
- [ ] My political/personal beliefs go against vaccination
- [ ] My religious beliefs go against the vaccine/vaccination

☐ Vaccination has become too politicized

☐ I believe there has been an abuse of presidential power to mandate vaccination

☐ I do not trust the media telling me to get vaccinated

☐ I do not have access to vaccination against Covid-19

☐ I have acquired natural immunity to Covid-19 by convalescence from SARS-CoV-2 (I have had Covid)

☐ I would rather build natural immunity to the virus than get vaccinated

☐ I do not have time to seek out vaccination or it is not a priority for me

☐ The vaccine is inconvenient to obtain

☐ The pandemic is already over/enough others have been vaccinated that I don't feel I need to be

☐ Reports of side effects have been censored

☐ I believe the vaccine's development was unethical

☐ The vaccine is meant to harm particular ethnic groups

☐ The vaccine is meant to harm those of low socioeconomic status

☐ I believe there is a microchip in the vaccine or that it will enable the government to track or control me in some way

☐ I do not trust scientists or pandemic researchers

☐ The vaccine is intended to maim or kill those who receive it

☐ I do not want pharmaceutical companies to profit off of me

☐ I do not trust the medical community to act in my best interest

☐ The vaccine is unnecessary

☐ I believe the pandemic has been unethically handled

☐ I believe the vaccine will give me Covid-19

☐ I am afraid of blood clots, seizures, myocarditis, or another specific side effect following vaccination

☐ I believe the vaccine will alter my DNA/genetic code

☐ Other (Please specify) _____

Q25 If you are **undecided** about vaccination or have chosen not to answer regarding your vaccination status, what are your primary reasons for and against receiving the vaccine? Mark all that apply. Reasons in favor of and opposed to vaccination have been grouped under their respective headings.
(Displayed if the respondent answered "No" to Question 19 AND answered "Undecided" or "Choose Not To Answer" to Question 22.)

For this question, participants were shown all answer choices for Questions 23 and 24.

Q26 Please answer the following questions regarding COVID-19 disease (1-7, very low to very high). If you have been infected with Covid-19 before, you may respond based on your experience.
(The following questions were presented on a Likert-style scale)

What do you consider to be your own probability of getting infected with the SARS-CoV-2 virus?

How severe would contracting the virus be for you (how seriously ill do you think you will be)?

If you become ill, how much of an impact do you think it will have on your daily life?

Q27 You have reached the end of this survey. If you would like to edit your responses, use the back button to navigate through the questions again before continuing.

- I understand and wish to submit

APPENDIX 1-3

Secondary/Follow-Up Survey Instrument

The secondary survey contained exactly the same vaccine opinion questions as the primary survey. It was identical in form to the primary survey except for the demographic questions, which were not displayed because participants in the secondary survey were by definition respondents to the primary survey; their demographic information had already been obtained. Primary and secondary survey responses were correlated via participants' email addresses.

APPENDIX 2

Quote/Concept Comparisons

In the following table, quotes and selected reasons not to be vaccinated are compared side-by-side to better illustrate the similarities between historical arguments and their contemporary manifestations. Within the "Historical Vaccine" category are arguments cited against all pre-modern and modern vaccines. The "Covid-19 Survey" category contains direct quotes from pilot study responses as well as selected answer choices from the primary survey, sorted by topic. This table is not meant to be comprehensive, but reveals some of the most direct similarities in responses from Americans over time.

Topic	***Historical Vaccine***	***Covid-19 Survey***
Politics	"Politics. Politicians took over when it should be worked out by doctors and scientists."- *Polio Survey Respondent, 1955* "According to the papers it's been politics but you can't believe all you read." - *Polio Survey Respondent*	"Politicians should not be doing the work of doctors without fully established a priori medical knowledge."- *Pilot Study Respondent, 2021* "I was only hesitant because I felt like there was a lot of political controversy surrounding what I thought to be a health issue, and all of the misinformation made it hard to know whether or not the vaccine was genuinely safe." - *Pilot Study Respondent*

Rushed Development/ Safety	"It was argued that syphilis, leprosy, polio, cancer, and a host of other diseases were inoculated into the bloodstream of innocent children…"-*Kaufman on smallpox antivaccinationists* "It isn't safe yet…44% of the total public, and two-thirds of those with opinions, referred in one way or another to the possible danger in the use of the vaccine at the time and to the need for further testing."- *Polio Survey Respondent and Article Exposition* "They got it out in too much of a hurry."- *Polio Survey Respondent* "Whoever was in charge should have seen that it was properly tested."- *Polio Survey Respondent*	"It's experimental…They want to take the wait-and-see approach."- *Pilot Study Respondent, 2021* "I am worried about unknown or long-term side effects." - *Survey answer choice* "I have concerns about the newness of mRNA vaccines or the speed with which they were developed."- *Survey answer choice* "Just the newness of it." - Pilot Study Respondent
Individual Rights	"The antivaccinationists also argued that compulsory vaccination was an infringement of basic human rights. For this reason, some doctors who believed in the efficacy of the practice joined in its denunciation. 'In this free country,' wrote Dr. Walter Coles, 'there are certain 'inalienable rights' which no state or municipality can take away. Compulsory vaccination is certainly an infringement upon these rights, and involves a principle which, if carried out, would soon involve medical, religious and social interests in a wild vortex of wreck and ruin.' J.W. Hodge, in his speech before the Western New York Homeopathic Medical Society,	"The paternalism of forcing people to make a health decision (even if it's in the name of public good) is an invasion of personal autonomy in my opinion." - *Pilot Study Respondent* "Many have said it violates their freedom." - *Pilot Study Respondent* "They think it's a form of government control."- *Pilot Study Respondent*

	argued that vaccination 'ranks with human slavery and religious persecution as one of the most flagrant outrages upon the rights of the human race.'"- *Kaufman on smallpox antivaccinationists*	Indicated that those who object do so because they "don't want to be sheep." - *Pilot Study Respondent*
Doubts About Disease Severity/Vaccine Necessity	"…the anti-vaccinators were prepared to argue that smallpox was not a serious illness in any case, and that it could be easily treated. For example, J. F. Banton wrote that smallpox was a 'disease not so much to be dreaded as we are wont to believe, leaving the system in a much healthier condition than most other diseases…' Bernarr Macfadden wrote that the disease was possible only to those who 'clothe heavily, bathe infrequently, eat very heartily and exercise rarely.'"-*Kaufman on smallpox antivaccinationists* "They just cry because a few kids get polio."- *Polio Survey Respondent, 1955* Modern flu vaccines typically have low uptake because people do not believe them to be necessary. Since Jenner developed vaccination, "millions upon	"…when I got Covid, I was almost asymptomatic. The only symptom was congestion, which I thought was my normal allergy flare-up until my friend called me and told me she had tested positive." - *Pilot Study Respondent* "Covid is just the flu." - *Pilot Study Respondent* "They know that they are healthy and would rather not put something in their body that they don't need." - *Pilot Study Respondent* "They don't know what they are being injected with."- *Pilot Study Respondent* "I believe that the vaccine will give me Covid-19." - *Survey answer choice*

	millions of sound and healthy human beings have been inoculated with the most loathsome pestilence, doomed to carry to the grave bodies wasted by consumption or marred and deformed by scrofula, cancer, and innumerable other ills."- *A smallpox antivaccinationist*	
Monetary Concerns	"They are letting the doctors make too much money on it." - *Polio Survey Respondent*	"I do not want pharmaceutical companies to profit off of me" -*Survey answer choice*
Mandates	"Comparing compulsory vaccination to King Herod's edict that all male children under two years of age shall be killed, the anti-vaccinationists demanded the repeal of compulsory vaccination laws."- *Kaufman on smallpox antivaccinationists* Anthrax vaccination was seen by some to be a violation of human rights and an example of government overreach into personal health.	"I am uncomfortable with how much it is being forced onto people with bribes and free shots left and right and up and down streets." - *Pilot Study Respondent* "…as the months have progressed, I've seen increased mandates and a use of emergency executive power in a way I feel is unethical…The levels of coercion ethically outweigh the benefits. The ends do not justify the means." - *Pilot Study Respondent* "Mandating vaccination on that basis of immunization knowledge alone, without existing research or even consultation on its holistic effects (e.g., effects on the microbiome, effects on thyroid, etc.) is an irresponsible use of political

		power." - *Pilot Study Respondent*
Religious	"If God wanted man vaccinated, He would have vaccinated him." *A smallpox antivaccinationist* "Vaccination introduces into the bloodstream 'a bioplasm, death laden—carrying with it all the vices, passions and diseases of the cow,' and he rated vaccination with 'alcohol, tobacco, lust and sensual love' as the most destructive elements of society." *A smallpox antivaccinationist* HPV vaccines are often considered unnecessary or an affront to Christian values.	"[the vaccine] resembles the Mark of the Beast since states are banning unvaccinated people to go places they were once able to…" - *Pilot Study Respondent* The use of stem cells in vaccine research has been cited as a reason not to be vaccinated against Covid-19 for reason of religious convictions.
Specific Reported Side Effects	MMR vaccines were the first to be (erroneously) linked to autism.	"Vaccines cause autism." - *Pilot Study Respondent*
Women's Health	"Dr. H. Lindlahr, the editor of Nature Cure Magazine, added a new twist to the argument that vaccination brought disease, a twist intended to throw fear into the heart of every American woman. Vaccination dries up the mammary glands, he wrote, and the widespread use of vaccination explains the popularity of 'bust foods and developers.'"*Kaufman on smallpox antivaccinationists*	"There are legitimate concerns about the unknown and long-term effects, especially in females, that, despite our best testing, simply cannot be known for several years." - *Pilot Study Respondent* "It makes you infertile." - *Pilot Study Respondent*

BIBLIOGRAPHY

GW-UMT. "A History of Measles in the United States | Online Public Health," March 19, 2019. https://onlinepublichealth.gwu.edu/resources/measles-history-in-the-united-states/.

An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program. Washington, D.C.: National Academies Press (US), 2002.

Arunachalam, Prabhu S., Madeleine K. D. Scott, Thomas Hagan, Chunfeng Li, Yupeng Feng, Florian Wimmers, Lilit Grigoryan, et al. "Systems Vaccinology of the BNT162b2 MRNA Vaccine in Humans." *Nature* 596, no. 7872 (August 19, 2021): 410–16. https://doi.org/10.1038/s41586-021-03791-x.

Baicus, Anda. "History of Polio Vaccination." *World Journal of Virology* 1, no. 4 (August 12, 2012): 108–14. https://doi.org/10.5501/wjv.v1.i4.108.

BARBERIS, I., P. MYLES, S.K. AULT, N.L. BRAGAZZI, and M. MARTINI. "History and Evolution of Influenza Control through Vaccination: From the First Monovalent Vaccine to Universal Vaccines." *Journal of Preventive Medicine and Hygiene* 57, no. 3 (September 2016): E115–20.

Barry, John M. "The Site of Origin of the 1918 Influenza Pandemic and Its Public Health Implications." *Journal of Translational Medicine* 2 (January 20, 2004): 3. https://doi.org/10.1186/1479-5876-2-3.

Baum, Howie. "A History of the World's Pandemics." University of Cincinnati, n.d. https://www.uc.edu/content/dam/refresh/cont-ed-62/olli/s21/history-of-pandemics.pdf.

Baylor University. "Baylor Coronavirus Dashboard," March 13, 2022. https://www.baylor.edu/coronavirus/index.php?id=972342.

Belongia, Edward A., and Allison L. Naleway. "Smallpox Vaccine: The Good, the Bad, and the Ugly." *Clinical Medicine and Research* 1, no. 2 (April 2003): 87–92.

"Birth-18 Years Immunization Schedule | CDC," June 16, 2021. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html.

Blanchard, Jaymie-Lynn, Caitlin Johnson, Margaret McIntyre, Natasha S. Crowcroft, and Andrea McLellan. "A Pre and Post Intervention Study Measuring the Effect of Interactive Education on Adolescent Perceptions of Vaccines, Vaccine Safety and Disease Risk." *Journal of Public Health (Oxford, England)* 42, no. 3 (August 18, 2020): e272–77. https://doi.org/10.1093/pubmed/fdz089.

Burki, Talha Khan. "Omicron Variant and Booster COVID-19 Vaccines." *The Lancet. Respiratory Medicine* 10, no. 2 (February 2022): e17. https://doi.org/10.1016/S2213-2600(21)00559-2.

CDC. "Burden of Influenza." Centers for Disease Control and Prevention, January 7, 2022. https://www.cdc.gov/flu/about/burden/index.html.

CDC. "COVID-19 Vaccination." Centers for Disease Control and Prevention, February 11, 2020. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/effectiveness/why-measure-effectiveness/breakthrough-cases.html.

CDC. "Disease of the Week - SARS." Centers for Disease Control and Prevention, March 3, 2016. https://www.cdc.gov/dotw/sars/index.html.

CDC. "History of Measles." Centers for Disease Control and Prevention, November 5, 2020. https://www.cdc.gov/measles/about/history.html.

Chen, Haiqian, Leiyu Shi, Yuyao Zhang, Xiaohan Wang, Jun Jiao, Manfei Yang, and Gang Sun. "Response to the COVID-19 Pandemic: Comparison of Strategies in Six Countries." *Frontiers in Public Health* 9 (2021). https://www.frontiersin.org/article/10.3389/fpubh.2021.708496.

Coleman, A.T. "Vaccination Certificate." *The Baylor Lariat*. August 8, 1908. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-8-no.-42-saturday-august-08-1908/54055.

"Common Human Coronaviruses | CDC," May 27, 2020. https://www.cdc.gov/coronavirus/general-information.html.

Corbett, Kizzmekia S., Darin K. Edwards, Sarah R. Leist, Olubukola M. Abiona, Seyhan Boyoglu-Barnum, Rebecca A. Gillespie, Sunny Himansu, et al. "SARS-CoV-2 MRNA Vaccine Design Enabled by Prototype Pathogen Preparedness." *Nature* 586, no. 7830 (October 2020): 567–71. https://doi.org/10.1038/s41586-020-2622-0.

Cortese, Margaret, and Umesh D. Parashar. “Prevention of Rotavirus Gastroenteritis Among Infants and Children Recommendations of the Advisory Committee on Immunization Practices (ACIP)</FONT>.” Centers for Disease Control and Prevention, February 6, 2009. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5802a1.htm.

designer, JHCHS website. “Public-Private Cooperation for Pandemic Preparedness and Response.” Johns Hopkins Center for Health Security. Accessed March 31, 2022. https://www.centerforhealthsecurity.org/event201/recommendations.html.

Diaz, Esteban, and Lariat Staff Writers. “Baylor Lariat Editorial.” *The Baylor Lariat*. September 20, 2011, Vol. 112 No. 12 edition.

Elliott, Leslie, and Kanyeemengtiang Yang. “Vaccine Acceptance and Hesitancy among College Students in Nevada: A State-Wide Cross-Sectional Study.” *Vaccines* 10, no. 1 (January 11, 2022): 105. https://doi.org/10.3390/vaccines10010105.

Missouri Department of Health & Senior Services. “Explaining Operation Warp Speed,” n.d. https://health.mo.gov/living/healthcondiseases/communicable/novel-coronavirus-lpha/pdf/fact-sheet-operation-warp-speed.pdf.

Fiedler, Randy. “Baylor’s Response to Epidemics over the Years.” Arts & Sciences Magazine | Baylor University. Accessed March 20, 2022. https://www.baylor.edu/artsandsciences/magazine/index.php?id=973701.

Fitzpatrick, Michael. “The Cutter Incident: How America’s First Polio Vaccine Led to a Growing Vaccine Crisis.” *Journal of the Royal Society of Medicine* 99, no. 3 (March 2006): 156.

Frazer, Ian H. “The HPV Vaccine Story.” *ACS Pharmacology & Translational Science* 2, no. 3 (May 29, 2019): 210–12. https://doi.org/10.1021/acsptsci.9b00032.

Marshfield Clinic. “Frequently Asked Questions About The Covid-19 Vaccine,” 2022. https://www.marshfieldclinic.org/specialties/infectious-diseases/covid-19-vaccine-faq.

Geoghegan, Sarah, Kevin P. O’Callaghan, and Paul A. Offit. “Vaccine Safety: Myths and Misinformation.” *Frontiers in Microbiology* 11 (March 17, 2020): 372. https://doi.org/10.3389/fmicb.2020.00372.

Gina Bari Kolata. *Flu: The Story of the Great Influenza Pandemic of 1918 and the Search for the Virus That Caused It*. Simon & Schuster, 1999.

He, Peng, Yening Zou, and Zhongyu Hu. "Advances in Aluminum Hydroxide-Based Adjuvant Research and Its Mechanism." *Human Vaccines & Immunotherapeutics* 11, no. 2 (February 18, 2015): 477–88. https://doi.org/10.1080/21645515.2014.1004026.

Hendriks, Jan, and Stuart Blume. "Measles Vaccination Before the Measles-Mumps-Rubella Vaccine." *American Journal of Public Health* 103, no. 8 (August 2013): 1393–1401. https://doi.org/10.2105/AJPH.2012.301075.

"History of 1918 Flu Pandemic | Pandemic Influenza (Flu) | CDC." Accessed January 30, 2022. https://www.cdc.gov/flu/pandemic-resources/1918-commemoration/1918-pandemic-history.htm.

Houser, Katherine, and Kanta Subbarao. "Influenza Vaccines: Challenges and Solutions." *Cell Host & Microbe* 17, no. 3 (March 11, 2015): 295–300. https://doi.org/10.1016/j.chom.2015.02.012.

"HPV and Cancer - National Cancer Institute." CgvArticle, March 1, 2019. Nciglobal,ncienterprise. https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer.

"Human Coronavirus Types | CDC," March 17, 2021. https://www.cdc.gov/coronavirus/types.html.

Intlekofer, Karlie A., Michael J. Cunningham, and Arthur L. Caplan. "The HPV Vaccine Controversy." *AMA Journal of Ethics* 14, no. 1 (January 1, 2012): 39–49. https://doi.org/10.1001/virtualmentor.2012.14.1.msoc1-1201.

Justia Law. "Jacobson v. Massachusetts, 197 U.S. 11 (1905)." Accessed April 11, 2022. https://supreme.justia.com/cases/federal/us/197/11/.

KAUFMAN, MARTIN. "THE AMERICAN ANTI-VACCINATIONISTS AND THEIR ARGUMENTS." *Bulletin of the History of Medicine* 41, no. 5 (1967): 463–78.

Kelekar, Arati, Ida Rubino, Maurice Kavanagh, Robin Lewis-Bedz, Gabrielle LeClerc, Leon Pedell, and Nelia Afonso. "Vaccine Hesitancy Counseling-an Educational Intervention to Teach a Critical Skill to Preclinical Medical Students." *Medical Science Educator* 32, no. 1 (February 2022): 141–47. https://doi.org/10.1007/s40670-021-01495-5.

Kelly, Heath. "The Classical Definition of a Pandemic Is Not Elusive." *Bulletin of the World Health Organization* 89, no. 7 (July 1, 2011): 540–41. https://doi.org/10.2471/BLT.11.088815.

Kestenbaum, Lori A., and Kristen A. Feemster. "Identifying and Addressing Vaccine Hesitancy." *Pediatric Annals* 44, no. 4 (April 2015): e71-75. https://doi.org/10.3928/00904481-20150410-07.

"Laboratory-Acquired Vaccinia Exposures and Infections --- United States, 2005--2007." Accessed April 11, 2022. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5715a3.htm.

Lariat Staff Writers. "A Protest." *The Baylor Lariat*. March 11, 1914, Vol. XIII edition. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-13-no.-21-wednesday-march-11-1914/55982.

———. "Flu Shots Suspended for Investigation of Deaths." *The Baylor Lariat*. October 13, 1976, Vol. 77 No. 28 edition. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-baylor-lariat-waco-texas-vol.-77-no.-28-wednesday-october-13-1976/103418.

———. "Sabin Vaccine Will Be Given At BU Sunday." *The Baylor Lariat*. September 12, 1962, Vol. 64 No. 2 edition. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/baylor-lariat-waco-texas-vol.-64-no.-2-wednesday-september-12-1962/156615.

———. "The Flu." *The Baylor Lariat*. October 17, 1918. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-20-no.-03-thursday-october-17-1918/57732.

———. "The Lariat: 'Influenza Affects Small Percent' & 'Wilkerson Brothers Influenza Victims.'" *The Baylor Lariat*. October 17, 1918. https://digitalcollections-baylor.quartexcollections.com/Documents/Detail/the-lariat-waco-texas-vol.-20-no.-03-thursday-october-17-1918/57732.

Lee, Leo Yi Yang, Leonard Izzard, and Aeron C. Hurt. "A Review of DNA Vaccines Against Influenza." *Frontiers in Immunology* 9 (July 9, 2018): 1568. https://doi.org/10.3389/fimmu.2018.01568.

Liebowitz, Dan. "Smallpox Vaccination: An Early Start of Modern Medicine in America." *Journal of Community Hospital Internal Medicine Perspectives* 7, no. 1 (March 31, 2017): 61–63. https://doi.org/10.1080/20009666.2016.1273611.

Lipka, Michael. “U.S. Religious Groups and Their Political Leanings | Pew Research Center.” Pew Research Center, February 23, 2016. https://www.pewresearch.org/fact-tank/2016/02/23/u-s-religious-groups-and-their-political-leanings/.

Livingston, Edward H., Preeti N. Malani, and C. Buddy Creech. “The Johnson & Johnson Vaccine for COVID-19.” *JAMA* 325, no. 15 (April 20, 2021): 1575. https://doi.org/10.1001/jama.2021.2927.

Lucia, Victoria C., Arati Kelekar, and Nelia M. Afonso. “COVID-19 Vaccine Hesitancy among Medical Students.” *Journal of Public Health (Oxford, England)* 43, no. 3 (September 22, 2021): 445–49. https://doi.org/10.1093/pubmed/fdaa230.

Undergraduate Admissions | Baylor University. “Majors & Minors,” 2022. https://www.baylor.edu/admissions/index.php?id=871985.

Matthews, Dr. Walter M. “Communicable Disease Control and STDs.” Lecture, Waco, Texas, February 2022.

Matthews, Dr. Walter M. “Outflanking the Tiniest Enemy: Washington’s Smallpox Inoculation of the Continental Army at Valley Forge, 1777-78.” National Defense University, 2013.

Mayer, Johanna. “The Origin Of The Name ‘Spanish Flu.’” *Science Friday* (blog), January 29, 2019. https://www.sciencefriday.com/articles/the-origin-of-the-spanish-flu/.

Murphy, Trudy V., Paul M. Gargiullo, Mehran S. Massoudi, David B. Nelson, Aisha O. Jumaan, Catherine A. Okoro, Lynn R. Zanardi, et al. “Intussusception among Infants Given an Oral Rotavirus Vaccine.” *New England Journal of Medicine*, August 20, 2009. https://doi.org/10.1056/NEJM200102223440804.

“National Childhood Vaccine Injury Act.” Texas Department of State Health Services, n.d. https://www.dshs.texas.gov/immunize/forms/11-11246/.

National Opinion Research Center. “Public Attitudes Toward Polio Vaccine--Its Development and Distribution.” University of Chicago, July 1956. https://www.norc.org/PDFs/publications/NORCRpt_57.pdf.

Oster, Matthew E., David K. Shay, John R. Su, Julianne Gee, C. Buddy Creech, Karen R. Broder, Kathryn Edwards, et al. “Myocarditis Cases Reported After MRNA-Based COVID-19 Vaccination in the US From December 2020 to August 2021.” *JAMA* 327, no. 4 (January 25, 2022): 331–40. https://doi.org/10.1001/jama.2021.24110.

Pardi, Norbert, Michael J. Hogan, Frederick W. Porter, and Drew Weissman. "MRNA Vaccines — a New Era in Vaccinology." *Nature Reviews. Drug Discovery* 17, no. 4 (April 2018): 261–79. https://doi.org/10.1038/nrd.2017.243.

Philadelphia, The Children's Hospital of. "Vaccine Ingredients – Fetal Cells." Text. The Children's Hospital of Philadelphia, November 6, 2014. https://www.chop.edu/centers-programs/vaccine-education-center/vaccine-ingredients/fetal-tissues.

Pincombe, Morgan, Victoria Reese, and Carrie B Dolan. "The Effectiveness of National-Level Containment and Closure Policies across Income Levels during the COVID-19 Pandemic: An Analysis of 113 Countries." *Health Policy and Planning* 36, no. 7 (August 1, 2021): 1152–62. https://doi.org/10.1093/heapol/czab054.

Polack, Fernando P., Stephen J. Thomas, Nicholas Kitchin, Judith Absalon, Alejandra Gurtman, Stephen Lockhart, John L. Perez, et al. "Safety and Efficacy of the BNT162b2 MRNA Covid-19 Vaccine." *The New England Journal of Medicine*, December 10, 2020, NEJMoa2034577. https://doi.org/10.1056/NEJMoa2034577.

CDC Web Archive. "Principles of Epidemiology | Lesson 1 - Section 11," December 20, 2021. https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html.

"Profile of Undergraduate Students: Fall 2020 and Fall 2021." IR Series. Baylor University Office of Institutional Research, Waco, Texas: Baylor University, September 13, 2021. https://www.baylor.edu/ir/doc.php/382061.pdf.

"Properties of Coronavirus and SARS-CoV-2 - PubMed." Accessed April 9, 2022. https://pubmed.ncbi.nlm.nih.gov/32342926/.

Rao, T. S. Sathyanarayana, and Chittaranjan Andrade. "The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud." *Indian Journal of Psychiatry* 53, no. 2 (2011): 95–96. https://doi.org/10.4103/0019-5545.82529.

Research, Center for Biologics Evaluation and. "Common Ingredients in U.S. Licensed Vaccines." *FDA*, February 2, 2021. https://www.fda.gov/vaccines-blood-biologics/safety-availability-biologics/common-ingredients-us-licensed-vaccines.

Riedel, Stefan. "Edward Jenner and the History of Smallpox and Vaccination." *Proceedings (Baylor University. Medical Center)* 18, no. 1 (January 2005): 21–25.

"Rotavirus Vaccination | CDC," October 27, 2020. https://www.cdc.gov/vaccines/vpd/rotavirus/index.html.

"Rotavirus Vaccination | What You Should Know | CDC," August 8, 2019. https://www.cdc.gov/vaccines/vpd/rotavirus/public/index.html.

Santibanez, Tammy A., and Erin D. Kennedy. "Reasons given for Not Receiving an Influenza Vaccination, 2011–12 Influenza Season, United States." *Vaccine* 34, no. 24 (May 23, 2016): 2671–78. https://doi.org/10.1016/j.vaccine.2016.04.039.

Santos, Igor de Andrade, Victória Riquena Grosche, Fernando Rodrigues Goulart Bergamini, Robinson Sabino-Silva, and Ana Carolina Gomes Jardim. "Antivirals Against Coronaviruses: Candidate Drugs for SARS-CoV-2 Treatment?" *Frontiers in Microbiology* 11 (2020). https://www.frontiersin.org/article/10.3389/fmicb.2020.01818.

Scherer, William F., Jerome T. Syverton, and George O. Gey. "STUDIES ON THE PROPAGATION IN VITRO OF POLIOMYELITIS VIRUSES." *The Journal of Experimental Medicine* 97, no. 5 (May 1, 1953): 695–710.

Schwartz, Jason L. "The First Rotavirus Vaccine and the Politics of Acceptable Risk." *The Milbank Quarterly* 90, no. 2 (June 2012): 278–310. https://doi.org/10.1111/j.1468-0009.2012.00664.x.

Shay, David K., Julianne Gee, John R. Su, Tanya R. Myers, Paige Marquez, Ruiling Liu, Bicheng Zhang, Charles Licata, Thomas A. Clark, and Tom T. Shimabukuro. "Safety Monitoring of the Janssen (Johnson & Johnson) COVID-19 Vaccine - United States, March-April 2021." *MMWR. Morbidity and Mortality Weekly Report* 70, no. 18 (May 7, 2021): 680–84. https://doi.org/10.15585/mmwr.mm7018e2.

Office of Science Policy, National Institutes of Health. "Significant Research Advances Enabled by HeLa Cells." Accessed April 11, 2022. https://osp.od.nih.gov/scientific-sharing/hela-cells-timeline/.

Simonsen, Kari A., and Jessica Snowden. "Smallpox." In *StatPearls*. Treasure Island (FL): StatPearls Publishing, 2022. http://www.ncbi.nlm.nih.gov/books/NBK470418/.

Skloot, Rebecca. *The Immortal Life of Henrietta Lacks*. Broadway Books, 2010.

"Smallpox | History of Vaccines." Accessed February 15, 2022. https://www.historyofvaccines.org/content/articles/history-smallpox.

World Health Organization. “Smallpox Vaccines,” May 13, 2016. https://www.who.int/news-room/feature-stories/detail/smallpox-vaccines.

“States With Religious and Philosophical Exemptions From School Immunization Requirements.” Accessed April 10, 2022. https://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.

Strassburg, Marc A. “The Global Eradication of Smallpox.” *American Journal of Infection Control* 10, no. 2 (May 1, 1982): 53–59. https://doi.org/10.1016/0196-6553(82)90003-7.

Subbaraman, Nidhi. “This COVID-Vaccine Designer Is Tackling Vaccine Hesitancy — in Churches and on Twitter.” *Nature* 590, no. 7846 (February 11, 2021): 377–377. https://doi.org/10.1038/d41586-021-00338-y.

Taber’s Medical Dictionary. 16th ed., 1989.

“The COVID-19 Coronavirus Epidemic Has a Natural Origin, Scientists Say.” Accessed April 17, 2022. https://www.scripps.edu/news-and-events/press-room/2020/20200317-andersen-covid-19-coronavirus.html.

Johns Hopkins Center for Health Security. “The Event 201 Scenario,” n.d. https://www.centerforhealthsecurity.org/event201/scenario.html.

Science in the News. “The Fight Over Inoculation During the 1721 Boston Smallpox Epidemic,” December 31, 2014. https://sitn.hms.harvard.edu/flash/special-edition-on-infectious-disease/2014/the-fight-over-inoculation-during-the-1721-boston-smallpox-epidemic/.

“Thimerosal and Vaccines | Vaccine Safety | CDC,” August 25, 2020. https://www.cdc.gov/vaccinesafety/concerns/thimerosal/index.html.

“Tuberculosis | History of Vaccines.” Accessed January 20, 2022. https://www.historyofvaccines.org/index.php/content/articles/tuberculosis.

“Understanding the Reasons Why Mothers Do or Do Not Have Their Adolescent Daughters Vaccinated Against Human Papillomavirus | Elsevier Enhanced Reader.” Accessed March 23, 2022. https://doi.org/10.1016/j.annepidem.2009.03.011.

The British Museum. “Use This Image 146958001 | British Museum.” Accessed April 14, 2022. https://www.britishmuseum.org/collection/image/146958001.

"Vaccine Definition & Meaning." In *Merriam-Webster.Com Dictionary*, April 11, 2022. https://www.merriam-webster.com/dictionary/vaccine#medicalDictionary.

Johns Hopkins Coronavirus Resource Center. "Vaccine Research & Development." Accessed April 3, 2022. https://coronavirus.jhu.edu/vaccines/timeline.

Wakefield, A. J., S. H. Murch, A. Anthony, J. Linnell, D. M. Casson, M. Malik, M. Berelowitz, et al. "RETRACTED: Ileal-Lymphoid-Nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children." *The Lancet* 351, no. 9103 (February 28, 1998): 637–41. https://doi.org/10.1016/S0140-6736(97)11096-0.

"What Is Anthrax? | CDC," February 16, 2022. https://www.cdc.gov/anthrax/basics/index.html.

"WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020," March 11, 2020. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

"WHO EMRO | Middle East Respiratory Syndrome (MERS) | MERS-CoV | Health Topics." Accessed April 3, 2022. http://www.emro.who.int/health-topics/mers-cov/mers-cov.html.

"WHO-Convened Global Study of Origins of SARS-CoV-2: China Part." World Health Organization, February 14, 2021.

Zanardi, L. R., P. Haber, G. T. Mootrey, M. T. Niu, and M. Wharton. "Intussusception among Recipients of Rotavirus Vaccine: Reports to the Vaccine Adverse Event Reporting System." *Pediatrics* 107, no. 6 (June 2001): E97. https://doi.org/10.1542/peds.107.6.e97.

Zhou, Peng, Xing-Lou Yang, Xian-Guang Wang, Ben Hu, Lei Zhang, Wei Zhang, Hao-Rui Si, et al. "A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin." *Nature* 579, no. 7798 (March 2020): 270–73. https://doi.org/10.1038/s41586-020-2012-7.