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Abstract

In early colonial America, the smallpox virus spread quickly among growing populations, killing as many as half of those who caught it. When one of the earliest forms of immunization called inoculation was introduced in the West, colonizers fought over whether it was safe. Their fear was reasonable: The process to inoculate against smallpox in the 1700s was much more harrowing, and less safe, than modern-day vaccination. But the principles are the same, and even back then statistics showed that immunizing communities helped reduce the number of deaths. The problem was that the process to inoculate soldiers would take weeks, and he hesitated to take any troops off the front lines. However, after losing a battle over British-occupied Canada in part due to an outbreak of smallpox in the camps Washington made a decision to have his soldiers inoculated. Today, many historians credit the move with helping the Continental Army win the Revolutionary War. Vaccines are one of the greatest success stories in public health; through use of vaccines, US have eradicated smallpox and nearly eliminated wild polio virus. The number of people who experience the devastating effects of preventable infectious diseases like measles, diphtheria, and whooping cough is at an all-time low. To ensure the continued success of vaccines in the United States, it's crucial to make sure that vaccines are safe. Before vaccines are approved by the Food and Drug Administration (FDA), scientists test them extensively to ensure they are effective and safe. Vaccines are the best defense we have against infectious diseases, but no vaccine is actually 100% safe or effective for everyone because each person's body reacts to vaccines differently. Vaccines, though designed to protect from disease, can cause side effects, just as any medication can. Most side effects from vaccination are mild, such as soreness, swelling, or redness at the injection site. Some vaccines are associated with fever, rash, and achiness. Serious side effects are rare, but may include seizure or life-threatening allergic reaction. In USA, the concern with vaccine hesitancy has been laid primarily at the feet of African American and Latinx communities in the United States. Study after study appears to show that more Black and Brown people, out of proportion to their numbers in the population, are getting sick and dying from COVID-19 compared with whites, yet resisting the vaccinations because of mistrust. Vaccines are the most successful medical invention to prevent many infectious diseases. Although many vaccines have been developed against various infectious disease unlike smallpox still there is an

existence of bio burden on vaccine-preventable diseases. However, modern research discovering has a greater contribution by finding new vaccines to protect society from infectious diseases. Although vaccines and vaccination programme are more successful, there was a lot of struggle behind the discovery of vaccines.

Keywords: *Vaccine, Vaccination, Dangers, Benefits, Prejudice, USA, Europe*

1.1 Introduction

Vaccines are one of the greatest success stories in public health. Through use of vaccines, we have eradicated smallpox and nearly eliminated wild polio virus (Curry, 2020). The number of people who experience the devastating effects of preventable infectious diseases like measles, diphtheria, and whooping cough is at an all-time low. To ensure the continued success of vaccines in the United States, it's crucial to make sure that vaccines are safe (Campbell, 2021). Before vaccines are approved by the Food and Drug Administration (FDA), scientists test them extensively to ensure they are effective and safe. Vaccines are the best defense we have against infectious diseases, but no vaccine is actually 100% safe or effective for everyone because each person's body reacts to vaccines differently (Colella, Orlandi & Cirillo, 2021). As infectious diseases become less common, we hear less about the serious consequences of preventable illnesses like diphtheria and tetanus and more about the risks associated with vaccines; it's good to be informed about health choices, but the reality is that Americans have never been healthier than we are today and vaccines have never been safer than they are today (Kim et al., 2021). According to Chavan Qureshi, Karnati and Kollikonda (2021), the benefits of vaccines far outweigh the risks, as science continues to advance, we strive to develop safer vaccines and improve delivery to protect ourselves against disease more effectively. This overview focuses on vaccine research, how vaccines are licensed, and how we make sure vaccines are safe (Qureshi et al., 2021).

The battle over whether to enforce vaccination is not new; in fact, it's older than the United States itself (Brinkmann, Souza, Esparza, Nitsche & Damaso, 2020). In early colonial America, the smallpox virus spread quickly among growing populations, killing as many as half of those who caught it (Brinkmann et al. 2020). When one of the earliest forms of immunization called "inoculation" was introduced in the West, colonizers fought over whether it was safe. Their fear was reasonable: The process to inoculate against smallpox in the 1700s was much more harrowing, and less safe, than modern-day vaccination. But the principles are the same, and even back then statistics showed that immunizing communities helped reduce the number of deaths. Gen. George Washington knew this. The problem for him was that the process to inoculate soldiers would take weeks, and he hesitated to take any troops off the front lines. However, after losing a battle over British-occupied Canada in part due to an outbreak of smallpox in the camps Washington made a decision to have his soldiers inoculated (Brunt Set al., 2020). Today, many historians credit the move with helping the Continental Army win the Revolutionary War.

Prevention is better than cure is the common proverb of the public across the world. Preventing infectious diseases by the vaccine is the most successful medical invention in the modern therapeutic era. The miracle of vaccines improved the status of public health across the world. This miracle was invented accidentally by Edward Jenner between 1749-1823 during 1796. Jenner met a dairymaid and heard her saying that "I shall never have an ugly pockmarked face". Jenner then understood that there are some principles due to which dairy maids were protected from this dreadful smallpox disease. This incidence made Jenner follow a path, in May 1796, Jenner

observed a young dairymaid who had fresh cowpox lesions on her hand. Jenner inoculated the matter from the leisions of dairymaid's hands to James Phipps, eight year old boy. After 9 days the boy developed mild fever, discomfort, cold and loss of appetite, later he recovered. After two months in July 1796, once again Jenner inoculated the boy with fresh smallpox lesion. But the boy did not develop any disease and confirmed the protection. In the year 1797, Jenner had sent a short communication to the Royal society regarding his findings but it was rejected. In the next year, Jenner studied by experimenting with various cases and published a small booklet called "An Inquiry into the Causes and Effects of the Variolae Vaccinae". Jenner termed his finding as “Vaccine” derived from “Vacca” means cow.

Later Jenner tried the same experiment on his baby son and other children, all were protected from smallpox (Sarkar, Zlojutro, Khan & Gardner, 2019). After these findings, Jenner spent the rest of his professional life by supplying cowpox material to others across the world and explained the scientific background. He himself called him “Vaccine Clerk to the World”. On recognizing his work in 1802 the British Government awarded him £10,000 and followed by the year 1807 he received £20,000. Few days before his death, Jenner stated to a friend: "I am not surprised that men are not grateful to me, but I wonder that they are not grateful to God for the good which he has made me the instrument of conveying to my fellow creatures (Sarkar, et al., 2019). Though Jenner’s work benefited to the society of human beings, later many controversies against Jenner’s concept and anti-vaccination movements were developed in England when Government made vaccination compulsory. By the year 1853 England Government introduced compulsory vaccination, with fines for non-cooperatives and imprisonment for non-payment. Later in 1885, Louis Pasteur developed rabies vaccine, actually, it was rabies antitoxin that was much useful as a post-infection antidote and explained the association between cow and cowpox to include all inoculating agents (Sarkar et al., 2019).

In 1882 Pasteur elucidated to Koch’s comment during the fourth International Congress of Hygiene and Demography held in Geneva, Switzerland (Zakir, Islam, Jabeen & Moni, 2019). By that time Koch became very famous due to the discovery of tubercle bacillus. Koch attended as an audience in Pasteur's presentation on attenuation and vaccination. Koch refused to recognize Pasteur's findings of attenuation techniques as he believed that biological and chemical characteristics of microbes are specific and permanent. In contrast to Koch's theory, Pasteur understands that microbial constituent can be lost and can be recovered. Pasteur stated that the existence of these variations was of great importance on understanding the epidemiology of various infectious diseases to which Koch did not agree and stated that Pasteur is not a physician and may not be having knowledge on the pathological process and symptoms of diseases. In 1882, Koch presented and demonstrated his findings at a meeting in Berlin Physiological society (Rodrigues, 2020).

The idea of attenuation of virulent infections developed slowly over the course of centuries (Weaver, 2018). Variolation was analogous to the use of small amounts of poison to render one immune to toxic effects. Jenner’s use of an animal poxvirus (probably horsepox) to prevent smallpox was essentially based on the idea that an agent virulent for animals might be attenuated in humans. This idea played a role in the development of bacillus Calmette Guérin but is even more obvious in the selection of rhesus and bovine rotavirus strains to aid the creation of human rotavirus vaccines as mentioned below under Reassortment (Weaver, 2018). It was Pasteur and his colleagues who most clearly formulated the idea of attenuation and demonstrated its utility, first with Pasteurella multocida, the cause of a diarrheal disease in chickens, then anthrax in sheep and

most sensationally rabies virus in animals and humans. Their first approaches involved exposure to oxygen or heat, both of which played a role in the development of the rabies vaccine and in the famous anthrax challenge experiment at Pouilly-le-Fort (Rodrigues, 2020). However, the more powerful technique of serial cultivation of a pathogen in vitro or in in-habitual hosts originated with Calmette and Guérin, who passaged bovine tuberculosis bacteria 230 times in artificial media to obtain an attenuated strain to protect against human tuberculosis. Later in the 20th century, Sellards and Laigret and, more successfully, Theiler and Smith attenuated yellow fever virus by serial passage in mice and in chicken embryo tissues, respectively (Weaver, 2018).

The practice of immunization dates back hundreds of years; Buddhist monks drank snake venom to confer immunity to snake bite and variolation (smearing of a skin tear with cowpox to confer immunity to smallpox) was practiced in 17th century China (Kiboneka, 2021). Edward Jenner is considered the founder of vaccinology in the West in 1796, after he inoculated a 13 year-old-boy with vaccinia virus (cowpox), and demonstrated immunity to smallpox. In 1798, the first smallpox vaccine was developed. Over the 18th and 19th centuries, systematic implementation of mass smallpox immunisation culminated in its global eradication in 1979. Louis Pasteur's experiments spearheaded the development of live attenuated cholera vaccine and inactivated anthrax vaccine in humans (1897 and 1904, respectively) (Kiboneka, 2021). Plague vaccine was also invented in the late 19th Century. Between 1890 and 1950, bacterial vaccine development proliferated, including the Bacillis-Calmette-Guerin (BCG) vaccination, which is still in use today (Weaver, 2018).

Despite the evidence of health gains from immunization programmes there has always been resistance to vaccines in some groups (Dubé, Ward, Verger & MacDonald, 2021). The late 1970s and 1980s marked a period of increasing litigation and decreased profitability for vaccine manufacture, which led to a decline in the number of companies producing vaccines. The decline was arrested in part by the implementation of the National Vaccine Injury Compensation programme in the US in 1986. The legacy of this era lives on to the present day in supply crises and continued media efforts by a growing vociferous anti-vaccination lobby (Dubé, et al., 2021). The past two decades have seen the application of molecular genetics and its increased insights into immunology, microbiology and genomics applied to vaccinology. Current successes include the development of recombinant hepatitis B vaccines, the less reactogenic acellular pertussis vaccine, and new techniques for seasonal influenza vaccine manufacture. Molecular genetics sets the scene for a bright future for vaccinology, including the development of new vaccine delivery systems (e.g. DNA vaccines, viral vectors, plant vaccines and topical formulations), new adjuvants, the development of more effective tuberculosis vaccines, and vaccines against cytomegalovirus (CMV), herpes simplex virus (HSV), respiratory syncytial virus (RSV), staphylococcal disease, streptococcal disease, pandemic influenza, shigella, HIV and schistosomiasis among others. Therapeutic vaccines may also soon be available for allergies, autoimmune diseases and addictions (Dubé et al., 2021).

2.1 Concept of Vaccination in USA

In the United States of America, before vaccines are licensed by the FDA, they are tested extensively in the laboratory and with human subjects to ensure their safety (Rodgers, et al., 2018). First, researchers use computers to predict how the vaccine will interact with the human immune system. Then researchers test the vaccine on animals including mice, guinea pigs, rabbits, and monkeys. Vaccine development and approval follows the same general pathway as for drugs and other biologics. A sponsor who wishes to begin clinical trials with a vaccine must submit an

Investigational New Drug application (IND) to FDA (Martínez-Vega, Carrasquila, Luna & Ramos-Castañeda, 2017). The IND describes the vaccine, its method of manufacture, and quality control tests for release. Also included are information about the vaccine's safety and ability to elicit a protective immune response (immunogenicity) in animal testing, as well as a proposed plan for testing the drug on humans (Martínez-Vega et al., 2017).

FDA reviews the IND to ensure a vaccine's use in clinical studies does not place human subjects at unreasonable risk of harm, and adequate informed consent and human subject protections are in place. Participation in these studies is completely voluntary. Many individuals choose to contribute their time and energy for the advancement of science. Before they participate in research, all participants must demonstrate that they understand the purpose of the study and its potential risks. Volunteers agree to receive the vaccine and undergo any medical testing necessary to assess its safety and efficacy. Once FDA licenses a vaccine, the Advisory Committee on Immunization Practices (ACIP) develops recommendations on how to use vaccines to control disease in the United States. ACIP is a group of medical and public health experts. Members of the American Academy of Pediatrics (AAP) and American Academy of Family Physicians (AAFP) are among some of the groups that also bring related immunization expertise to the committee. The Committee's recommendations are forwarded to CDC's Director for approval. Once the ACIP recommendations have been reviewed and approved by the CDC Director and the U.S. Department of Health and Human Services, they are published in CDC's Morbidity and Mortality Weekly Report (MMWR). The MMWR publication represents the final and official CDC recommendations for immunization of the U.S. population.

The Biden administration is considering reserving about a fourth of the doses for the U.S. to dispense directly to individual nations of its choice (Tanne, 2021). The growing U.S. stockpile of COVID-19 vaccines is seen not only as a testament to American ingenuity, but also its global privilege. More than 50% of Americans have received at least one dose of the vaccine, and more than 135 million are fully vaccinated, helping bring the rate of cases and deaths in the U.S. to the lowest level since the earliest days of the pandemic (Tanne, 2021). Scores of countries have requested doses from the United States, but to date only Mexico and Canada have received a combined 4.5 million doses. The U.S. also has announced plans to share enough shots with South Korea to vaccinate its 550,000 troops who serve alongside American service members on the peninsula. The broader U.S. sharing plan is still being finalized, a White House official said, having been the subject of policy debate inside the White House and across the federal government, and also involving COVAX and other outside stakeholders like drug manufacturers and logistics experts (Tanne, 2021).

Our nation's going to be the arsenal of vaccines for the rest of the world," Biden said on May 17, when he announced the U.S. pledge to share more doses. He added that, compared to other countries like Russia and China that have sought to leverage their domestically produced doses, "we will not use our vaccines to secure favors from other countries. Still, the partnership with the South Korean military points to the ability of the U.S. to use its vaccine stockpile to benefit some of its better-off allies (Oxford Analytical, 2021). It was not clear whether South Korea would pay for its doses from the U.S. Most of the other doses were expected to be donated. Administration officials cautioned that Biden had not yet signed off on the precise split and that it could still change. The White House official, who spoke on condition of anonymity to discuss internal plans, said the administration would be working in coming days to synchronize its supplies with the global vaccine sharing organizations (Oxford Analytical, 2021). Biden has committed to providing

other nations with all 60 million domestically produced doses of the AstraZeneca vaccine. That vaccine has yet to be authorized for use in the U.S. but is widely approved around the world. The U.S.-produced doses will be available to ship as soon as they clear a safety review by the Food and Drug Administration (Oxford Analytical, 2021).

3.1 Vaccine Side Effects and Adverse Events in USA

During the mid-1970s, there was an increased focus on personal health and more people became concerned about vaccine safety (Millward, 2019). Several lawsuits were filed against vaccine manufacturers and healthcare providers by people who believed they had been injured by the diphtheria, pertussis, tetanus (DPT) vaccine. Damages were awarded despite the lack of scientific evidence to support vaccine injury claims. As a result of these decisions, liability and prices soared, and several vaccine manufacturers halted production. A vaccine shortage resulted and public health officials became concerned about the return of epidemic disease. To reduce liability and respond to public health concerns, Congress passed the National Childhood Vaccine Injury Act (NCVIA) in 1986. This act was influential in many ways. Vaccines, though they are designed to protect from disease, can cause side effects, just as any medication can. Most side effects from vaccination are mild, such as soreness, swelling, or redness at the injection site (Millward, 2019).

Some vaccines are associated with fever, rash, and achiness. Serious side effects are rare, but may include seizure or life-threatening allergic reaction (Sharma & Gaur, 2021). A possible side effect resulting from a vaccination is known as an adverse event. Each year, American babies (1 year old and younger) receive more than 10 million vaccinations. During the first year of life, a significant number of babies suffer serious, life-threatening illnesses and medical events, such as Sudden Infant Death Syndrome (SIDS). Additionally, it is during the first year that congenital conditions may become evident (Millward, 2019). Therefore, due to chance alone, many babies will experience a medical event in close proximity to a vaccination. This does not mean, though, that the event is in fact related to the immunization. The challenge is to determine when a medical event is directly related to a vaccination. The Food and Drug and Administration (FDA) and the Centers for Disease Control and Prevention (CDC) have set up systems to monitor and analyze reported adverse events and to determine whether they are likely related to vaccination (Sharma & Gaur, 2021).

To understand the range of possible vaccination side effects events, it is useful to compare a vaccine with relatively few associated side effects, such as the vaccine for *Haemophilus influenza* type B, with a vaccine known to have many potential side effects, such as the infrequently used smallpox vaccine (given to military personnel and others who might be first responders in the event of a bioterror attack). *Haemophilus influenza* type B is a bacterium that can cause serious infections, including meningitis, pneumonia, epiglottitis, and sepsis (WHO, 2021). The CDC recommends that children receive a series of Hib vaccinations starting when they are two months old. Smallpox is a serious infection, fatal. In 30% to 40% of cases, and caused by the *Variola major* or *Variola minor* virus. No wild smallpox cases have been reported since the 1970s. The World Health Organization has declared it eradicated. The information below about side effects of Hib and smallpox vaccination is from the Centers for Disease Control and Prevention (WHO, 2021).

The CDC and FDA established The Vaccine Adverse Event Reporting System in 1990. The goal of VAERS, according to the CDC, is “to detect possible signals of adverse events associated with vaccines.” (A signal in this case is evidence of a possible adverse event that emerges in the data

collected.) About 30,000 events are reported each year to VAERS; between 10% and 15% of these reports describe serious medical events that result in hospitalization, life-threatening illness, disability, or death. VAERS is a voluntary reporting system (WHO, 2021). Anyone, such as a parent, a health care provider, or friend of the patient, who suspects an association between a vaccination and an adverse event may report that event and information about it to VAERS. The CDC then investigates the event and tries to find out whether the adverse event was in fact caused by the vaccination. Not all adverse events reported to VAERS are in fact caused by a vaccination. The two occurrences may be related in time only. And, it is probable that not all adverse events resulting from vaccination are reported to VAERS. The CDC states that many adverse events such as swelling at the injection site are underreported. Serious adverse events, according to the CDC, "are probably more likely to be reported than minor ones, especially when they occur soon after vaccination, even if they may be coincidental and related to other causes.

The VSD has some drawbacks; for example, few completely unvaccinated children are listed in the database. The medical groups providing information to VSD may have patient populations that are not representative of large populations in general (Ozkan et al., 2019). Additionally, the data come not from randomized, controlled, blinded trials but from actual medical practice. Therefore, it may be difficult to control and evaluate the data. Rapid Cycle Analysis is a program of the VSD, launched in 2005. It monitors real-time data to compare rates of adverse events in recently vaccinated people with rates among unvaccinated people. The system is used mainly to monitor new vaccines (Ozkan et al., 2019). Among the new vaccines being monitored in Rapid Cycle Analysis are the conjugated meningococcal vaccine, rotavirus vaccine, MMRV vaccine, Tdap vaccine, and the HPV vaccine. Possible associations between adverse events and vaccination are then studied further (Ozkan et al., 2019).

Smallpox may be the worst disease ever known to man. It killed about half a billion people from 1880 to 1980, before it was eradicated (Hammond, 2017). And the smallpox vaccine is deadly, too. Scientists call it the most dangerous vaccine known to man. Today, smallpox is a potential weapon of mass destruction that could be wielded against the U.S. by enemies like Iraq and al Qaeda. With that in mind, President Bush is expected to announce on Friday a plan which will gradually make the smallpox vaccine available to all Americans who want it. That's according to administration sources who say the shots will be mandatory for about 500,000 military personnel and recommended for another half-million who work in hospital emergency rooms and on special smallpox response teams (Hammond, 2017). The general public will be offered the vaccine on a voluntary basis as soon as large stockpiles are licensed, probably early in 2004, though the government will not encourage people to get them.

The United States stopped giving mandatory smallpox vaccinations 30 years ago; soon after that, doctors eradicated the disease from the planet (Cousoulis, 2021). But now, the government has decided to bring back the vaccine because of fear that terrorists, or Iraq, could use the virus as a weapon. But smallpox was, or is, a terrible, virulent disease. It kills one out of every three of its victims. The vaccine effectively immunizes against smallpox. But that protection has a price. Some people die from it; and others have serious reactions, some permanent. Scientists say it's the most dangerous vaccine known to man (Cousoulis, 2021). It could protect Americans from the unthinkable destruction of a smallpox attack. But the vaccine has a dark side. There is a heated debate going on in the scientific community right now about such things as, for each victim of smallpox, how many people are going to catch it from each victim? That's known as the multiplier of a virus. If the multiplier of smallpox is 10 - that is to say, if each person infected with smallpox

on average gives it to another 10 people - then a smallpox outbreak would be explosive in our society (Termini, 2021). The multiplier was much higher than 10 in a small town in Germany in 1970. One man was hospitalized with the disease, and kept in an isolation ward. But 19 hospital staff and patients, who never saw the man, got smallpox. Still, doctors were able to control that outbreak with what is known as "ring vaccination (Termini, 2021).

4.1 Vaccination Prejudice in USA

The concern with vaccine hesitancy has been laid primarily at the feet of African American and Latinx communities in the United States. Study after study appears to show that more Black and Brown people, out of proportion to their numbers in the population, are getting sick and dying from COVID-19 compared with whites, yet resisting the vaccinations because of mistrust (Löffler, 2021). Rather than a nuanced analysis for this mistrust of conventional medical care, however, we routinely hear a litany of historical explanations. In Black communities, a holy trinity of medical horror stories are trotted out: Dr. J. Marion Sims' use of slave women for gynecological experimentation, the 40-year study in Tuskegee of "untreated syphilis in the Male Negro," or the taking of Henrietta Lacks' cervical cancer cells to begin the first reproducible cell lines. In the Latinx communities, the explanations focus more on requirements to present government-issued identification, mistrust of government sponsorships given the histories of forced sterilizations and experimentation on Black and Brown bodies, and reliance on herbal remedies (Dai et al., 2020).

Against this backdrop, many of the news stories on the refusal to wear masks or socially distance tie such actions to political conservatives, libertarians, or some form of toxic masculinity (Oguz, 2019). Yet it is not just white people who get their news from rightwing media outlets, social media, and word of mouth that spread fears of vaccine consequences, or a sense that the government is using the vaccine to harm people, or will implant things to track individuals. Such disinformation and fears have spread through Latinx communities as well (Oguz, 2019). All of these historical and conspiratorial factors matter of course, but in ways not frequently acknowledged. When people of color refer to such historical claims it is often as a way to say that structural racism is real, or I, my family, or community have been subjected to this kind of racist treatment, but when it comes to health care I will explain this experience in historical terms because it sounds less crazy (Dror et al., 2021). When mass incarceration, unlawful police actions, and unwarranted immigration raids shape a community's experience, why should they trust the government? In turn, conspiracy theories have always been fundamental to American politics, infiltrate medical beliefs, and affect health behaviors (Dror et al., 2021).

While only a long-term perspective and commitment to public health, primary care, and affordable health insurance can change some of the underlying structural problems that shape the pandemic, there is much we can do now: acknowledge that the mistrust is realistic, keep an equity lens in full view as the vaccines are rolled out, consider deploying vaccinators to local churches and independent pharmacies, keep explaining why the vaccine is safe and effective and be transparent if there are problems, make sure that immigration police are kept out of vaccination centers, press for vaccination in the prisons, or better yet demarcation (Ansari, Aghaei, Rezaie & Rostam-Abadi, 2021). We may be in a biological battle with the virus, but winning will require more than medical research prowess alone. We must harness social and political tools to dismantle the structural barriers that perpetuate deadly health disparities (Ansari et al., 2021).

5.1 Conclusion

Vaccines are the most successful medical invention to prevent many infectious diseases. Although many vaccines have been developed against various infectious disease unlike smallpox still there is an existence of bio burden on vaccine-preventable diseases. However, modern research discovering has a greater contribution by finding new vaccines to protect society from infectious diseases. Although vaccines and vaccination programme are more successful, there was a lot of struggle behind the discovery of vaccines. The present modern era of vaccinology has to focus the vaccine efficacy to transit from prophylaxis to therapeutic to combat many infectious and noninfectious diseases, which is highly challenging and spurring with promising results against new disease targets.

REFERENCES

Ansari, M., Aghaei, A. M., Rezaie, Y., & Rostam-Abadi, Y. (2021). Discrimination in COVID-19 vaccination programs–A possible risk for mental health. *Asian Journal of Psychiatry*, *63*, 102758.

Brinkmann, A., Souza, A. R., Esparza, J., Nitsche, A., & Damaso, C. R. (2020). Re-assembly of nineteenth-century smallpox vaccine genomes reveals the contemporaneous use of horsepox and horsepox-related viruses in the USA. *Genome Biology*, *21*(1), 1-6.

Brunt, S., Solomon, H., Leavitt, H., Lasek-Nesselquist, E., LaPierre, P., Shudt, M., ... & Davis, A. D. (2020). Origin of 3 Rabid Terrestrial Animals in Raccoon Rabies Virus–Free Zone, Long Island, New York, USA, 2016–2017. *Emerging Infectious Diseases*, *26*(6), 1315.

Campbell, K. (2021). Public Health and History: Vaccination Regulation in the Northeastern States.

Chavan, M., Qureshi, H., Karnati, S., & Kollikonda, S. (2021). COVID-19 Vaccination in Pregnancy: The Benefits Outweigh the Risks. *Journal of Obstetrics and Gynaecology Canada*, *43*(7), 814.

Colella, G., Orlandi, M., & Cirillo, N. (2021). Bell's palsy following COVID-19 vaccination. *Journal of Neurology*, 1-3.

Cousoulis, K. (2021). 21st Century Medicine versus Anti-Vaccination Myths: Analyzing the World-Wide Resurrection of Measles and Why the United States Should End Religious and Philosophical Vaccination Exemptions. *Geo. Mason J. Int'l Com. L.*, *12*, 1.

Curry, L. (2020). Richard J. Altenbaugh, Vaccination in America: Medical Science and Children's Welfare.

Dai, H., Han, J., & Lichtfouse, E. (2020). Who is running faster, the virus or the vaccine?.

Dror, A. A., Daoud, A., Morozov, N. G., Layous, E., Eisenbach, N., Mizrachi, M., ... & Sela, E. (2021). Vaccine hesitancy due to vaccine country of origin, vaccine technology, and certification. *European Journal of Epidemiology*, 1-6.

Dubé, È., Ward, J. K., Verger, P., & MacDonald, N. E. (2021). Vaccine Hesitancy, Acceptance, and Anti-Vaccination: Trends and Future Prospects for Public Health. *Annu. Rev. Public Health*, *42*, 175-191.

Hammond, J. J. (2017). The Mormon Hawaiian Mission and the Smallpox Epidemic of 1853. *The John Whitmer Historical Association Journal*, *37*(1), 117-131.

Kiboneka, A. (2021). Understanding childhood immunizations, their serological interpretation and vaccines-A review article. *World Journal of Advanced Research and Reviews*, *10*(3), 233-238.

Kim, J. J., Simms, K. T., Killen, J., Smith, M. A., Burger, E. A., Sy, S., ... & Canfell, K. (2021). Human papillomavirus vaccination for adults aged 30 to 45 years in the United States: A cost-effectiveness analysis. *PLoS medicine*, *18*(3), e1003534.

Löffler, P. (2021). Vaccine Myth-Buster–Cleaning Up With Prejudices and Dangerous Misinformation. *Frontiers in Immunology*, *12*, 2220.

Martínez-Vega, R. A., Carrasquila, G., Luna, E., & Ramos-Castañeda, J. (2017). ADE and dengue vaccination. *Vaccine*, *35*(32), 3910-3912.

Millward, G. (2019). *Vaccinating Britain: Mass vaccination and the public since the Second World War* (p. 290). Manchester University Press.

Oguz, M. M. (2019). Improving influenza vaccination uptake among healthcare workers by on-site influenza vaccination campaign in a tertiary children hospital. *Human vaccines & immunotherapeutics*.

Oxford Analytica. (2021). Biden's team keen to hasten the pace of vaccination. *Emerald Expert Briefings*, (oxan-es).

Ozkan, G., Franco, P., De Marco, I., Xiao, J., & Capanoglu, E. (2019). A review of microencapsulation methods for food antioxidants: Principles, advantages, drawbacks and applications. *Food chemistry*, *272*, 494-506.

Rodgers, A. M., McCrudden, M. T., Vincente-Perez, E. M., Dubois, A. V., Ingram, R. J., Larrañeta, E., ... & Donnelly, R. F. (2018). Design and characterisation of a dissolving

microneedle patch for intradermal vaccination with heat-inactivated bacteria: A proof of concept study. *International journal of pharmaceutics*, *549*(1-2), 87-95.

Rodrigues, A. G. (Ed.). (2020). *New and Future Developments in Microbial Biotechnology and Bioengineering: Microbial Biomolecules: Properties, Relevance, and Their Translational Applications*. Elsevier.

Sarkar, S., Zlojutro, A., Khan, K., & Gardner, L. (2019). Measles resurgence in the USA: how international travel compounds vaccine resistance. *The Lancet Infectious Diseases*, *19*(7), 684-686.

Sharma, R., & Gaur, A. (2021). Adverse events associated with Measles and Rubella vaccination campaign 2019 in India. *Clinical and experimental vaccine research*, *10*(1), 44.

Tanne, J. H. (2021). Covid-19: Biden aims for 70% of Americans to have at least one vaccination by 4 July.

Termini, R. B. (2021). An Essay on Public Health and Liberty-The Impact of the 1905 United States Supreme Court Decision of Jacobson: Compulsory Vaccination under State Police Power vs. the Individual Right to Refuse a Vaccination in this Modern-Day Era of the COVID-19 Pandemic. *Widener Law Review, Forthcoming*.

Weaver, L. T. (2018). The Historical Roots of Paediatric Gastroenterology, Hepatology and Nutrition. *Journal of pediatric gastroenterology and nutrition*, *66*(Suppl 1), S2.

Zakir, F., Islam, F., Jabeen, A., & Moni, S. S. (2019). Vaccine development: A historical perspective. *Biomedical Research*, *30*(3), 452-455.