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HISTORICAL AND SOCIAL ASPECTS OF VACCINATION AND THE ANTI-VACCINATION MOVEMENT WORLDWIDE: INFLUENCES ON SERBIA

Katarina M. PETKOVIĆ[1]
Institute of Virology, Vaccines, and Sera "Torlak"
Belgrade (Serbia)

[1] katarinapetkovic.ph@gmail.com; https://orcid.org/0009-0003-3156-6322

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Abstract. Infectious diseases have significantly shaped the course of human history. The earliest recorded pandemic was described during the Peloponnesian War in 430 BC. Since then, numerous smallpox, cholera, and influenza epidemics have been recorded, including the 20th and 21st centuries. This year marks the 228th anniversary of the use of the Jenner smallpox vaccine. For nearly two centuries, vaccines have protected people from infectious diseases and, alongside improved hygiene measures, contributed to a higher quality of life. Despite the well-documented benefits of immunization, vaccine-preventable diseases continue to pose a global threat.

In Serbia, compulsory immunization was introduced as early as 1839, establishing a long-standing tradition of vaccination and domestic vaccine production. In more recent history, Serbia was among the first countries to implement vaccines against whooping cough, mumps, and measles, as well as hepatitis B for at-risk populations.

The anti-vaccine movement employs various strategies to persuade the public that vaccines are unsafe, casting doubt on their quality and on the intentions of those advocating for their use. Globally, anti-vaccine activism fosters vaccine hesitancy or outright refusal, thereby undermining efforts to halt and eradicate infectious diseases. This resistance complicates epidemiological conditions and results in avoidable illnesses and, in some cases, fatalities from diseases that are preventable through safe and effective vaccination. Effective communication is essential to the success of public health interventions, and citizens' trust in science and the healthcare system must be restored and strengthened.

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Introduction

Infectious diseases have not only caused mass deaths throughout history but have also greatly influenced its course (Radovanović, 2017). The oldest recorded pandemic occurred during the Peloponnesian War in 430 BC. The Plague of Athens is the officially accepted name for an infectious disease epidemic that plagued Ancient Greece, although it had nothing to do with plague (Ravančić, 2006). DNA analysis of dental pulp proved that the cause of the Plague of Athens was typhus, with the bacterium *Salmonella enterica typhi* as the causative agent (Drancourt, 2012). It is believed that the epidemic first broke out in the port of Piraeus in Athens, which was the entrance point for life provisions, and then spread to Dalmatia, Rome, and other regions of the eastern Mediterranean, and that it was present intermittently in 429 BC and in the winter of 427/426 BC (Ravančić, 2006). There has scarcely been a historical era untouched by the presence of epidemics—from the earliest civilizations to the modern age. Since then, numerous outbreaks of smallpox, cholera, and influenza epidemics have been recorded, including the 20th and 21st centuries (Vitiello et al., 2022). The modern world has a more developed healthcare system and the technological capacities to successfully respond to and defend against infectious diseases, which was not the case in the past. However, microorganisms, especially viruses, now spread faster than before.

As a unique class of pharmaceutical products with a complex composition, vaccines are significantly different from other medicines. They are considered a preventive measure against infectious diseases, given to healthy individuals and children at vulnerable ages. Unlike other drugs, exposure to vaccines is short-lived, with no apparent immediate benefit to the vaccinated person. However, the immune response is relatively long-lasting, as the administration of one or several doses of a vaccine provides prolonged immunity. The success of vaccination is reflected only in the reduction of the frequency of infectious diseases in an environment. When the majority of the population of a community is vaccinated against a disease, the entire population is protected, including those who did not receive the vaccine due to temporary or permanent contraindications.

Vaccines are among the most effective tools for preventing infectious diseases and safeguarding public health. Their use protects not only individuals but also entire communities through the mechanism of herd immunity. By preventing the spread of disease, vaccines reduce illness and mortality, ease the burden on healthcare systems, and contribute to social and economic stability. Thanks to vaccination, diseases such as smallpox have been eradicated, while others—like polio and measles—have been significantly reduced. In today's interconnected world, where pathogens spread rapidly, vaccination remains a cornerstone of population health protection.

This year marks the 228th anniversary of Jenner's development of the smallpox vaccine. For more than two centuries, together with advanced sanitary measures, vaccines have protected humans against certain infectious diseases and contributed to the drastic reduction and eradication of diseases that previously had a high percentage of fatal outcomes (World Health Organization, 2024). The World Health Organization (2024) ranks safe water supply as the most important factor for people's health, followed by vaccination. According to the Centers for Disease Control and Prevention in Atlanta, USA (2002), vaccination was the first of the ten greatest health achievements in public health in the 20th century. However, despite the proven benefits of immunization, vaccine-preventable diseases continue to pose a threat worldwide.

History of Vaccination and Vaccine Manufacturing in Serbia

The discovery by the English doctor Edward Jenner in 1796 that resistance to smallpox can be achieved by exposure to a relatively harmless pathogen (cowpox) changed the course of history. It is recognized as the beginning of vaccine production under controlled conditions and the moment of introduction of mass vaccination against a disease that had claimed human lives for centuries. It is not known when and where the first vaccine was administered in Serbia. However, in his book *On the Occurrence and Suppression of Diseases among Serbs, 1202–1813* (1965), Dr. Relja Katić notes that sheep were vaccinated against smallpox as early as 1542. Another mention of inoculation as a method of obtaining immunity against smallpox dates back to 1784, when the authorities in Dubrovnik appointed seven barbers to vaccinate the population against the disease (Катић, 1965).

Miloš Obrenović recognized the importance of vaccination against smallpox in 1839, one year after the issuance of the 1838 *hatt-i sharif* and Serbia's gaining of independence. In cooperation with the Medical State Service, headed by Dr. Karlo Pacek, Serbia's Ministry of the Interior issued the Smallpox Vaccination Regulation on July 8, 1839 (Kršljanin, 2021). That year, the annual vaccine requirement for Serbia was roughly 100,000 doses, all procured from abroad. Immediately after

mandatory immunization was established, a proposal was made to establish the Serbian Serovaccinal Institute.

After immunization was made compulsory in Serbia, the authorities recognized the need to produce vaccines locally. In 1884, Laza K. Lazarević was sent to Vienna to learn the technique for producing the smallpox vaccine. In 1895, Dr. Milan Jovanović-Batut made efforts to establish the Institute for the Preparation of Animal Lymph in Serbia. Thanks to the considerable efforts of Dr. Ljubomir Stojanović and with the support of Milan Obrenović, construction of a vaccine production institute began in Niš in 1898 (Јанковић, 1995). In the spring of 1900, Serbia's first vaccination institute was officially established. Production of the smallpox vaccine commenced that spring, followed by rabies vaccine production in the fall of the same year (Милојевић, 1990). Just thirteen years after the Pasteur Institute in Paris began operating, the so-called Pasteur Institute in Niš—an independent Serbian initiative inspired by Pasteur's methods—was founded, positioning Serbia among the developed countries of the time.

At the beginning of the First World War, there was a serious typhus outbreak among Serbian soldiers. In response, a military bacteriological laboratory was established in the village of Sedis on the Thessaloniki front. Dr. Ludwig Hirschfeld, a Polish doctor, played a pivotal role in setting up this laboratory. Despite the difficult conditions, Dr. Hirschfeld managed to develop vaccines against cholera, typhoid, and paratyphoid A, B, and C in this makeshift laboratory at the front. Under conditions of extreme scarcity and epidemic threat on the Thessaloniki Front during the First World War, Dr. Ludwig Hirschfeld succeeded in producing a typhus vaccine using improvised means. According to accounts from that period, the vaccine was cultured in sterilized beer bottles, which served as substitutes for standard laboratory vessels.

Controlled clinical trials were not feasible in wartime, but field observations indicated a significant reduction in disease incidence among vaccinated soldiers. Approximately half a million doses were produced, contributing greatly to preserving the operational capacity of the Serbian army. Though this episode remains partially obscured by historical uncertainty, it clearly illustrates the importance of scientific ingenuity, improvisation, and rapid public health response under the most challenging conditions (Хиршвилд, 1962). From 1919 to 1926, bacterial vaccines were manufactured at all established bacteriological laboratories (stations) across the country. The Pasteur Institute in Niš ceased operations temporarily in 1915 after occupying forces from Austria and Bulgaria looted and destroyed its laboratory equipment (Кривошејев, 2022).

Unlike many other infectious diseases that have been successfully controlled or eradicated through vaccination, malaria has long remained an exception. Known since ancient times and causing a significant number of deaths, especially in tropical regions and during wartime, malaria has only recently seen the development of an effective vaccine. Previously, prevention relied on a combination of measures:

controlling mosquitoes as disease vectors, using protective nets, insecticides, and prophylactic drugs such as quinine and later chloroquine.

The seriousness of malaria was particularly evident on the Thessaloniki Front during the First World War, where the disease decimated troops. In these conditions, the young physician Dr. Kosta Todorović stood out by organizing systematic malaria control among Serbian soldiers. His approach, which included both preventive and therapeutic measures, resulted in a significant reduction in illness and mortality. This wartime experience had far-reaching consequences: upon returning home, Todorović founded the Clinic for Infectious Diseases in Belgrade and laid the foundations of modern infectology in Serbia (Šuvaković et al., 2019).

Only in the 21st century have the first malaria vaccines, such as RTS,S/AS01 (Mosquirix), been developed, marking a historic breakthrough in the fight against this disease (Laurens, 2019). Although these vaccines are still limited in application and efficacy, they represent a new phase in combating parasitic infections. Linking the historical efforts of physicians like Dr. Todorović with contemporary achievements, it is clear that the fight against malaria requires a continued multidisciplinary approach, in which vaccination plays an increasingly important role.

Following the First World War, the Pasteur Institute in Serbia commenced its work in 1919, paving the way for the establishment of the Epidemiological Institute in 1923. In 1921, a Pasteur Institute was founded in Novi Sad with the primary goal of enhancing anti-rabies vaccine production. At the First Conference of the Directors of the Hygiene Institutes of Yugoslavia, held in Cetinje in 1928, a pivotal decision was made: the Novi Sad institute was designated as the exclusive national center for producing the life-saving rabies vaccine. This strategic move enabled a decentralized vaccination process, effectively implemented across all institutes in the country, and marked a significant triumph in public health initiatives (Ковачевић, 2022, May 6).

The building of the Central Institute of Hygiene in Belgrade was completed in 1924. After the laboratory was equipped, the Institute began producing bacterial vaccines in 1926. Notably, production of the BCG vaccine was introduced in 1927, merely a year after the first vaccine was developed in France (Vasiljević, 1964). The groundbreaking discovery of the first effective and safe BCG vaccine was spearheaded by Dr. Milutin Ranković, a member of the Calmette-Guerin laboratory, where the vaccine originated. On February 9, 1927, Dr. Nadežda Stanojević administered the first dose of a domestically produced BCG vaccine against tuberculosis (Lazović & Sujić, 2007). This pivotal moment marked a significant step forward in the fight against the disease, showcasing the dedication and ingenuity of these pioneering medical professionals. In 1928, thanks to the dedication of Professor Smilja Kostić-Jovanović, obstetric clinics across Serbia began immunizing newborns. This was a major milestone, considering that, at the beginning of the 20th century, the leading cause of mortality in Europe and North America was pneumonia caused by influenza and tuberculosis.

The imperative to protect the war-weary population led to a growing demand for vaccinations. It became clear that establishing a Serovaccinal Department in an isolated location was necessary. In 1927, construction began on Torlak, a hill above Belgrade. The building and its accompanying facilities, specially designed for the production of vaccines and sera, were completed in 1929. Production started in 1930, marking the beginning of a golden era in vaccine and serum manufacturing in Yugoslavia (Centralni higijenski zavod u Beogradu, 1931).

The expansion into the new facilities, alongside the training of experts under optimal working conditions, resulted in a major achievement in 1930: the production of Ramon's diphtheria vaccine, as well as sera for diphtheria and tetanus. Under the leadership of Dr. Dobrila Šnajder, production of the tetanus vaccine began in 1934. These were years marked by massive and recurring diphtheria epidemics, and achieving self-sufficiency in vaccine production proved to be the decisive step in bringing them under control (Јанковић, 1995). In 1937, the diphtheria vaccine became compulsory for all children before entering school.

The challenging conditions of the Second World War resulted in a temporary downturn in production. However, in the post-war period, production resumed and steadily expanded. Ongoing efforts to modernize manufacturing processes led to significant improvements in the quality and safety of vaccine production. The introduction of diphtheria and tetanus vaccines into routine use resulted in a reduction in the morbidity of these serious infectious diseases, significantly changing the epidemiological landscape. In the 1950s, whooping cough and poliomyelitis became the leading causes of death, especially among children. In the late 1950s, after years of dedicated effort, production of the whooping cough vaccine began using isolates from Yugoslavia. This groundbreaking development led to mass production in 1958.

Furthermore, under the leadership of Dr. Ljubinko Stojković, production of the inactivated polio vaccine also commenced during this period. Given recent developments in microbiology and the global spread of poliomyelitis, the need for the oral (Sabin) vaccine became increasingly evident. In a groundbreaking move, Dr. Albert Sabin visited the Torlak Institute in 1960, generously donating poliovirus strains for the production of the live oral polio vaccine (OPV). This pivotal contribution marked the beginning of OPV production, catapulting the Torlak Institute to international prominence. In the early 1960s, successful administration of the vaccine brought an end to the largest recorded epidemic of poliomyelitis in Yugoslavia, marking a monumental triumph over the disease (Јанковић, 1995).

The influenza virus brought widespread devastation and claimed millions of lives from the late 19th through the 20th century. Staggering numbers include 4 million deaths from the Russian flu in 1889, 100 million deaths from the Spanish flu between 1918 and 1920, and 2 million from the Asian flu in 1957. These chilling statistics underscore the urgent need for preparedness and vigilance in the face of potential pandemics (Great Britain, Local Government Board, 1893;

Spreeuwenberg et al., 2018; World Health Organization, 2011). The potential impact of the pandemic highlights the importance of influenza vaccination. Since 1962, the Torlak Institute has been producing whole virus influenza vaccines. Additionally, in 2009, Serbia became part of the WHO Global Action Plan for Influenza Vaccines project. As a result of this collaboration, new technologies for influenza vaccine manufacturing have been introduced (Chadwick et al., 2022).

Torlak's dual competence—as both a vaccine manufacturer and reference laboratory—has been a cornerstone of the country's epidemic response system. The last significant outbreak of smallpox in Europe occurred in early 1972, following the return of a pilgrim from the Middle East who became the index case for the spread of *Variola major* in Yugoslavia. A total of 175 people were infected, and 35 died before the outbreak was brought under control through strict public health measures. Dr. Ana Gligić, a virologist at the Torlak Institute in Belgrade, played a central role in identifying the virus. On March 15, she confirmed the presence of smallpox through overnight laboratory analysis and subsequently coordinated efforts in field diagnostics and virus inactivation (Ilić & Ilić, 2022).

The success of the containment strategy also relied heavily on rapid mass vaccination. In response, a comprehensive vaccination campaign was swiftly implemented, particularly in Kosovo and Metohija—the epidemic's main epicenter—where nearly the entire population was vaccinated by the end of March. Due to a small percentage of vaccine non-responders, the campaign was extended through April to achieve a 95% immunization success rate. Simultaneously, a nationwide mass vaccination program covered over 18 million people across Yugoslavia (Бањошевић, 2012). In collaboration with the World Health Organization, the United States, the Soviet Union, and other international partners, Yugoslavia vaccinated nearly 18 million people in under six weeks, employing a ring vaccination strategy alongside rigorous quarantine measures (Vuljevic, 2022). Active case detection and isolation were critical components of the response, with Dr. Gligić personally participating in field interventions within high-risk zones.

Thanks to a coordinated and scientifically informed response, the epidemic was officially declared over by mid-May 1972. On May 9, Yugoslavia was declared free of smallpox, setting a global standard for outbreak management in the pre-eradication era. Dr. Gligić's contributions remain a hallmark of crisis virology and serve as a reminder of the vital role of laboratory science in public health emergencies (Ristanović et al., 2017).

Epidemiological, Social, and Institutional Responses to the 1972 Smallpox Epidemic in Yugoslavia

In 1962, a plan for epidemic response was adopted in Belgrade, and in 1967, the Federal Institute for Public Health issued guidelines to prevent the importation and spread of smallpox, measures that would later be applied during the 1972

outbreak (Vučetić, 2022). Since the disease had been absent for 42 years, doctors initially had difficulty recognizing its symptoms, and a lack of trained medical staff and poor quarantine organization caused additional problems. The outbreak was initially concealed by the media, which caused concern within the medical community. Once the disease was confirmed on 22 March 1972, the public was called for mass vaccination, to be completed by the end of the month—specifically from March 23 through 28. Disagreements arose over vaccination priorities and issues related to vaccine shortages and funding. The republics clashed: one side advocated vaccinate prioritizing epidemic hotspots and surrounding areas to contain the disease, while others pushed for equal vaccination of all Yugoslav citizens as a preventive measure (Vučetić, 2022).

At the time of the outbreak, smallpox vaccination was mandatory for children up to 3 years of age, with revaccination required for those aged 7 to 14. Vaccination was also compulsory for certain professional groups (e.g., medical staff) and for travelers to regions where smallpox was endemic. The index case, along with 25 other pilgrims, had been vaccinated in December 1971. However, retrospective serological testing showed that 20 of them did not have protective antibody titers, indicating a lack of effective immunity (Jakovljević et al., 1973). In the broader SFRY population, it was estimated that 25% had residual immunity, 30–40% were partially protected, and 35% were susceptible to smallpox.

These findings suggest that vaccination coverage was incomplete and that vaccine-induced immunity was not long-lasting, underscoring the risk of outbreaks even in previously vaccinated populations. At the onset, only 1 million doses of smallpox vaccine were available in Yugoslavia. However, with international aid, an additional 30 million doses were quickly secured, allowing for the immunization of nearly the entire population (Ranitović, 1973). In Belgrade alone, between March 23 and 30, a total of 1,205,792 people were vaccinated, and 310,380 were revaccinated (Dovijanić, 1972).

To facilitate mass immunization, a jet injector (jet gun) was used, enabling the vaccination of up to 1,000 individuals per hour. Adverse reactions were reported at a frequency ranging from 1 in 600 to 1 in 3,000 vaccinated individuals, depending on the region. The majority of these were mild local reactions, including *vaccinia inoculata* and *vaccinia accessoria* (Mocić et al., 1973; Mravunac et al., 1973; Teftedarija et al., 1973; Vuković et al., 1973). Serious complications were rare, but included: *vaccinia generalisata*, *eczema vaccinatum*, *postvaccinal encephalitis*, *encephalomyelitis*, and *myeloradiculo-neuritis*.

In addition to vaccination, quarantine was a key control measure in managing the smallpox outbreak. Several types of quarantine were implemented. Quarantine sites in Serbia included hotels, guesthouses, and mountain lodges, all under police supervision with no free entry or exit. Isolated individuals had their temperature measured several times a day, and disinfection of spaces and personal belongings was mandatory. A doctor, a sanitary inspector, and nursing staff stayed

at the quarantine sites, with isolation usually lasting sixteen days. Although the situation was stressful, there were light moments such as jokes, playing football, and enjoying food and drinks. Mass gatherings were banned; schools and work continued, and life mostly went on as usual. Despite fear, people followed TV programs and celebrated holidays at home.

A total of 15,595 individuals were quarantined: 1,218 in hospital quarantine, 803 in hotel quarantine, 388 at home, and 13,186 in village quarantines (geographic distribution: 50% in Kosovo and Metohija, 36% in Serbia, 13% in Vojvodina, and 0.2% in Montenegro). Among the quarantined, 105 cases of smallpox were confirmed: 52 in hospital quarantine, 7 in hotel quarantine, 44 in village quarantine, and 2 in-home quarantine. Daily monitoring included physical examinations and temperature checks once or twice a day. These strict measures proved highly effective: only three individuals contracted smallpox while in quarantine; all others had been infected before isolation. The use of methisazone (an antiviral) and gamma-globulin during quarantine did not significantly prevent infection (Zdravković et al., 1973).

During the pandemic, the authorities of the SFRY emphasized the importance of public health and cooperation with the World Health Organization. The healthcare system was modernized and physician training improved, including education abroad. A decline in mortality from infectious diseases was recorded due to better living conditions, education, faster diagnostics, and more effective treatment. The main role in controlling the epidemic was played by federal, republican, provincial, and local headquarters; the epidemiological service worked around the clock to trace contacts, place individuals in quarantine, and carry out mass vaccination (Vučetić, 2022).

The smallpox outbreak had a significant impact on both the health and economic situation in the SFRY. It also caused considerable social disruption, as many individuals were quarantined without the possibility of contacting their families, leading to stress and dissatisfaction. The direct economic cost of the outbreak was estimated at 6 billion SFRY dinars (equivalent to 600 million U.S. dollars in 1972) (Rokvić et al., 2016). Despite all challenges, the mass vaccination of the population in Yugoslavia is regarded as one of the most successful campaigns in the world.

History of the Anti-Vaccination Movement

Fear of vaccines dates back to the very origins of vaccination itself. Resistance to vaccination has existed since its inception and predates the terms "vaccine" and "vaccination." Even in the 18th and 19th centuries, some posters mocked people vaccinated against smallpox using cow's lymph, portraying them as naive and shocked by the changes in their bodies caused by the lymph. In 1763, Dr. Gatti, originally from Italy, practiced inoculation in Paris but failed to follow quarantine

rules, which led to the spread of smallpox (Martini et al, 2022). In response to his unprofessional practice, inoculation was banned in Paris after causing widespread discontent among the population. Even the great writer Voltaire was a strong opponent of inoculation. Despite the initial poor practices among adults, inoculation became increasingly popular for children.

Mandatory immunization in Europe was first introduced in 1806 by Élisa Bonaparte, sister of Napoleon Bonaparte, during her rule over Lucca and Piombino—territories that now form parts of Italy and France (Pavli & Maltezou, 2022). In America, mandatory immunization against smallpox was established in 1809 in Massachusetts (Jackson, 1969). Compulsory immunization of children was first introduced in America in 1850, in Great Britain in 1853, and in the same year, an anti-vaccination league was founded in London (College of Physicians of Philadelphia, 2022; Durbach, 2005). The global anti-vaccination movement gained significant momentum when British activist William Tebb visited America in 1879, igniting a worldwide wave of resistance against vaccination (Wolfe & Sharp, 2002). By 1880, this fervent opposition had spread to other countries, consolidating into a powerful and influential global movement.

The debate surrounding vaccination has remained remarkably consistent over the centuries. Enduring questions about vaccine safety, vaccination failure, personal freedoms, and conspiracy theories involving the medical profession and authorities continue to captivate our attention. The lingering mistrust of vaccines is evident in hesitancy to accept or refuse vaccination services despite their availability. The term "vaccine hesitancy" implies a spectrum of behaviors, from complete refusal to be vaccinated to delay or selective acceptance of vaccines. This hesitation is often rooted in uncertainty and mistrust, which can vary by time, location, and specific vaccines. It is crucial to understand and address these concerns to ensure widespread vaccination and community health. The arguments against vaccination are consistently refuted by scientific evidence. Vaccine production and regulation are governed by strict legislation, ensuring safety and efficacy. Expert public health authorities are responsible for determining the appropriate number of doses for both primary vaccination and revaccination. The World Health Organization recognizes vaccination as an essential human right. On the other hand, anti-vaccination activism stands as one of the most dangerous threats to global public health.

In the 20th century, several global anti-vaccination campaigns were launched. In 1902, after a smallpox outbreak, the Board of Health in Cambridge, Massachusetts, mandated mass vaccination. Henning Jacobson refused vaccination, arguing the law violated his right to care for his own body as he saw fit (Gostin, 2005). As a result of the refusal, the city filed criminal charges against him. After losing a court battle locally, Jacobson appealed to the U.S. Supreme Court, which ruled in favor of the state in 1905. The verdict emphasized that the state has authority to enact mandatory laws to safeguard the public during outbreaks of

infectious diseases. This landmark case marked the first time the U.S. Supreme Court addressed state power in public health law, setting a significant precedent (Mariner et al., 2005).

Despite the remarkable success of vaccines and mass vaccination in the early 20th century, there was still significant resistance from the public. A striking example occurred in 1926 when health workers attempting an immunization drive in Georgetown were met by an angry mob and forced to leave the city. Furthermore, due to pressure from lobbyists, Sweden imposed a moratorium on the whooping cough vaccine from 1979 to 1996. During this period, more than 60% of children contracted whooping cough by age 10 (Hallander et al., 2005).

In the early and mid-20th century, opposition to vaccines and vaccination stemmed from a lack of understanding and reluctance to embrace new methods. Fast-forward to the 1980s and 1990s, when a new trend emerged involving celebrities. These were not just any celebrities—they were influential figures from film and television who, along with self-proclaimed "experts," lacked medical training or expertise in infectious diseases or pediatrics.

Main arguments against vaccination in the 20th century included claims that vaccines caused autism, attention deficit disorder, learning disabilities, and other conditions; that mandatory vaccination violated parental rights; that vaccine components were unnatural and harmful; that too many vaccines could overwhelm a child's immune system; that natural immunity was superior to vaccine-induced immunity; that disease reduction was primarily due to hygiene and sanitation rather than vaccines; and that vaccines could cause the diseases they were intended to prevent.

In 1998, British doctor Andrew Wakefield suggested a possible connection between bowel disease, autism, and the MMR vaccine, which he published in *The Lancet* (Hackett, 2008). This unfounded suspicion quickly spread through the media, sowing public fear and confusion about vaccine safety (Deer, 2011). The General Medical Council, Great Britain's independent regulatory body, uncovered a "fatal conflict of interest" in Wakefield's research. Further investigations found that he breached professional rules, committed scientific fraud by falsifying data, and had a profit-driven agenda based on unfounded claims (Deer, 2011). Numerous studies have rigorously evaluated the safety of the MMR vaccine and consistently found no link with autism (Taylor et al., 2014).

In the 20th century, Serbia did not experience significant anti-vaccination campaigns. The country consistently kept up with modern immunization trends and had a nearly century-old tradition of successful vaccine production. However, the situation changed dramatically at the turn of the 21st century. Just before the 2009/2010 flu pandemic, Serbia experienced a significant increase in anti-vaccination sentiments, which continued to grow after the pandemic. Information about vaccines is now spread by entertainers and informal groups promoting the negative aspects of vaccines and vaccinations. Instead of relying on expert

advice, people are exposed to sensationalist headlines created by long-standing anti-vaccine activists via media and social networks. The issues surrounding vaccines are becoming increasingly politicized. For example, at one point, Italian Minister of the Interior Matteo Salvini supported groups fighting to abolish vaccinations (BPPJ, 2018). During his first term, U.S. President Donald Trump expressed skepticism about vaccines, falsely linking them to autism; however, he later encouraged parents to vaccinate their children (Cha, 2015). The COVID-19 pandemic provided fertile ground for the spread of anti-vaccine beliefs. Managing a new disease and finding an instant solution posed a great challenge for national health systems as they struggled to control the pandemic.

The Anti-Vaccination Movement as a Transcultural and Social Phenomenon

The anti-vaccine movement is a phenomenon that transcends national and cultural boundaries. It should therefore not be viewed as a local issue, but as a global, well-organized network. This movement leverages various messaging platforms and strategies across different countries (Vučurović et al., 2023). These efforts often unfold across social media and online environments, disseminating misinformation and mobilizing supporters worldwide—posing a significant challenge to global public health. Anti-vaccine groups actively market their content using methods such as bots and trolls to rapidly generate and amplify anti-vaccination messages (Ortiz-Sánchez et al., 2020). They also promote the use of social media as a primary source of health-related information, often disregarding professional guidelines. In addition, they emphasize controversial claims regarding the economic interests of pharmaceutical companies. Although healthcare professionals should remain the primary source of health information, including that related to vaccines, the internet—due to its accessibility and persuasive design—has become a dominant channel for health communication (Bean, 2011). The vast array of search results creates a fertile ground for websites with unreliable content, which in turn fosters false beliefs. Given the significance and widespread nature of the anti-vaccine movement, the information shared on social networks has had a great impact on global populations. These messages should be understood as a form of social engineering, capable of shaping public attitudes and behaviors. Misinformation shared on social media has often bypassed state regulations and restrictions through coordinated strategies. For this reason, the anti-vaccine movement must be recognized not only as a social phenomenon but also as a potential political instrument.

The anti-vaccination movement aligns closely with the core principles of social movements. It emerged and grew from a group of individuals united by shared beliefs and values, with a focus on challenging scientific norms, institutions,

and systems perceived as working against their collective interests (UNICEF, n.d.). Through dialogue and networking, the movement coalesced around policy changes that its members regard as a priority.

Anti-vaccination groups often exhibit a more organized internal structure than official authorities, which enhances their effectiveness in spreading messages. This includes decisive leadership, strategic and proactive communication, and the capacity to mobilize followers rapidly. Their use of social media and community networks enables swift information sharing and fosters a strong sense of belonging among members. Such a level of organization presents a significant challenge for public health authorities and related initiatives, making it difficult to counteract the movement's influence.

Consequences of Anti-Vaccination Campaigns for Global Public Health

The amount of misinformation and disinformation regarding vaccines has significantly increased in recent years, especially during the COVID-19 pandemic. This surge has posed major challenges for public perception and trust. Globally, anti-vaccine activism has succeeded in creating indecision by spreading misinformation and misinterpretations of facts that support it. The persistent denial of scientific evidence and the systematic undermining of empirical data have repeatedly raised concerns about the ethical integrity of experts involved in vaccine development and promotion. The deliberate manipulation of data through claims of insufficient epidemiological evidence regarding causal relationships fosters public confusion and heightens anxiety (Ortiz-Sánchez et al., 2020). Although mandatory childhood immunization remains crucial for protecting the most vulnerable populations, parental hesitation or outright refusal can significantly reduce overall coverage rates (Janković, 2014).

Serbia has a centuries-old tradition in both vaccination and vaccine production, and for many years it successfully resisted anti-vaccination influences, a trend that has changed in recent years. Historically, our country was among the first to implement vaccines against whooping cough, mumps, and measles, as well as hepatitis B for the broader population, not just for at-risk groups. While the global use of vaccines has led to the eradication of smallpox and poliomyelitis, as well as a significant reduction in other vaccine-preventable diseases, modern society now faces the challenge of sustaining immunization efforts. Immunization refusals are on the rise, correlating with increased anti-vaccine activism. This trend threatens to halt progress in eradicating infectious diseases, complicates the epidemiological situation, and leads to unnecessary illnesses and, in some cases, deaths from diseases that can be prevented with effective and safe vaccines.

The COVID-19 pandemic revealed numerous structural vulnerabilities in global healthcare and political systems, one of which was the significant rise of the

anti-vaccination movement as a complex social phenomenon. While this movement is often reduced to misinformation and scientific ignorance, it is essential to consider other factors that played a substantial role during the coronavirus crisis.

A key factor was the erosion of public trust in healthcare systems. Throughout the pandemic, the public was exposed to contradictory messaging from official institutions, frequent changes in health recommendations, and a general lack of transparency in decision-making. This loss of institutional credibility fueled growing skepticism, particularly toward vaccines that were developed at an unprecedented speed.

Moreover, the financial aspects of the COVID-19 pandemic generated considerable controversy. Multinational pharmaceutical companies accrued substantial profits from vaccine sales, much of which was facilitated by significant public funding for research and development (de Haan & ten Albert, 2023). Concurrently, many contracts between these companies and governments were kept confidential, leading to legal disputes and raising justified concerns regarding transparency and equitable access (Transparency International Global Health, 2021).

Another critical issue was the politicization of vaccination. In several instances—such as the refusal of EU member states to recognize Russian and Chinese vaccines (e.g., Sputnik V and Sinopharm)—vaccination became a geopolitical matter. Such politically motivated exclusion undermined the principles of equal access to healthcare, encouraging conspiracy theories and the dissemination of misinformation.

These dynamics underscore the need for a broader, interdisciplinary understanding of the anti-vaccination movement, extending beyond a narrow biomedical lens. A combination of political analysis, sociological insight, and ethical critique is crucial for developing more transparent, equitable, and sustainable public health strategies in the future.

In addition to systemic and political factors, a significant portion of public resistance to vaccination during the COVID-19 pandemic stemmed from shortcomings in communication by medical professionals and institutions. In many instances, healthcare authorities failed to clearly and transparently communicate objective risks, potential contraindications, and known side effects of the vaccines—factors that were, in fact, listed by manufacturers in official documentation. This lack of comprehensive patient education contributed to the perception among parts of the population that critical information was being downplayed or withheld, thereby undermining trust instead of reinforcing it.

Another contributing factor was general mistrust toward new technologies, which tends to increase in times of crisis. The introduction of mRNA-based vaccines—while scientifically innovative—was perceived by some as premature or insufficiently tested, despite their approval by regulatory agencies. The speed of their deployment, combined with limited public understanding of the underlying science, created fertile ground for uncertainty and vaccine hesitancy. In many

cases, health communication strategies were not adequately adapted to address these emerging concerns in real time.

This points to a critical need for future public health campaigns to emphasize informed consent, transparency, and patient-centered communication. Ensuring that patients are meaningfully informed about both the benefits and risks—rather than merely reassured—can strengthen public trust in health systems and reduce the influence of misinformation during future health emergencies.

Drawing on the experiences of key figures during past epidemics, in 18th-century Serbia, the clergy—led by individuals such as Archimandrite Stefan Stratimirović—played a crucial role in promoting smallpox vaccination, educating the public, and securing broad acceptance through trusted communication (Ninković & Vasin, 2019). This historical example underscores a key lesson for today: medical professionals must recognize the importance of vaccination and ensure clear, consistent communication with the public to maintain trust and promote informed decision-making.

According to data cited by Academician Todorović, between 1895 and 1911, a total of 13,603 cases of smallpox were registered in Serbia, with 2,292 deaths—indicating a mortality rate of nearly one in five. However, this number significantly declined in the former Yugoslavia due to improved public health measures and vaccination campaigns. Following the 1972 outbreak, which lasted from February 16 to April 11, no further cases of smallpox were recorded in Yugoslavia (Šuvaković et al., 2014).

Early and transparent engagement of healthcare professionals plays a crucial role in mitigating anti-vaccination narratives. For instance, despite limited prior experience with smallpox, medical personnel were actively involved in its control and treatment. Notably, Prof. Dr. Vojislav Šuvaković and Prof. Dr. Miomir Kecmanović from the Infectious Diseases Clinic in Belgrade made significant and sustained contributions through continuous collaboration with fellow physicians and healthcare staff. This example underscores the importance of timely and clear communication by medical professionals in fostering public trust and reducing vaccine hesitancy.

Conclusion

Health workers have an ethical obligation to uphold the principles of official science and to refute the unfounded views of anti-vaccine activists with scientifically confirmed facts. Continuous and planned education for both health workers and the public can significantly improve the situation. Anti-vaccination lobbyists and associations are not just a sociological phenomenon; their impact on public health must be taken seriously and not underestimated. The media plays a crucial role in promoting the ideas of this movement, and its influence on public decision-making is substantial.

Engaging public health experts is essential for building trust, enhancing understanding, encouraging active participation, countering misinformation, fostering collaboration, and gathering valuable feedback. By prioritizing expert involvement, we can effectively highlight the critical role of science in navigating crises, leading to more informed and resilient communities. With the right tools, healthcare providers can be part of the solution by spreading positive messages online. Social networks are ideal for genuinely connecting with patients. Informative video messages are especially effective at promoting responsible behavior. It is essential to tackle this important issue, but also crucial to ensure that interventions are accurate. Misguided efforts can have unintended negative consequences and may worsen the situation.

Effective communication is essential for the success of public health interventions, and restoring and strengthening public trust in science and the health system is crucial. Authorities should put efforts into developing communication strategies and interventions aimed at addressing vaccine misinformation.

The COVID-19 pandemic revealed the risks of relying on global supply chains for medicines and vaccines. Developing domestic production is crucial for faster responses and better control over quality and costs. Beyond technology, clear crisis protocols, efficient logistics, and trained healthcare staff are essential. Improving communication between doctors and patients through ongoing, science-based education builds trust and prepares society for future crises. Long-term investment in local pharmaceutical industries, crisis management, and public education must be key priorities for post-pandemic health policies.

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Катарина М. ПЕТКОВИЋ

Институт за вирусологију, вакцине и серуме „Торлак”
Београд (Србија)

Историјски и друштвени аспекти вакцинације и антивакцинални покрет у свету: утицаји на Србију

Резиме

Заразне болести су кроз историју значајно утицале на друштвене токове и цивилизацијски развој. Најстарија документована пандемија описана је током Пелопонеског рата 430. године пре нове ере. Од тада, свет је био погођен бројним епидемијама – од малих богиња и колере до вируса грипа – које су обележиле и XX и XXI век. Ове године обележава се 228 година од примене Џенерове вакцине, која је означила почетак нове ере у превенцији заразних болести. Вакцине већ скоро два века штите људску популацију и у комбинацији са напредним хигијенским мерама, доприносе значајном побољшању квалитета живота. Ипак, и поред доказане ефикасности имунизације, болести које се могу спречити вакцинама и даље представљају глобалну претњу.

У Србији је обавезна имунизација уведена 1839. године, чиме је започета дуга традиција вакцинације и домаће производње вакцина. У новијој историји, Србија је била међу првим земљама које су увеле вакцине против великог кашља, заушака, морбила, као и хепатитиса Б за ризичне групе.

Антивакцинални покрет, присутан широм света, користи различите стратегије како би подрио поверење јавности у безбедност и квалитет вакцина, као и у намере оних који их промовишу. Његов глобални утицај огледа се у порасту неодлучности или потпуном одбијању вакцинације, што представља озбиљну препреку у борби за елиминацију заразних болести које су на путу ерадикације. Тај отпор компликује епидемиолошку ситуацију, доводи до непотребних оболевања, па и смртних исхода од болести које се могу спречити безбедним и ефикасним вакцинама. Кључ успеха јавноздравствених интервенција лежи у транспарентној и емпатичној комуникацији. Враћање и јачање поверења грађана у науку и здравствени систем мора бити приоритет свих актера у области јавног здравља.

Кључне речи: Србија; историја вакцинације; антивакцинални покрет; јавно здравље.