



Healthcare: Public Policies, Social Practices, and Individual Experiences

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Vaccine as a Sociocultural Artefact: The Example of Locally Produced Polio Vaccine in Serbia

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Abstract: The paper argues that vaccines could be viewed as artifacts which communicate various social messages and are used as instruments for fulfilling different sociopolitical goals besides meeting public health needs. It further suggests that such social, cultural and political influences may have real effects on the choices of vaccine technologies or vaccine production, and aims to demonstrate their importance in the area which is normally seen as the domain of objective science. This is demonstrated by using the example of the locally produced oral polio vaccine (OPV) in Serbia during the socialist and post-socialist periods in the country's history.

Keywords: polio vaccine; artefact; vaccine production; vaccine technologies; socio-cultural influences

Introduction

During the recent Covid-19 pandemic, considerable attention has been placed on different aspects of vaccines and vaccination. Besides the topics of vaccine hesitancy and refusal, the issue of vaccines as products has also become prominent, indicating that vaccines could be viewed as artefacts invested with particular meanings and values, and treated as symbols. This was especially reflected in some governments' preferences for acquiring vaccines produced by the so-called Western or Eastern manufacturers, notably based on different political and ideological orientations or motives (see Kazharski and Makarychev 2021). Thus, the choices of different Covid-19

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vaccines became symbolic markers of political (non)alignment (Trifunović and Blume 2023). Likewise, the technologies used as platforms for developing these vaccines have been evaluated in the public as superior or inferior, and more or less trustworthy based on which manufacturer implemented them.¹ This paper considers similar tendencies and outcomes of treating vaccines as symbols, but in a local Serbian context and in some previous periods.

The paper aims to demonstrate how various influences framed the locally produced polio vaccine as a sociocultural artefact, which then served for fulfilling wider sociopolitical goals. The polio vaccine, originally developed elsewhere and for the benefit of humanity, acquired a special status in the local context where it became valued as techno-cultural heritage. The paper will identify sociocultural, economic and political influences which created such a status of this vaccine and determined its usage for different purposes in socialist and postsocialist periods besides meeting public health needs. This further reflected on the process of “lock-in” around the technology applied in its production and partly caused local resistance to inevitable global changes in the field of vaccines. Thus, the paper will explore how ideas and values attributed to the locally produced polio vaccine affected its production by contributing to its rise during socialism and decline in the postsocialist context.

In the decades prior to the Covid-19 pandemic the political economy of vaccine manufacturing had been significantly transformed. Various global geopolitical factors were identified and extensively researched as important influences on the developments in that respect (see Blume and Baylac-Paouly 2021). Besides new production technologies, the free market ideology of the 1980s led to the closing of public sector manufacturers or to their privatisation by multinational corporations, while the knowledge underpinning the production of vaccines was reconfigured as intellectual property. The Covid-19 pandemic initiated another technological and political transformation, shaping the emerging system of vaccine production with renewed interest in domestic manufacturing. In understanding the course of these developments, it is important to acknowledge various factors which could have potential influence on the decisions in those domestic contexts. Considering vaccines as items of material culture points to often neglected effects of cultural factors on local vaccine production. This perspective sheds light on culturally determined logic which domestic institutions might follow due to specific symbols associated with locally produced vaccines. The interpretation of vaccines and vaccine production

¹ This could be vividly depicted by quoting one blog post about the politics of pharmaceutical branding: “‘The Chinese vaccine? Hell no,’ she replied. ‘I am a Pfizer girl,’ and she proudly tapped her shoulders where she received the jab”. Bineth, Ariel. 2021. “‘Not the Chinese, I’m a Pfizer Girl!’ The Covert Politics of Pharmaceutical Branding in Covid Struck Hungary.” *Medical Anthropology at UCL*. 13 May 2021. <https://medanthucl.com/2021/05/13/not-the-chinese-im-a-pfizer-girl-the-covert-politics-of-pharmaceutical-branding-in-covid-struck-hungary/> (accessed 23 October 2023).

within the frames of material culture contributes to understanding the real effects of sociocultural influences in the field which is normally analysed through the prism of global geopolitical influences.

Theoretical Framework and Methods

The concept of lock-in is an approach to understanding the successions of technologies or ways in which experience in the use of a technology excludes alternative technological procedures (Blume 2005). It has been applied in considering the history of polio vaccines, with a focus on scientific and socioeconomic logic behind lock-in around a particular technology (Blume 2005). This paper will illustrate sociocultural influences in this process by using an analytical framework devised for studying technologies and material culture as influenced by representations, beliefs and ideas which have little to do with basic scientific or technological logic (Lemonnier 1992). Lemonnier's theory mostly deals with the relationship between technological systems and other social phenomena, striving to demonstrate how technologies are integrated into the larger social, economic and symbolic whole. According to him, besides immediate or obvious informational aspects of material culture (such as shape or style), there are more subtle informational or symbolic aspects of technological systems that involve arbitrary choices of techniques or materials that are not simply dictated by function, but which are integral components of the larger symbolic system (Lemonnier 1992).

For Lemonnier (1992), even the most advanced domains of modern technology, such as the designing of nuclear missiles or planes, can serve as a prism for essentially cultural manifestations like values or ideas. As products of technologies that are constantly being modernised and normally evaluated on objective, scientific grounds, vaccines have not been often analysed as items of material culture and through the lens of sociocultural influences. In that respect, the paper will follow Lemonnier's guides for exploring the cultural manifestations in technologies and artifacts—"the information that must be taken into account includes not just the shape or decoration of the artifact, but also the materials it has been made from, the way it has been made, the way it has been used, the artifacts or technological behavior that could have been made or used instead" (Lemonnier 1992, 97). According to Lemonnier (1992), collecting the aforementioned information would be the way to avoid missing entire sets of social phenomena that are related to the making and use of items of material culture. Being parts of systems, technologies and artifacts can only be understood if they are related to the other elements of the system they belong to (Lemonnier 1992). Perhaps the most obvious characteristic that distinguishes vaccines from other artifacts is the primacy of the technological

aspect and not so much the importance of shape or decoration. Therefore, vaccines appear especially suitable for integrating the stated approach with the concept of lock-in in considering how sociocultural influences could affect their production.

The paper draws on more comprehensive research conducted in 2020 about the functions, achievements and weaknesses of vaccine production in the public sector. In the conducted qualitative interviews with nine former employees of the Serbian Torlak Institute,² the theme of the locally produced polio vaccine emerged as prominent and interesting, indicating that this vaccine was ascribed a special status. The analysis in this paper will be based on the same sources, but this time with the focus on ideas, values and meanings attributed to the polio vaccine and on various influences which shaped its production.

The participants in interviews were different generations of experts who were professionally active during the socialist and/or postsocialist period. Also, some were engaged in the production of bacterial vaccines, some in the production of viral vaccines and some held management positions. The participants were recruited using the snowball method and the interviews took place in September and October 2020 (Trifunović 2022). In order to protect their identities, the names of interview participants will not be revealed. Informed consent was obtained from all individuals included in this study.

The First Developed Polio Vaccines: Influences, Evaluations and Usage

The creation of two main polio vaccines occurred under the pressure of various influences, while specific factors provided the grounds for their different evaluation. Both vaccines were characterised by advantages and weaknesses, which were partly constructed within the frames of certain ideas and social goals of that time.

Poliomyelitis (often called just polio) is an exclusive human disease transmitted from person to person through the fecal-oral route due to poor hand hygiene, shared objects, or contaminated food and water (Mehndiratta, Mehndiratta, and Pande 2014). It is described as “an acute viral infection that influences the motor neurons within the spinal cord and brain, leading to the classic manifestations of paralysis” (Ahmad et al. 2014, 143). Although the disease has been associated with crippling deformities and sometimes death, the most severe form, paralytic poliomyelitis, is seen in less than 1% of the infected, while the majority of cases (around 95%) are

² The official name of the Institute has changed over time. For the sake of simplicity, the “Torlak Institute” will be used in this paper.

asymptomatic (Mehndiratta, Mehndiratta, and Pande 2014). Yet, polio is considered a high-impact epidemic disease mostly because of its immense social, scientific and cultural influence (Snowden 2019). It acquired such status primarily by inspiring major public health strategies to contain it, among which vaccine development is one of the most important.

Polio became an epidemic of significant concern in the twentieth century. Before that, the virus circulated in unsanitary conditions not causing great pandemics or epidemics like smallpox, influenza, or the bubonic plague. Historically, the disease was considered an affliction of early childhood and, for the majority, the outcome was mild infection followed by a lifetime of immunity (Oshinsky 2005). However, in the early twentieth century, a dramatic change occurred prompted by hygienic advances in the industrialised West, when polio began to strike older children, adolescents and young adults. Significantly improved sanitary conditions prevented contact with the virus early in life, gradually forming a large pool of susceptible individuals, which in turn provided the basis for more frequent outbreaks that struck at later ages (Snowden 2019). Moreover, it was noted that the chances of serious paralysis and death rose dramatically with age (Oshinsky 2005). In the United States, polio was a source of terror and the focus of considerable attention not just because it killed or marked for life, but also because of the age and class profile of its victims, and emerging social orientations at the time of the largest outbreaks. Unlike other infectious diseases, polio had a predilection for affluent neighborhoods, attacking white children in preference to ethnic minorities (Snowden 2019). The disease reached its peak in the 1940s and 1950s when an increasingly suburban, family-oriented society was focused on establishing high standards of protection for the young (Oshinsky 2005). Social awareness about polio especially rose when Franklin Delano Roosevelt was diagnosed with it in his late thirties (Oshinsky 2005).

Considering these important social effects of polio in the United States (Snowden 2019), it is not surprising that comprehensive public health strategies against this disease were initiated there. One such strategy was generous funding of a fierce competition for developing a vaccine. In that endeavor, two different technologies were promoted and later on became great competitors. Albert Sabin aimed to develop a live-virus (attenuated) vaccine that would trigger a natural infection weak enough to cause a serious case of polio, but strong enough to generate lasting antibodies against it, while Jonas Salk, on the other hand, favoured a killed-virus (inactivated) vaccine that was supposed to stimulate the production of desired antibodies without causing a natural infection (Oshinsky 2005). Preferences for these two technologies differed between polio researchers and the leaders of the National Foundation which funded the development of vaccines. The former backed the live-virus approach arguing that it would provide a better immune response and eventually lead to the eradication of polio. The latter supported the simpler

killed-virus vaccine which could be marketed more quickly and with fewer health risks to the public (Oshinsky 2005). Namely, it was more challenging to attenuate a virus than to kill it, and attenuated viruses could also revert to virulence³ and cause outbreaks.

Jonas Salk, thus, created the first successful inactivated polio vaccine (IPV), which proved effective in 1954 via the so-called Salk Vaccine Field Trials which included almost two million elementary school children in the United States. Salk was instantly celebrated as a hero and a benefactor of humankind, while his vaccine was viewed as America's gift to the world that would benefit children everywhere (Oshinsky 2005). However, as Oshinsky noted, while Salk was a favourite of the people, he was not so much a favourite of the academy like Sabin. In line with Lemonnier (1992)'s theory that meanings and values are not excluded from the technological domain, not everybody was impressed with Salk's achievement. Namely, the technology which Salk applied in creating the vaccine did not seem appealing enough to some of his colleagues. Certain experts in the field thought of it as an obsolete way of producing a vaccine that did not bring anything new, and viewed it as a mere old science to be used until something better came along (Oshinsky 2005). Albert Sabin seemed to have voiced the opinion of some of the most influential researchers of the time when he remarked: "You could go into the kitchen and do what he did" (Oshinsky 2005, 7). For these high-ranking professionals, the technology which Salk used was not creative enough and it did not provide basis for new discoveries. In their eyes, Salk was not a research pioneer, but old-fashioned and unoriginal (Oshinsky 2005). Precisely on the grounds that he made no fundamental scientific discovery, Salk was denied admission to the elite National Academy of Sciences.

It should be noted that the inactivated polio vaccine was also contested because of its other and more important drawbacks. Securing adequate protection required three properly spaced shots with an additional booster dose once a year. This implied the need for qualified vaccinators and made vaccination too expensive for worldwide use (Snowden 2019). Furthermore, the application of this vaccine turned polio from a disease that struck the middle class into an affliction of the unvaccinated which were mostly the poor who were beyond vaccinators' reach (Snowden 2019). This meant that polio eradication goal could not be achieved with an inactivated vaccine, which did not fit into the enthusiastic vision of achieving a final victory over infectious diseases that took root in the United States at the time (Snowden 2019). Last but not least, a year after successfully conducted trials, the so-called Cutter incident cast a dark shadow on the Salk vaccine. Upon vaccination, more than 200 polio cases were traced to contaminated lots of the vaccine produced

3 Virulence is the capacity of microorganism to cause the disease.

by Cutter Laboratories in California. Most of the victims were severely paralysed and eleven people died (Oshinsky 2005). This pharmaceutical disaster incited the introduction of new regulations and production rules which ensured the safety of inactivated vaccine. Although there were no more similar incidents, public confidence was shaken and the circumstances were ripe for an alternative live-virus vaccine. The new technology already had the overwhelming support of the researchers in the field who viewed the Salk vaccine as a relic of the past (Oshinsky 2005).

According to most experts of that time, a live-virus vaccine had many advantages over an inactivated vaccine. It did not require trained vaccinators because it could be swallowed on a sugar cube instead of being injected. It was believed that a single dose would be enough to provide life-long immunity, so there was no need for a booster. Additionally, a live-virus vaccine appeared to work faster, within days rather than weeks, which meant that it could stop an outbreak already underway (Oshinsky 2005). Sabin also believed that only a live-virus vaccine could accomplish complete eradication of polio. According to his findings, those who received the oral polio vaccine (OPV) extensively shed the attenuated virus in a community and raised its herd immunity by “passively immunising” the unvaccinated (Snowden 2019, 394). Sabin successfully tested his vaccine in the Soviet Union in 1959, and soon thereafter the oral polio vaccine replaced the inactivated vaccine in the United States and much of the world. Seen as a more effective product, easier to administer and cheaper to produce, OPV became dominantly accepted (Oshinsky 2005). These factors additionally provided grounds for lock-in around OPV technology worldwide (Blume 2005). Finally, the oral vaccine was endorsed by the World Health Organization (WHO) as the best means of eradicating polio around the globe. In other words, the preference of OPV technology over IPV technology was also partly based on the then-dominant idea of achieving a final victory over microbes (Lemonnier 1992; Snowden 2019).

There were clear advantages of the live-virus vaccine over a killed-virus vaccine, but the former was not without important flaws. If properly prepared, the inactivated vaccine was completely safe and after the Cutter incident there were no more cases of polio in the United States linked to this vaccine. A live-virus vaccine, on the other hand, did cause a small number of polio cases (around one in a million doses), especially in children with weakened immune system. Although wild poliovirus had been eliminated, after 1980 about a dozen cases of polio per year were attributed to the live-virus vaccine in the United States (Oshinsky 2005). The attenuated virus in the vaccine always possessed the potential to mutate and revert to virulence, causing the outbreaks of the vaccine-associated paralytic polio. Thus, a paradox emerged whereby it was impossible to eradicate polio without a live-virus vaccine, but it was also impossible to eradicate polio with it (Snowden 2019). Therefore, new

recommendations appeared during the 1990s about combining OPV and IPV, while in 2000 the Centers for Disease Control (CDC) endorsed a full return to the inactivated vaccine in the United States. The WHO, on the other hand, remained convinced about the benefits of OPV in low-income countries. The debate about which vaccine was better and should be used long outlived the creators of these vaccines (Oshinsky 2005).

Initiating and Advancing the Local Production of Polio Vaccine: Political, Ideological, and Economic Influences

Ever since becoming an important part of public health policies around the world, locally produced vaccines have been treated as symbols of national pride and prestige (Stern and Markel 2005). Such a status could be linked to the reputation of the first developed vaccines as legacy and tokens of the modern, progressive world. This was also the case in Serbia where the state organised production of vaccines can be traced to the very beginning of the 20th century. Besides economic and health-related motives, additional reasons for initiating vaccine production in this country were political and ideological. These included aspirations towards creating the reputation of a modern country and escaping the identification with backwardness often associated with the emerging nations in the 19th-century Balkans. In connection to the changing sociopolitical circumstances over time, national vaccine production was subsequently also seen as a symbol of the country's independence (Trifunović 2019).

All this points to specific values and meanings attributed to vaccines and consequently to the national institutes in charge of their production. One such institution was the Central Hygiene Institute founded in Belgrade in 1924. Its vaccine manufacturing department eventually evolved into a separate institution, later named the "Institute for Sera and Vaccines Torlak", which became the leading vaccine manufacturer during the socialist period in the country's history (Torlak 1995). The institute produced the BCG vaccine (against tuberculosis), the combined DTP vaccine (against diphtheria, tetanus and pertussis) and the influenza vaccine, but the most important in ideological and economic regards appeared to be the polio vaccine.

Following World War II, vaccine production in Serbia, at the time a republic within a larger socialist state, Yugoslavia, was significantly determined by the

internal and external political and economic factors. After the political break with the Soviet Union in 1948, the Yugoslav socialist system evolved as an alternative to the Eastern bloc. In economic respects, the state-ownership over the means of production was replaced by social-ownership. This experiment created a specific model of the economy called socialist, or workers' self-management, with the goal of enabling active participation of workers in governing enterprises conceived as social and not state property. Within these frames, the Yugoslav economic system also went through many modifications that generated its distinct subtypes over the course of time. For example, the period of the 1960s and early 1970s, when the local production of vaccines was gaining momentum, was known as market socialism due to reforms that introduced elements of market mechanism into the economy (Trifunović 2022).

In geo-political terms, the break with the Soviet Union turned Yugoslavia towards the Western block which brought about foreign loans, reparations and aid, prompting rapid economic expansion and growth. Thus, intensified and improved vaccine production in the following period served to demonstrate extraordinary social development and modernisation taking place in the established socialist order. In other words, besides obvious health-related reasons, ideological motives once again underpinned the introduction of new technologies and novelties in local vaccine production. The country was also one of the initiators of the Non-Aligned Movement, an organisation that brought together numerous developing states throughout the world, which were opting for independence from the two power blocs. The support of the West and ties forged with the third-world countries intensified Yugoslavia's foreign relations and involvement in world markets, particularly encouraged by the state's policy to give more freedom to enterprises in their foreign trade operations (Trifunović 2022).

This stimulated the exportation of the locally manufactured polio vaccine, which increased its importance in economic, political and cultural terms. International circumstances in the vaccines field also contributed to a favourable climate for the local vaccine production. At the time there was almost no patent protection for vaccines, and knowledge on production techniques was usually freely exchanged between institutions or experts (Blume 2008). These local and global sociopolitical influences provided the basis for a spectacular rise of the production of the polio vaccine during the socialist period in Serbian history. This vaccine became the most important product of the Torlak Institute, invested with certain meanings and values which practically ensured its status as local technological heritage.

Meanings, Values and Political Usage of Locally Produced Polio Vaccine

In the late 1950s, the Virology Sector of the Central Hygiene Institute merged with the previously established Torlak Institute and started manufacturing Jonas Salk's inactivated polio vaccine. The accounts of some experts who participated in this endeavour testify about the importance attributed to establishing the production of this vaccine. This was particularly demonstrated by their work enthusiasm based on a sense of mission and the beginning of something special:

In '59, the department for polio vaccine production started working. There were twenty of us who moved on to vaccine production and the Salk vaccine was first made with a live virus.⁴ We all came, we with a university degree and technicians, with absolutely no previous knowledge because it was a completely new thing and not only was it new, but it was very dangerous because it was a live virus, so we all got vaccinated and it was hard work... So, it was a very hard work with a lot of enthusiasm, and very quickly, I don't know if it had been a year, we conquered⁵ the production of the Salk vaccine. (Respondent 2)

However, the production soon reoriented to Albert Sabin's vaccine. This decision could be ascribed to the international trend of replacing IPV with OPV during the 1960s, but also to the representations of the OPV technology as more advanced. Given the aforementioned ideological motives to demonstrate the process of modernisation in the established socialist order, the introduction of OPV technology also communicated the message of being up to date with the latest world trends. In Lemonnier's terms, this essentially cultural factor could at least partly account for a change in technological behaviour (Lemonnier 1992). Therefore, it could be said that the choice of new technology was also compatible with social and political efforts towards further aligning with the developed countries.⁶

It was this vaccine that acquired a special local reputation through the values attributed to it on various grounds. In that respect, besides the

⁴ This refers to the production process and not to the final product which was a killed-virus vaccine.

⁵ As explained by interview participants, this term was commonly used in referring to establishing the production of polio or any other vaccine.

⁶ Although OPV was dominantly accepted worldwide, some countries like Finland, the Netherlands and Sweden continued to use the Salk vaccine alone. This suggests other motives in technology choices. For instance, the Dutch institute had little interest in exploring the possibilities of developing an international market for its IPV. Instead, the production was on a scale sufficient for the country's needs, indicating that public health and not commercial considerations influenced the choice (Blume 2005).

implementation of the latest technology, of additional importance was the material the vaccine was made from and the way it was used for wider sociopolitical purposes (Lemonnier 1992).

Firstly, the vaccine was manufactured from the strains provided by Albert Sabin himself and according to his instructions, which was in line with the common practice of free knowledge sharing at the time. Therefore, the origin of the strains and Sabin's authority initially provided a basis for constructing a special status of the locally produced polio vaccine, making it an artifact created from specific "materials" and in a special way (Lemonnier 1992):

We got the seed for that vaccine from the father, the creator, Sabin. He also came to our institute and production was initiated. (Respondent 1)

OPV [in the Torlak Institute] was made directly under the control and supervision of Sabin. He came to the Torlak four times and I talked to a colleague who was sitting and writing, and Sabin was standing above her dictating the production protocol. So, he directly told her what and how to do it. That is why we were the third country in the world which made the polio vaccine according to Sabin's instructions, and then the production grew, we exported it... during socialism, we exported 100 million doses of polio vaccine, and for the domestic market around 1.5 million doses were used throughout Yugoslavia. (Respondent 7)

The ways in which this vaccine was further used, apart from meeting public health needs, suggest social and ideological purposes which artefacts normally have. First, the locally manufactured vaccine served as a symbol of international success of the Torlak Institute. The "conquered" production, which followed shortly after the vaccine had been created, implied equality with state-of-the-art institutes elsewhere in following the latest trends. Consequently, the production of this vaccine also contributed to building the authority of the Torlak Institute in the field of public health within the country:

The golden years of the Torlak were the 1960s and 1970s, when you were equal with them [the world]. That's the time when Sabin brought the strains to Belgrade. At the same time, you start the production of OPV in Moscow, Belgrade, and Paris. Mind that: at the same time! You are equal with the world there. (Respondent 8)

I think there was a very positive opinion. When you say "the Torlak", people believed in both vaccines and experts. The opinion of the public was very positive. The positive opinion was because people saw what the Torlak produced, people had confidence in those products. (Respondent 3)

... We sold the polio vaccine in almost 120 countries around the world which we produced just three years after Sabin had made it. He gave Serbia the strains and it took us three years to make it, register it and start exporting it. (Respondent 5)

The decades following the end of the World War II were marked by great enthusiasm about the power of science and technology, which yielded confidence in eradicating many diseases, including polio (Snowden 2019). These global ideological motives additionally stimulated the mass production of the polio vaccine in the Torlak Institute and its exportation to South America, Europe, Africa and Asia. The Institute also supplied the United Nations Children’s Fund (UNICEF), the World Health Organization and the Pan American Health Organization with its polio vaccine, thus contributing to what became the Global Polio Eradication Initiative (Trifunović 2022). While the conquered production of polio vaccine mostly symbolised the success of the Torlak Institute, its mass exportation further turned it into the status symbol of the whole country:

[Exportation was important] not just for the Torlak, but for the whole country. Big money, great reputation, imagine you vaccinate the whole of South America with a vaccine from Serbia, that was something. The eternal contest for prestige in the world. (Respondent 1)

Local production was of immense importance because the [polio] vaccine was exported. Half of the world was vaccinated with that vaccine, and all of Yugoslavia. (Respondent 2)

The Torlak exported in more than one hundred countries. That was a huge achievement. (Respondent 6)

The quoted accounts suggest that the local polio vaccine had a vital role in the demonstration of international prestige, which seems to have been an important ideological motivator of domestic vaccine production during the socialist period. Like vaccines produced in previous periods, the polio vaccine served to signal the country’s modern and progressive reputation both nationally and internationally. Needless to say, mass production and exportation brought significant revenues, which provided additional grounds for valuing the local polio vaccine. Therefore, it is not surprising that this vaccine acquired a privileged status in comparison to other products:

... Polio [vaccine] was exported. Other vaccines not that much. Those who worked on the polio vaccine were privileged. The main vaccine was polio. All directors treated the polio vaccine differently because of the revenues. The Department of Virology and the Sector for Bacterial Vaccines and Serums sometimes had a strained relationship. Bacterial vaccines were at their peak in the first half of the 20th century, and then viral vaccines, which were new and “trendy”, took over. Those who worked on bacterial vaccines earned less than those working on viral vaccines. The polio vaccine was pushed forward because of the profits it made. (Respondent 7)

Don’t think it was easy for those who weren’t in the production [of polio vaccine] to get something... (Respondent 1)

The Decline of Local Polio Vaccine: Sociocultural Influences

So far, it has been shown that mass production and exportation of the polio vaccine were very much determined by political and economic circumstances of the time, and also by ideological motives. Consequently, the locally manufactured polio vaccine became valued on political, economic, ideological and sociocultural grounds. The real effects of these influences were not only positive. As much as they were the cause of the spectacular rise of the local polio vaccine in the beginning, they were also partly the source of its weaknesses and subsequent decline of its production. For a start, due to its value and acquired status, the vaccine became too important to be questioned, which was especially evident in terms of rare side effects associated with OPV. The incidents from the 1980s and 1990s, when the polio vaccine caused paralysis in a number of Serbian children (Mujović-Zornić 2016), resonated in the public almost three decades later and served as one of the arguments for the anti-vaccine movement which emerged in the country during the postsocialist period (Trifunović 2019):

There were also secrets, we later found out that there were serious post-vaccination reactions in children who received polio [vaccine]. All this was covered up, the public could not find out about it, which was wrong, and then measures were not taken in time... but money, money, money, to sell it, not to embarrass ourselves in front of the world. Afterwards, many people sued the Torlak. (Respondent 5)

The media and the public found out about it after 29 years. [One of the persons in charge] claimed that it was not a vaccine virus, but a wild one. Later it was proven to be the vaccine virus. (Respondent 7)

The Torlak Institute also preferred to stick to the production of OPV despite the subsequent trend of gradual return to IPV in other countries. As indicated before, the Institute already had experience in producing an inactivated vaccine. In Lemonnier's terms (1992) this means that a perfectly understood technology was ignored for some reason even in circumstances which required its re-introduction. Therefore, it could be said that causes other than the absence of "know-how" blocked the return to the production of IPV. In that sense, Lemonnier points to the social context of a technological choice and notably the "meaning" attributed to various elements in the technological system as crucial factors (Lemonnier 1992, 7). Beside a major concern of most vaccine manufacturers that the costs of setting up IPV production would be considerable (Blume 2005), the following accounts seem to suggest some additional factors which contributed to lock-in around OPV technology in the local context:

I don't know why it didn't happen, I guess because the production on monkey kidneys was absolutely conquered, there was a big demand, a big exportation, I think we vaccinated the whole of South America and India. (Respondent 2)

According to this, already successful production and large revenues associated with OPV probably led to continuity and not change in technological choice. In other words, the factors which initially participated in building a special status of the local polio vaccine subsequently contributed to “technological inertia” with ultimate negative effects on local production.

Perhaps large revenues from exportation could have been directed to re-establish the manufacturing of IPV. Instead, in a specific sociopolitical context those revenues were intended for other social purposes, which indirectly reflected on the technological choice. As already indicated, the Yugoslav system went through many modifications that generated its distinct subtypes over the course of time. After the so-called market socialism in the 1960s and early 1970s, a period of so-called contractual socialism ensued with the reforms implemented by the 1974 Constitution and the 1976 Associated Labor Act (Mencinger 2000). New organisational forms were supposed to enable workers in enterprises to directly and on equal terms exercise their economic and self-management rights. Although this system was controversial in practice in terms of the full involvement of workers in the management of enterprises, interviews suggest that workers at the Torlak Institute did participate in at least some important decisions, like profit distribution (Trifunović 2022).⁷ The determinants that shaped the collective decisions in that respect could be found in a primary focus on providing housing for workers and in the society's dominant consumer orientation at the time (Trifunović 2022). Therefore, large revenues primarily served for satisfying workers' needs, which possibly further contributed to lock-in around OPV. An additional contributor seems to have been the decision of some key experts based on their perception about the risks of IPV technology:

I tried to persuade [certain persons in charge who had experience with producing previous IPV] to re-start the production. The whole world started applying the inactivated vaccine, it was slowly coming back. However, they didn't want to. I said “But you had already made it before”, and the answer was “I did, but I won't do it again, it's dangerous”. In order to make an inactivated vaccine, you have to work with the most virulent strain that exists. They didn't want that, even though they knew how to make it. (Respondent 7)

⁷ Local production of polio vaccine counters the argument that all Yugoslav enterprises were intrinsically uncompetitive, but it affirms the argument about the shortcomings of a managerial system of those enterprises. There is now a widespread consensus that the system of self-management agreements was the root cause of the subsequent deterioration in productivity of Yugoslav enterprises (Palairt 1993).

Eventually, IPV came into use again and the exclusive need for OPV drastically fell, which consequently affected the local production. As demonstrated in this section, specific sociocultural factors also contributed to the lock-in process and the subsequent decline of local OPV. This adds another aspect to the decline of national vaccine production which is usually linked to important political occurrences in Yugoslavia and global changes in the vaccines field. During the early 1990s, Yugoslavia disintegrated shortly after a civil war had broken out and Serbia entered the process of postsocialist transformation. The international sanctions, then imposed by the United Nations, led the country into extreme isolation with serious social and economic repercussions. The isolated country had lost its Yugoslav and global markets and the production of vaccines was reduced to satisfying only local needs (Trifunović 2022). Subsequent blows to the production and exportation of the polio vaccine were global changes in the vaccines field which were gaining momentum in the same period.

The Clash with Global Trends and New Concepts

Lost revenues during the sanctions did not immediately undermine the status of the polio vaccine. On the contrary, in new circumstances additional important meanings and values were attributed to this vaccine which was viewed as a way of returning to the international market once the sanctions were lifted. High hopes were placed on restoring exportation which was supposed to bring back large revenues and initiate general modernisation of vaccine production in the Torlak Institute: “The idea was to improve the production and to invest in other vaccines from the income we would get from exportation” (Respondent 8).

Although wealthy countries mostly switched to IPV, the WHO maintained that only OPV should be used in most of the world. This was possibly seen as an opportunity for a locally produced vaccine. On the other hand, it soon became obvious that significant global changes had occurred in the field. Re-establishing cooperation with the UN procuring agencies required the implementation of the WHO’s vaccines prequalification programme that had been developed in the meantime with the aim of establishing global standards of quality, safety and efficacy (Trifunović 2022). The programme introduced a new concept of quality by giving increasing importance to Good Manufacturing Practice (GMP). In other words, vaccines were no longer considered of high quality if the end products passed certain tests, but only if the quality was built into every stage of the production process through maintaining and monitoring the consistency of production (Milstien, Batson, and Meaney 1997):

The Torlak exported large batches of polio vaccine before the sanctions and during the sanctions that stopped. So, after the sanctions it was necessary to start redistributing the vaccine, and the condition for that was prequalification. That's an administrative form by the WHO, where you apply with all your potential: personnel, space, and equipment, in order to receive a certificate that you can continue exporting the vaccine. So, we did the best we could at that moment to get prequalification from the WHO and we didn't get it. (Respondent 8)

You couldn't get certificates to go anywhere outside with the vaccine if you didn't produce it in a controlled way, and that's expensive. (Respondent 6)

The GMP standards implied the need for adequate control environments, validation of equipment and procedures and supporting documentation, all of which involved significant costs and efforts for the Torlak Institute (Trifunović 2022). Thus, the demands of the WHO's prequalification programme not only proved to be an important barrier, but the new practices also provoked negative feedback and resistance at the local level. According to the accounts of some respondents, those were framed in accordance with specific views about vaccine manufacturing and status already ascribed to the locally produced polio vaccine. Namely, during the 1980s significant changes in the field of vaccines began to occur globally. Advanced biotechnological processes were being applied in the production of new and improved vaccines, while the technology had been patented by large pharmaceutical manufacturers, who were no longer willing freely to collaborate or to share knowledge (Blume 2008). This could be marked as a kind of a global "paradigm shift" in vaccine production, which reflected a change from cooperation to competition:

Until the 90s, you could go to an institute abroad to get educated, learn something and have them pass on knowledge to you. Since the 90s, that has become impossible. What is called a "know-how" is a closely guarded secret now and it is not revealed to anyone. (Respondent 4)

Unfortunately, large multinational companies started to commercialize vaccine production. They began to dictate extra conditions for production: standards, new premises, sterile rooms, and sterile air. Small producers could not get a certificate so easily even though they had a quality product. They were supposed to have the conditions which demonstrated that it was production according to the so-called GMP. (Respondent 5)

Such new circumstances were in stark opposition to the way knowledge about manufacturing the polio vaccine was transferred to the Torlak Institute. Moreover, the old practice of passing on technological knowledge was important in building the aura of value and prestige around the locally produced polio vaccine. As already indicated, the status of this vaccine was partly grounded in Sabin's authority and the fact that he provided the strains and freely shared "know-how" with the Torlak Institute. Contrary to that tradition, in new circumstances, anonymous consultants dictated vaccine manufacturing protocols instead of a distinguished scientist who

created the vaccine. It seems that those consultants were never perceived at the local level as having the same authority which Sabin once had. Thus, new practices and rules in the field of vaccines were interpreted by some as degrading for the Torlak Institute:

[Do you know] who a consultant is, the one coming from the wide world? That is someone who will take the watch off your hand, tell you what time it is and put it back onto your hand... Because those who came [to the Torlak Institute] were not some renowned scientists, but someone from the administration to tell you how you should do it [produce vaccine]. And many of them didn't even know what we [experts in the Torlak Institute] knew, and then they come and tell you how you should do it. (Respondent 8)

This suggests that global concepts and demands clashed with local concepts and interpretations of those demands, partly based on meanings and values built around the locally produced polio vaccine. The Torlak Institute has always taken great pride in having Sabin's original strains, which were also perceived as a valuable asset, given that national vaccine production has been traditionally viewed as a symbol of the country's independence. Therefore, an internationally required technical procedure of certifying the original strain was also negatively interpreted within the frames of local economic interests and cultural representations (Trifunović 2022, 191):

The original strains [Sabin's polio strains] needed to be certified, handed over to them [the WHO] to get a certificate, because without that we were not able to sell in the market that they [the WHO] provided. The Torlak refused that. When you give it to them, then it is theirs, and the only trump card for us was to have the original strain that we could trade with. If you give it to them for certification, that's one of the mechanisms to oppress you and remove you... We are the only ones in the world who have the original strain. The WHO and the Americans were after that, but normally it's not something that you just give away. (Respondent 6)

All those strains are preserved, and that's a great asset for us. It's a great national treasure in case we need to start the production again. (Respondent 8)

According to all these accounts, challenges in adapting to global requirements in vaccine production also came from cultural resistance to new tendencies perceived as demeaning, particularly with respect to the status of local polio vaccine. This portrays the field of vaccine production as a sphere of negotiations between local and global concepts and values (Trifunović 2022).

The pressure of international standards and political trends eventually led to the complete suspension of the local production of the polio vaccine. This was especially prompted by the country's orientation to catching up with global neoliberal developments, when the priorities and values changed at the state level. In line with the newly adopted neoliberal agenda in the early 2000s, there seemed to be no

ideological grounds for a long-term government financial support for the state institutes which produced vaccines, as they were seen as a token of an obsolete socialist system. Moreover, there was a commitment to breaking both ideologically and practically with the previous system and its symbols (Trifunović 2022). Consequently, the Serbian government failed to provide sufficient financial support for the production of the polio vaccine, indicating its dependence not only on technological global developments in the field of vaccines but also on changes in ideological orientations.

Concluding Remarks

The application of Lemonnier (1992)'s approach in searching for cultural manifestations in technologies and artifacts revealed how a biological product, such as a vaccine, could acquire a special status in a local context, and how that could affect the course of its production over time. Made from Albert Sabin's strains and based on the latest technology at the time, locally produced OPV was valued as an artefact created from a distinguished "material" and in a prestigious way. As such, the vaccine and its production were used for communicating political and ideological messages, and for serving economic and social purposes. This demonstrated how vaccines and vaccine technologies are integrated into the larger social, economic and symbolic whole and shed light on values and commitments guiding the production of the polio vaccine in local context.

In analysing artefacts as related to other elements of the system they belong to, Lemonnier also suggested taking into account the artifacts or technological behaviour that could have been made or used instead (Lemonnier 1992). Thus, this approach illuminated sociocultural determinants of lock-in around OPV technology at the local level despite the international trend of reestablishing an alternative production process. In that sense, the approach contributes to answering the question of "how and why might the public health system become 'locked-in' around a vaccine that becomes suboptimal as needs and epidemiological profiles change?" (Blume 2005, 162).

In arguing for the utility of the concept of lock-in, Blume points out that it directs our attention beyond the technological options that have become excluded from the practices and interests that give rise to this exclusion (Blume 2005). According to his analysis, the initial process of lock-in around OPV at the international level was based on a set of clear-cut scientific arguments which subsequently played a vital part in the socioeconomic logic leading to lock-in (Blume 2005). For public health authorities, the reasons for not changing course were existing immunisation schedules, established routines of healthcare workers and the familiarity and faith of

the public. For the vaccine manufacturers, the reasons were economic and based on a concern about the costs of initiating IPV production and the investments tied up in existing facilities (Blume 2005). The approach adopted in this paper pointed to the cultural logic beside the socioeconomic logic of the lock-in around OPV. Furthermore, this perspective revealed that sociocultural influences can have real and important positive, but also negative, effects on the production of vaccines.

Global pharmaceutical companies eventually became dominant in the production of vaccines worldwide. This and other indicated global trends are typically seen as the main cause of the general decline of vaccine production in public sector institutions (Blume 2008; Blume 2017). The approach in this paper additionally sheds light on the local response to those global developments, which manifested in resistance based on a special status and value attributed to the locally produced polio vaccine. In other words, complying with global demands was not easy only for economic reasons, but also for cultural reasons. This perspective appears important in understanding the logic that public sector institutions follow when engaged in vaccine production (Blume and Baylac-Paouly 2021). Although of less importance than global trends and developments, local sociocultural influences, at least in Serbia, have also contributed to the rise and fall of national vaccine production.

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Bionote

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