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Lessons from the Past - The Smallpox Outbreak in Yugoslavia, An Impact on Public Health and the Economy

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Abstract: Smallpox is a deadly disease caused by a virus from the group of orthopoxviruses. It is best characterised by a rash that appears 12 days after the infection. The virus spreads rapidly through aerosols and can lead to explosive epidemics with unforeseeable consequences. Smallpox has been widespread in the world for centuries, and about 30% of patients die from it. The largest outbreak of Smallpox (*Variola vera*) in Europe after World War II was that in the former Socialist Federal Republic of Yugoslavia (SFRY) in 1972. The death rate was 20%, i.e. 35 out of the 175 infected people died in a population of approximately 20,600,000. These numbers made the epidemic one of the most dramatic in the 20th century when it comes to public health in the Balkan region. Social and economic consequences were profound. In addition to disrupting social life (meaning that a lot of people were quarantined and had no chance to make contact with their families, which exposed them to stress and made them dissatisfied), the spread of smallpox in the SFRY had a significant impact on the country's health and economy. A total of 6 billion SFRY dinars (about 600 million US dollars) was spent on the epidemic in 1972.

Keywords: smallpox, public health, vaccine, direct costs, health economics, externalities

1. Introduction

The index case was a pilgrim from the village of Danjane, who was one of the 24 pilgrims to have visited Makkah and Medina. He had paid a visit to the holy places of Dervish Muslims in the vicinity of the cities of Basra and Baghdad (Iraq) in the period from 2nd to 6th February 1972, where smallpox had already been reported. The pilgrim's symptoms and signs were non-specific. The disease ended shortly, without any other clinical manifestations. Only the serological tests subsequently done revealed that the said person had, in fact, been infected with the smallpox virus, the clinical picture of the disease being light and atypical [1].

Out of the 175 infected people, 35 of them died (20 percent). Smallpox had not been reported in Yugoslavia since 1930, and mandatory vaccination had been in place for more than half a century [2].

This paragraph explains the beginning of this major health issue in the former Socialist Federal Republic of Yugoslavia (SFRY), which had significant consequences for the health and lives of people in this country and also caused profound economic consequences. In this context, through an analysis of the content (method) or available sources that testified to the impact of disease outbreaks on public health and an analysis of available sources attesting to their impact on direct costs, the paper also deals with external effects in health economics.

2. Method

Content analysis was used as a method for this research study. Content analysis is a method for determining the existence of specific words, themes, or concepts in a given qualitative dataset, i.e. text. It is possible to quantify and examine the meanings and relationships of these words or concepts through the use of content analysis.

Content analysis is a popular method for conducting qualitative studies. There are three distinct techniques to content analysis: conventional, guided, and summative, rather than a single way of conducting it. As a result, all three techniques adhere to the naturalistic paradigm by analysing text content. Coding schemes, the origins of codes, and the challenges to trustworthiness are the main differences between the approaches. Traditional content analysis derives coding categories from the text data directly. A theory or related research findings are used as direction for the initial codes in a directed approach to analysis. There are many ways to conduct summative content analysis, but they all revolve around analysing the data and drawing conclusions from it. Examples from the field of end-of-life care illustrate the analytic approaches for each strategy and technique addressing trustworthiness [3].

We have analysed WHO reports prepared by Litvinkenko, Arsic, and Borjanovic in 1973 [4] and the Declaration of global eradication of smallpox (1980) issued by the World Health Organization [5] as well as available research studies on PubMed and Saga and SFRY newsletters dating 1972-1973.

Given the limited political freedoms and political context that existed at the time of the smallpox epidemic in the country, there is not much official data on the direct costs caused by the epidemic. On the other hand, the same is true for the effects of the epidemic on public health. The analysis was done on the basis of available news articles and scientific papers written decades after the epidemic.

3. Results

In Yugoslavia, smallpox had been registered in 1930 for the last time. In the meantime, compulsory vaccination of children (primary vaccination at the age of 3 months to 3 years and revaccination at 7 and 14 years of age) was regularly carried out. Also, the male population was vaccinated in the army. About 80% of conscripts were vaccinated, but the success of the vaccination programme was not checked at all in some areas. As time went by, the percentage of vaccinated town children was decreasing, as well as the number of elderly citizens who had got their jab, which meant a great many people could contract smallpox [4].

On March 14, the Institute for Public Health of Serbia (Belgrade) was warned about the eight patients suffering from suspected smallpox who had been hospitalised in the meantime, all of them cousins of the index case, and some of them having been in contact with that person. That signified the outbreak. Their samples were taken the next day. On March 16, the virological examination confirmed the smallpox diagnosis. A state of emergency was immediately declared by the state authorities and the whole country was quarantined. The World Health Organisation’s epidemiologists Donald Henderson and Reinhard Lindner from Austria were asked for help [6]. Thus, a broader epidemic was prevented. The measures taken following the imposition of martial law (on March 16) entailed blocking entire villages and neighbourhoods, the installation of roadblocks, the prohibition of public gatherings, closing borders and the prohibition of all non-essential travel. The neighbouring countries simultaneously closed their borders [7]. As has just been said, that was the last major outbreak of the smallpox disease in Europe, which took 35 lives out of the 175 infected individuals [8].

Numerous reasons contributed to the mentioned large outbreak, such as the so-called “silent” importation of smallpox (which was a result of the light and atypical clinical picture of the index case), the belated detection of the outbreak, as well as the belated introduction of the measures intended to control the disease. Of the other reasons that contributed to the spread of the epidemic, the following can be mentioned: the country lacked an immunisation strategy that would generate the best effects in the described circumstances, namely the so-called ring vaccination (which involves vaccinating contacts in the peak of the outbreak first, and only then moving on to others in concentric rings); there were difficulties in conducting the vaccination, e.g. delays and unavailability of the vaccine and the specific immunoglobulin, which resulted in a large portion of the vaccination programme being unsuccessful. There was no disease containment strategy and the public was not informed in a timely and accurate manner in order to be familiarised with the epidemic either [9].

The outbreak of smallpox had a powerful effect on the health of the population of the SFRY and the economic situation in the country, leading to the disruption of social life to some extent too (meaning that a lot of people were quarantined and had no chance to make contact with their families, which exposed them to stress and made them dissatisfied) [10].

Vaccination suppresses the disease. The last detected and confirmed case was registered in 1977 (Somalia). Vaccination and isolation of patients proved to be of the utmost importance in the prevention of the disease. Although smallpox was declared eradicated in 1980 by the WHO [5], the experience gained from the outbreak may contribute to the training and education of healthcare workers in the domain of the prevention and control of the spread of this so-called “mother of all plagues”, particularly considering the emerging threat of smallpox. Table 1 shows cases and deaths by age and vaccination status.

Table 1. Cases and Deaths by age and vaccination status [4].

	Age (years)	<1 age	1-6 ages	7-14 ages	15-19 ages	20+ ages	Total
All cases	Vacc.	-	1	6	7	91	105
	Unvacc.	12	14	13	6	21	66
	Total	12	15	19	13	110*	175*
Deaths	Vacc.	-	-	1	1	6	8
	Unvacc.	8	3	3	2	7	23
	Total	8	3	4	3	17*	35*
Case-fatality ratio		67%	20%	21%	23%	15%	20%

*Includes four unknown vaccination statuses.

In many communities, an epidemic is not accepted or acknowledged because it threatens specific social, economic, and institutional interests [11]. When an outbreak begins, an author observes a pattern that has recurred over centuries: doctors identify a few “suspicious” cases and either keep their concerns to themselves or report their suspicions to authorities, who are usually reluctant to acknowledge the presence of such a dangerous intruder publicly [11]. The Yugoslav smallpox epidemic faced the same problem.

3.1. Externalities in health economics

In economics, external effects are the benefits or harms that one entity causes to another entity through its behaviour (production or consumption) in a way that it cannot control. Costs, i.e. benefits that occur in this way, cannot be the subject of market transactions [12].

External effects, both positive and negative, are often expressed in health care when using health services. By satisfying his needs, the individual consumer often does something that also has social benefits. Prevention and treatment of infectious diseases are typical examples of such actions.

If the majority of the population is vaccinated as a protective measure against infectious disease, the probability of a person belonging to the rest of the population getting sick will be significantly reduced. For example, it is for this reason that developed countries are interested in fighting infectious diseases in developing countries. A barrier preventing the spread of diseases is created far from their own borders, while some diseases such as smallpox are completely stopped. These actions can be driven by humanitarian reasons, but we can also see in them concern for the health of our own population [13].

Huge external benefits can also be found in the results of medical research. Medical knowledge and the progress of science in this field, communication of new results, and discoveries bring benefits wherever the conditions for their application exist. This is especially true if the use of scientific results is not limited by various barriers and an interest in profit.

Prevention programmes are also characterised by the enormous benefits that the community realises through their implementation. Promotional activities that contribute to curbing the prevalence of the disease by reducing the level of exposure of the population to risk factors that cause the disease can have a long-term effect on reducing health care expenditures and improving the productive potential of the community.

Such promotional activities for the improvement of health do not have to be exclusively limited to the actions of health care providers, although most often they appear to initiate them and carry them out. Other sectors can also be successful promoters and initiators of actions that contribute to the protection and improvement of health, such as education, mass media, companies, etc.

Negative external effects related to health occur in different forms. Driving under the influence is a typical example of an action that puts at risk not only drivers and passengers but also other people. Environmental pollution can lead to a deterioration in the health of a large number of people. Various kinds of production (e.g. the production of cigarettes, alcohol, etc.), trade in these products, and aggressive marketing have negative consequences for the health of a country's population.

Various production activities can worsen the living conditions of people living nearby. There are many examples: untreated ash dumps next to thermal power plants and plants in the chemical industry can be the cause of air pollution; the discharge of untreated wastewater into rivers, and so on. The use of dangerous weapons in regions where there are crisis hotspots can have long-term consequences on the quality of the environment (e.g. the use of depleted uranium, etc.).

As of recently, the pharmaceutical industry follows strict screening procedures when introducing new drugs. The side effects of new drugs in different circumstances of its use are now investigated. If, however, some adverse effects of a drug remain unknown, future consumers of the drug may be exposed to the risks of a dangerous deterioration of health. The "thalidomide tragedy" is well known and is already in the annals of medical history.

Nowadays, according to CDC's guidelines, live vaccines such as smallpox, anthrax, and typhoid are only recommended for a small percentage of the population in certain research and travel situations in the United States [14].

The world's population under the age of 40 is particularly vulnerable because there hasn't been a single public vaccination campaign against smallpox since the 1980s [15].

3.2. *The costs of smallpox*

About 10 to 15 million cases of smallpox occurred in more than 50 countries in 1966. Between 1.5 and 2 million people died each year as a result of the disease. With no new cases of smallpox reported since 1978, smallpox has been officially eradicated. Nevertheless, debate continues over whether smallpox strains should be kept in specific laboratories due to the threat of bioterrorism.

It could be a program or intervention. The establishment of the Smallpox Eradication Unit at the World Health Organisation in 1965 and a pledge from the campaign's largest donor, the United States, reinvigorated international efforts to eradicate smallpox. With the aid of the bifurcated needle, vaccination was made easier for those countries where the disease was prevalent. In the five remaining countries, a concentrated effort was made in 1973 to monitor and contain outbreaks. Somalia recorded its final endemic case of smallpox in 1977. Smallpox was declared eradicated by the World Health Assembly in May 1980, after two years of monitoring and searching.

Between 1967 and 1979, the annual cost of the smallpox campaign totalled US\$23 million per year. International donors contributed 98 million dollars, while the endemic countries contributed 200 million dollars. The USA saves the entire amount of all its contributions every 26 days because it does not have to vaccinate people or treat the disease [16].

According to estimates, eliminating smallpox from the world cost a significant amount of money. The vaccine, personnel, and transportation accounted for the bulk of the programme's costs in 1967. This equated to around 10 cents per shot in developing countries. It is estimated that \$50,000 a year were spent vaccinating about a fifth of the 2.5 billion people who lived in underdeveloped countries at the time. The endemic countries, on the other hand, spent only \$10 million a year on the project. In underdeveloped countries, India is the only one to have calculated the economic impact of smallpox. It was estimated in 1976 that the cost of treating a smallpox patient in India was \$2.85 per patient; the total annual cost of patient care for India was \$12 million. Estimates based on India's claimed share of global smallpox incidence put the cost of caring for people with smallpox in developing nations at over \$20 million in 1967. Using a person's lifetime economic output, it has been estimated that India loses \$700 million each year due to a decrease in economic performance. Eradicating smallpox, underdeveloped countries as a whole were losing at least \$1 billion a year in 1967, if 1.5 million people died of smallpox, which is a conservative estimate based on the data available at the time. As a result of this, industrialised countries suffered the costs of vaccination programmes in order to prevent the reappearance of the disease. Only \$92.8 million was spent in 1968 on 5.6 million primary vaccines and 8.6 million revaccinations in the United

States, or \$6.50 per injection. 8,024 people required medical attention, 238 people were hospitalised, 9 people died, and 4 were permanently disabled as a result of vaccination. In 1968, the vaccine programme cost 75 cents per person, which included various indirect costs like absenteeism from work. If other industrialised countries have lower costs, the annual cost for these countries is approximately \$350 million, based on their population. Smallpox was estimated to have cost the world over \$1.35 billion in the late 1960s, including both direct and indirect costs. International and endemic country contributions were \$98 million and \$200 million, respectively, between 1967 and 1979 for the enhanced eradication operation. The largest donor, the United States, saves the sum of all its contributions every 26 days. Preventing the spread of smallpox by means of vaccines is one of the most cost-effective ways to help people stay healthy [16]. The direct cost of the outbreak was reflected in a total of 6 billion SFRY dinars (an equivalent to approximately 600 million US dollars) in 1972 [10].

4. Discussion

Based on content analyses, some drawbacks were made. The Institute for Public Health of Serbia (Belgrade) was notified of eight people hospitalised with possible smallpox, all of them relatives of the index case and some in contact with him. That was the outbreak, patients were tested, and a virological test proved smallpox. The state authorities declared a state of emergency and quarantined the entire country. The WHO enlisted the aid of epidemiologists and a larger epidemic was avoided. To implement martial law, entire towns and neighbourhoods were blocked, roadblocks were set up, public meetings were prohibited, borders closed, and all non-essential movement was prohibited. That was the last significant outbreak of smallpox in Europe, and 35 people died of the 175 infected [4]. In the instance of smallpox, the grounds for the massive outbreak were the late detection of the outbreak and the late implementation of control measures. Other factors that contributed to the spread of the epidemic include: the country lacked an effective immunisation strategy, namely ring vaccination (vaccinating contacts during an outbreak, then progressing in concentric rings), and faced difficulties in conducting mass vaccinations, such as delays, unavailability of the vaccine and the specific immunoglobulin, which is why vaccination failed to a great extent. There was no disease containment strategy, and no accurate information was given to educate the community.

The smallpox outbreak had a tremendous impact on the health and economic position of the SFRY's population, as well as social life (meaning that a lot of people were quarantined and had no chance to make contact with their families, which exposed them to stress and made them dissatisfied). In 1972, the epidemic cost the SFRY 6 billion dinars (about 600 million USD).

Vaccination halted the spread. The last confirmed case occurred in 1977 in Somalia. Vaccination and patient segregation were crucial in preventing the sickness. In light of the emerging threat of using the smallpox virus as a biological weapon [5] the experience gained from the outbreak may be useful in training and educating healthcare workers about the prevention and control of the spread of this so-called "mother of all plagues".

5. Conclusion

The spread of smallpox in the SFRY had a tremendous influence on health and economics, as well as social unrest. Citizens were quarantined and had no chance to make contact with their families, which exposed them to stress and made them dissatisfied and had other psychological consequences. According to the available data, more than 600 million dollars was spent on fighting the disease in 1972, which cost 6 billion SFRY dinars.

The enormous contribution to the increase in life expectancy and the growth of the world's population that occurred during the nineteenth and twentieth centuries is due to discoveries in medicine, the discovery of vaccines and drugs that have made it possible to prevent or cure many diseases. The invention of antibiotics has greatly changed people's lives. Mortality from infectious diseases has been reduced by using drugs that could be made available to all segments of the population. There has been strong international interest and appropriate economic support for such actions to curb and eradicate certain diseases, e.g. smallpox. When it comes to chronic diseases, drugs that can slow the progression of the disease, prevent complications, raise the quality of life, and prolong life have been discovered.

The experience with smallpox contributed further to the progress of medicine, in addition to having an impact on the health economy on a global scale. Major lessons were learned, such as how important it is to vaccinate vulnerable groups in a timely manner.

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