

Strategy for the global eradication of poliovirus: a model for infectious diseases

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The past two centuries have witnessed a tremendous reduction in the rates of mortality and morbidity as a result of communicable disease. These changes are fundamentally due to an improved health infrastructure, increased availability of intervention tools, such as vaccines, and amended hygiene-related practices. The global eradication of poliovirus has been a crucial issue on the public-health agenda for several decades. If polio is successfully eradicated, it will represent the third disease in history to be fully eliminated (preceded by smallpox and rinderpest, respectively). This forms the discussion of a much greater narrative with an increase in global outbreaks of vaccine-preventable diseases. The aim of this article is to consider the challenges that complicate eradication efforts, using poliovirus as a model. An understanding of global strategies will inform future efforts to eliminate infectious diseases.

Background

There have been numerous outbreaks of poliovirus, with cases recorded as early as the eighteenth century.¹ Transmission occurs both directly, through aerosols and faeces, and indirectly, via contaminated food and water sources.² Whilst asymptomatic in the majority of cases, infection with poliovirus may lead to debilitating paralysis with no curative treatment available.³ Effective vaccinations include the inactivated polio vaccine (IPV) and the oral polio vaccine (OPV).⁴

Considerations of eradication programmes

Vaccination against infectious diseases introduces several benefits: (1) the ability to control spread; (2) elimination of disease; and (3) the possibility of eradication. Eradication represents a permanent reduction and is possible once the reservoir of the causal agent has been identified, control measures are in place to interrupt transmission and surveillance has been implemented.⁵

To formulate an effective eradication strategy, it is important to consider the factors that encourage viral dissemination. For example, poliovirus has been shown to survive in soil for many months.⁶ Contamination may occur through unsanitary conditions, ineffective

sewage systems and lack of irrigation.⁷ In such conditions, the virus exists in abundance, increasing disease prevalence and making eradication efforts systematically harder.⁸

The success of an eradication campaign is also heavily reliant on social and political commitment. From a political standpoint, it is imperative to note that, in the developing world, where nations are vulnerable to civil war and other disturbances, eradication programmes may not be a national priority.⁹

Strategy in practice and problems faced

In 1988, the eradication strategy put forth by the World Health Organization (WHO) was based on four key stages: maintaining routine immunisations, supplementary immunisation, global surveillance and 'mop-up' campaigns.¹⁰

Numerous features contribute to the recrudescence of a virus, including the failure to vaccinate and inability to institute control measures. In the developing world, the cost of manufacturing and the availability of technical facilities makes vaccine development difficult to sustain.¹¹ The added pressures of climate and a deficit in refrigeration resources contribute to the concern of preserving vaccine efficacy and potency.

Since efforts began, recorded cases of polio have decreased by 99%.¹² Today, polio remains endemic in three countries (Nigeria, Afghanistan and Pakistan).¹³ Despite a robust eradication programme, there have been many challenges to the eradication of polio. For example, eradication in Nigeria has been difficult due to political instability and insurgency.¹⁴ Furthermore, the northern district of Nigeria is curtailed by illiteracy, with a population that regards the government as corrupt and untrustworthy.¹⁵ In 2003, vaccinations in the metropolitan district of Kano, Nigeria, came to an abrupt halt when rumours circulated between tribes that the vaccine was associated with sterility.¹⁶ Convincing local leaders that these rumours had no foundations was not easy and by the time health officials had been able to do so, the virus had dissipated beyond Nigeria's borders. The virus spread to countries where poliovirus had been previously

eliminated and the cost of rectifying the consequences amounted to more than \$500 million.¹⁷

In densely populated regions, campaigns have been created to target sanitation habits (i.e. regular hand washing), as poor sanitation contributes to viral dissemination. However, monitoring such practices is impossible. Furthermore, in developing countries, more vaccine doses may need to be administered to elicit herd immunity.¹⁸ This means sourcing and distribution becomes an issue and keeping track of those in need of vaccines is logistically difficult.

In Afghanistan, incidence is closely linked to instability and uncertainty; in some cases, this is a lack of trust towards the vaccine itself and its production in the United States.¹⁹ Levels of migration are often high, with individuals moving due to natural disasters, financial struggle and violence. Porous borders in countries of political-economic fragility further exacerbates spread.

Conclusion

The task to declare the international community polio-free is taking longer than expected. Whilst variables beyond international jurisdiction may complicate efforts, vaccine hesitancy plays a significant role in disease resurgence. In 2019, the WHO listed refusal to vaccinate as one of the top ten threats to global health. With vaccination being a cost-effective strategy in disease prevention, understanding underlying reluctance to it will be imperative to eradication efforts.

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