Citation: Tariq, T., Ahsan, M., Rehman, M., Wazir, N., & Khan, T. A. (2020). A Bird's Eye of the Situation of Poliomyelitis in World: Past, Present and Future Strategies towards Polio Eradication from Pakistan. *Global Immunological & Infectious Diseases Review, V*(I), 20-31 https://doi.org/10.31703/giidr.2020(V-I).03

www.giidrjournal.com GIIDR Global Immunological & Infectious Diseases Review

Pages: 20 – 31 | Vol. V, No. I (2020)

A Bird's Eye of the Situation of Poliomyelitis in World: Past, Present and Future Strategies towards Polio Eradication from Pakistan

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Abstract *Humanity has faced numerous calamities, natural disasters, and even the outbreaks of numerous communicable diseases since the dawn of time, and poliomyelitis is one of these diseases. The first cases of the disease occurred in the 1940s, alerting the health authorities and experts to create a vaccine to improve children's immunity to the virus. Since then, polio workers all across the globe are trying their best to create awareness about the importance of polio vaccination which is especially needed in the tribal areas of Pakistan because the people living there are mostly backward and illiterate who don't vaccinate their children due to safety concerns as well as religious and general misbeliefs about the vaccine. The focus of these campaigns is to make sure that every child in Pakistan and Afghanistan is properly vaccinated to stop the transmission of the virus by the year 2022.*

Key Words: Communicable Disease, Poliomyelitis, Eradication, Polio Immunization

Introduction

Poliomyelitis (acute central nervous system disease) stemmed in Europe and the United States at the onset of the twentieth century. (Racaniello, 2006). In 1998, the world health organization agreed that poliomyelitis would be eradicated from the world by 2000 (Kabir and Afzal, 2016). Currently, Pakistan, Nigeria, and Afghanistan are considered polio-endemic states. (Bandyopadhyay et al., 2015). Poliomyelitis is a deadly viral infection caused by three poliovirus serotypes, most of which affect children under the age of 5 years and can lead to severe muscle paralysis or even death. The virus is transmitted to the healthy persons if they encounter water or food contaminated with the faecal matter of the infected individual. There is still no treatment available for the disease, but it can be prevented by effective immunization of the children against the virus. The worldwide effort to eradicate poliomyelitis was initiated in 1970s, the primary motive of which was to remove poliovirus from all over the world until 2000 (Mehndiratta, Mehndiratta and Pande, 2014). Thus, Global immunization day was celebrated for disrupting the transmission chain in many developed countries where the entire population under the age of 5 was immunized regardless of whether they had already been previously vaccinated or not. This collective effort bore fruit and most of the countries of the world got fortunate in eradicating this virus from their country entirely by the year 2012 with the exception of Pakistan, Nigeria and Afghanistan who are still struggling to clear themselves of this virus. (Bandyopadhyay et al., 2015) This review focuses on the eradication campaign of polio in Pakistan and highlights the major hurdles in the eradication of polio from Pakistan.

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Virology

The word poliomyelitis emanates from Greece with "polio" denoting "grey" while "myelon" meaning "marrow" (Mehndiratta, Mehndiratta and Pande, 2014). This highly infectious disease is brought about by human Enterovirus (genus) of picornaviridae family i.e. poliovirus, consisting of serotypes 1,2, and 3(Hussain et al., 2016; Kabir and Afzal, 2016; Nadeem, 2016). The three serotypes of poliovirus cause paralytic diseases and are antigenically different (Racaniello, 2006).

Forms of Poliomyelitis

There are three forms of poliomyelitis: S poliomyelitis, Bulbar poliomyelitis (2%), Bulbospinal poliomyelitis around 19% (Nadeem, 2016).

Polio Virus Structure

Structure of polio virus comprises of single stranded (+)- strand RNA having 700 nucleotides in length and diameter is 25-30 nm. Its capsid contain 60 protomers and virion in each protomers are four (VP1, BP2, VP3,VP4). (Mendelsohn, Wimmer and Racaniello, 1989; Racaniello, 2006; Mehndiratta, Mehndiratta and Pande, 2014) All three serotypes are composed of CD155 receptors (Mendelsohn, Wimmer, and Racaniello, 1989). CD155 has three extracellular domains: a V-type domain distal to membrane (for poliovirus binding), and two C2-type domains (Koike et al., 1990).

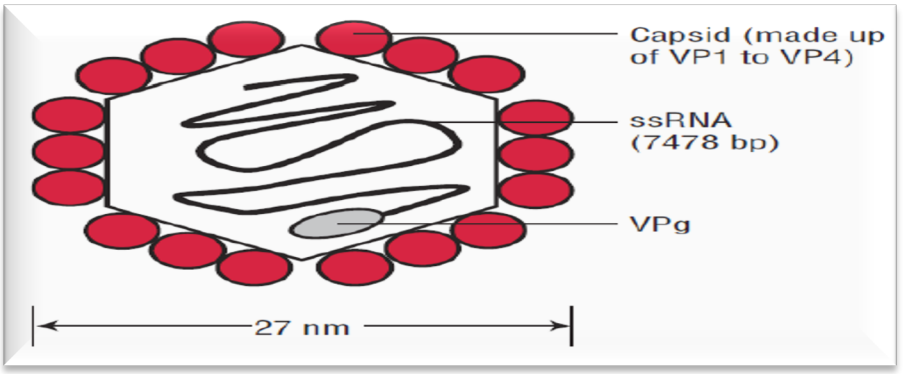


Figure 1: Structure of Polio Virus (Virus, 2020).

Symptoms

Mostly the person suffering from this virus is asymptomatic (Mehndiratta, Mehndiratta, and Pande, 2014). While other symptoms includes influenza-like illness, gastroenteritis, severe muscle spasm of the back, lower limbs and neck, mild respiratory tract infection (Mehndiratta, Mehndiratta, and Pande, 2014). The gravest form of poliomyelitis is paralytic poliomyelitis, observed in fewer than 1% of patients, in which there are severe episodes of ache in lower limbs and back (Bone, 2006).

Parts of the Body Damaged by Disease

Poliovirus may attack the human nervous system (Kabir and Afzal, 2016).

Mode of Transmission

Poliovirus multiplies in the intestine and is transmitted horizontally through the fecal-oral route, oral-oral route, and water or milk (in rare cases) (Hussain et al., 2016). Also transmitted by the saliva of an infected person (Kabir and Afzal, 2016). Where there is poor sanitation spread of poliovirus is rapid and also especially among the susceptible population. Propagation commences in summer season in temperate regions (Mehndiratta, Mehndiratta and Pande, 2014).

Mechanism of Action

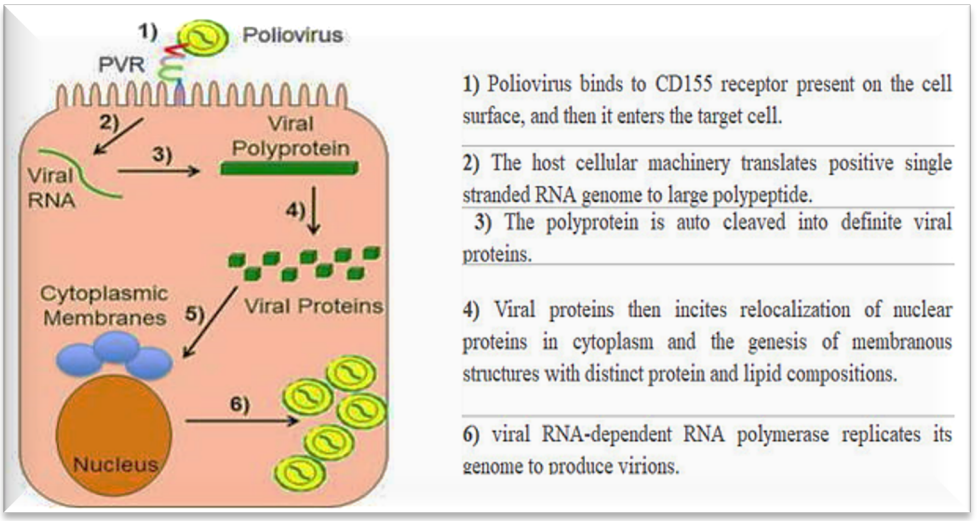


Figure 2: Schematic diagram of the mechanism of action of poliovirus (Bowers et al., 2017).

Epidemiology

Background

Poliovirus has been associated with human beings for centuries but the first clinical description of poliomyelitis was reported by British physician Michael Underwood, who in 1789 described it as a disease of lower extremities. The causative agent of poliovirus was identified by Landsteiner and Popper in 1908 (Monto, 1999). In the 19th century, the early outbreak was documented in Europe while in 1843, the first outbreak of polio was reported in USA. In 1938, March of Dimes (previously the National Foundation for Infantile Paralysis) was established which provided supportive care to patients and funds for the research (De Jesus, 2007). In 1988, WHO decided that Polio will be eradicated from our planet till 2000, and also succeeded in achieving this target with few exceptions. Pakistan and Afghanistan are the only prevailing reservoirs of poliovirus. The Extended Programs on Immunization (EPI) have succeeded in battling against polio. It reduced the number of polio cases from 198 in 2011 to only 54 in 2015. The target of EPI was to successfully eradicate polio from Pakistan till 2018 (Nadeem, 2016).

Extended Programs on Immunization

The Extended programs on immunization began in Pakistan in 1978 (Hussain et al., 2016). They scheduled 3 OPV doses for the infants at 6,10 and 14 weeks of age. Later on, a birth dose of the vaccine was added to the polio eradication initiative in Pakistan in 1994 (Murakami et al., 2014).

The Global Polio Eradication Initiative (GPEI) and Polio in Pakistan

The Global Polio Eradication Initiative was launched in 1988 which decreased the world-wide cases many folds. Pakistan, through this initiative, seemed to be on the verge of progress in 2016, when only 54 cases were registered. But still, they didn't meet their goal and the cases arose again in 2017 (Talan, Moran, and Feikin, 2014).

Epidemiology of Poliovirus in the World

The number of poliovirus cases was decreased from 350,000 in 1988 to 407 in 2013, a decline of about 99% was observed. America, Europe, South East Asia, and Western Pacific region were certified polio-free till the end of the twentieth century. (Macklin et al., 2020) .

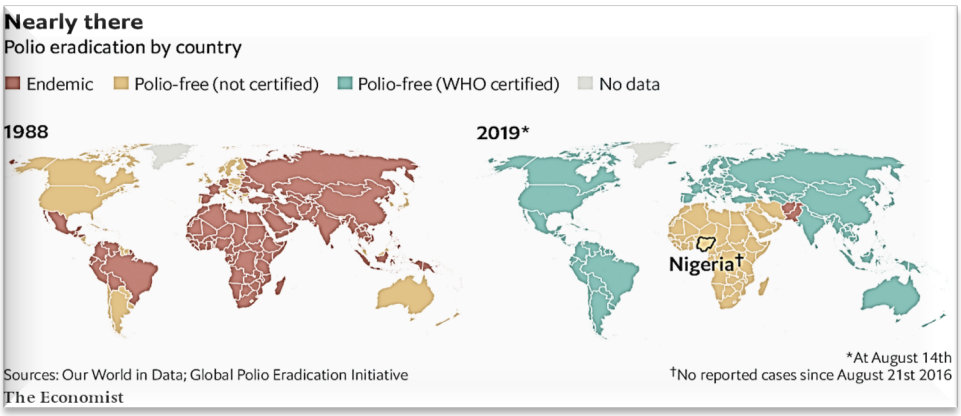


Figure 3: Epidemiology of Poliovirus in the World (Garon and Patel, 2017).

Epidemiology of Poliovirus in Pakistan

Pakistan is still struggling in the battle against the polio virus. We can better understand the hurdles in eradication of the virus from Pakistan by studying epidemiology case reports. (Kabir and Afzal, 2016). The table below shows the statistics of polio cases that have been reported during the last 5 years. Currently, Pakistan has been affected mostly by wild poliovirus type 1 and vaccine-derived poliovirus type 2 (Kabir and Afzal, 2016).

Tablet 1. WPV Polio Cases Across Pakistan's Provinces (Endpolio, 2020).

Province	Year					
	2015	2016	2017	2018	2019	2020
Punjab	2	0	1	0	12	14
Sindh	12	8	2	1	30	22
KPK	33	10	1	8	93	22
Baluchistan	7	2	3	3	12	26
Gilgit-Baltistan	0	0	1	0	0	0
ICT	0	0	0	0	0	0
Total	54	20	8	12	147	84

Tablet 2. cVDPV2 Polio Cases Across Pakistan Province (Endpolio, 2020).

Province	Year			
	2015	2016	2019	2020
Punjab	0	0	1	17
Sindh	0	0	0	22
KPK	2	0	16	42
Baluchistan	0	1	0	2
Gilgit-Baltistan	0	0	4	0
ICT	0	0	1	0
Total	2	1	22	83

When the Global Polio Eradication Initiative was launched in 1988, the virus was incapacitating about 350,000 children per year. By 2016, the number of cases of any form of polio had been lowered to 34 cases worldwide. However, in the year 2020, cases are projected to increase even further in the months to come. More

than 200 cases of wild polio have been identified so far this year, with approximately 600 cases of the vaccine-derived version of the disease. (Health, 2012) .

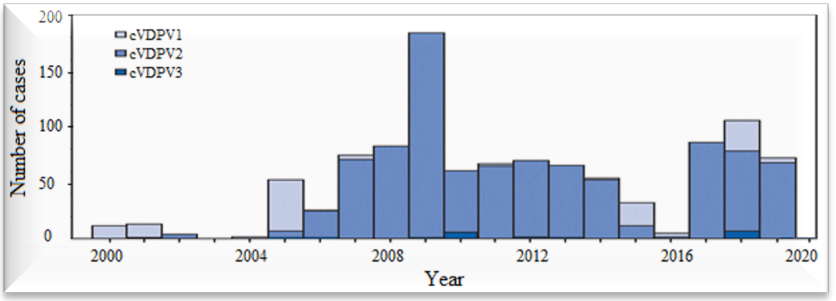


Figure 4: The Decline in the Number of Polio Cases over the Years (Jorba et al., 2019).

Vaccines

Development of Vaccines

A large number of incidents of paralytic poliomyelitis outbreaks occurred in the 1950s in North America which grasped the attention of the health authorities and the national foundation for infantile paralysis set aside millions of dollars for the sole objective of developing a vaccine for the prevention of the spread of the polio-virus. Robbins, Enders, and Weller successfully cultured Lansing strains of poliomyelitis in human embryonic tissue which further lead to the development of formalin-inactivated poliovirus vaccine (IPV) in 1953 by Jonas Salk which was administered as an injection and live attenuated polio vaccines (OPV) by Albert Sabin in 1956 which was given in the form of oral drops (Pearce, 2004; Wilton et al., 2014).

A marked decline in the viral spread and cases in United States from around 20,000 cases per year in 1950s to fewer than 1,000 cases by 1960s was observed due to the development of the inactivated poliovirus vaccine (IPV) (Orenstein et al., 2015). However, in developing countries, the live-attenuated oral poliovirus vaccine (OPV) is still the most popular vaccine due to its cost-effectiveness, ease of administration, and comparatively stronger induction of intestinal immunity than the IPV (Hussain et al., 2016). Polio eradication activities started in Pakistan in 1994 (Nathanson, 1982). The financial expenditure of Pakistan on the polio vaccine is 157,318,761 million PKR per year (Naqvi et al., 2018). The vaccines currently used in Pakistan are being imported from Belgium and Indonesia, manufactured by Biopharma pharmaceuticals, and are validated by W.H.O which are then purchased by UNICEF. Cold chains of vaccines have been maintained and stored at a temperature of 0℃ to -20℃. (Naqvi et al., 2018).

Effect of IPV Vaccine

IPV vaccine successfully reduced the occurrence ratio from 13.9 cases per 100,000 in 1954 to 0.5 cases per 100,000 in 1961. Meanwhile, the researchers continued trying to find a way to develop a vaccine that would succeed in inducing even stronger GI immunity than IPV and in 1963 they developed trivalent oral poliovirus vaccine which consisted of live attenuated viruses (Baicus, 2012).

Introduction to OPV

OPV is particularly effective in reducing poliomyelitis induced by wildtype polioviruses. The oral poliovirus vaccine activates the immune system to develop anti-poliovirus type 1, 2, and 3 poliovirus antibodies. The live virus persists in the intestine of recipients for 4-6 weeks, inducing both mucosal and serum anti-poliovirus antibodies capable of killing wild poliovirus. But there is a problem associated with OPV i.e. it can cause vaccine-derived poliovirus (which are genetically mutated strains) (Nadeem, 2016).The clinical trials of OPV showed quite promising results and it efficiently replaced IPV in almost all the countries of the world except Finland, Sweden, and the Netherlands (Nadeem, 2016). Although OPV is suspected of causing Vaccine Associated Paralytic Poliomyelitis affecting 8 to 10 OPV immunized patients in US per year, still the overall therapeutic efficacy of OPV is manifolds higher than IPV so in other terms, its benefits altogether outweigh the risk of VAPP i.e. due to the

conversion of the attenuated genome back to the virulent one which occurs mostly when the immune system is quite week due to malnourishment or any other reason. Although in 1979, the United States of America got freed of the wild poliovirus circulation but still the risk of contracting VAPP couldn't be ignored so the experimenters pursued their efforts to design a safer vaccine with a better efficacy and safety profile than OPV and got successful in preparing "enhanced potency IPV(E-IPV)" in the 1980s which rapidly replaced the trivalent OPV in routine pediatric immunization programs in most of the developed countries(The Current tours Pakistan's Polio Lab,2019). IPV is quite expensive but effective. It has been used for 15 years in USA, while OPV is used in lower-income countries such as Pakistan, so it is very important to reduce IPV vaccine price so that middle-class countries would be able to afford the vaccine (The Current tours Pakistan's Polio Lab,2019). On August 24, 2015, Pakistan took another step towards a polio-free future by incorporating IPV into its regular immunization schedule in a ceremony chaired by Miss Saira Afzal Tarar, Minister of State, Ministry of Supervision and Coordination of National Health Services, and attended by representatives of WHO, UNICEF, GAVI and other development partners, such as USAID, and the UK Department. (The Current tours Pakistan's Polio Lab,2019).

The launch of the inactivated polio vaccine (IPV) in Pakistan is a breakthrough that will support over 6 million children annually and will be administered along with other life-saving vaccines. In April 2016, a global transition was made to exclude live attenuated polio vaccine from immunization program, following the global certification of the eradication of wild poliovirus type 2 (WPV-2).(Davis and Jackson, 2021).

A Comparison of Ideal Vaccine with Available Vaccines

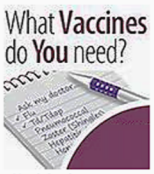
	Ideal Vaccine	Oral Polio Vaccine	Inactive Polio Vaccine
			
Route of administration	Noninjection	Oral	im. injection
Thermo stability	Heat and freeze stable	Heat sensitive	Heat and freeze sensitive
Humoral immunogenicity	Good	Good	Good
Intestinal immunogenicity	Good	Good	Poor
Cost	<US$0.10/dose (similar to current OPV cost)	~US$0.15/dose (UNICEF prices US$0.10–0.20)	~US$1/dose
Safe production	Widespread and low risk	Widespread and low risk	Only in select countries, risk of reintroduction of WPV from manufacturing facilities
Safety	No safety issues	VAPP, VDPVs	No safety issues
Schedule/duration of protection	1 dose	Multiple doses	At least one dose in combination schedules, four to five doses in IPV only schedules
Method of administration	Routine immunization and SIAs	Routine immunization and SIAs	Routine immunization and small-scale SIAs
Waste management	No risk	No risk	Sharps disposal
Cold storage space	Small	Small	Small (<5–7% of total volume)

Figure 5: Ideal properties desired in apolio vaccine, and a comparison of oral and inactivated polio vaccine.

Challenges Faced in Polio Eradication

Just after the initiation of the polio eradication programs, many challenges were faced by the health authorities that made it difficult to achieve the mission of eliminating polio. Illiteracy, religious misconceptions (vaccine hesitancy), conflicts, insecurities, terrorist attacks, poor vaccine quality resulted in the failure of immunization campaigns in the beginning stages of the program. The civil conflict was also one of the main barriers to the eradication of poliovirus. Other main problems for developing countries were poor management strategies, health communication, limited documentation at the district and provincial level of vaccine resources. Society elders did not educate the people and some religious issues were also prevalent in the community especially in Northern Nigeria and Pakistan.

Challenges Faced by Pakistan

The WHO reported that Pakistan is responsible for 80% of the worldwide reported cases of polio.

Concerns Regarding OPV Efficacy

For enhancing OPV efficacy cold chain was needed, but due to the scarcity of proper equipment and frequent power breakdown in the region which is prone to virus-like Pakistan, the use of such OPV produced VAPPs and cVDPVs, which are more likely to induce poliomyelitis in children. (Hussain et al., 2016).

Vaccination Bans and Security Concerns

Taliban in the region of FATA and KP banned vaccinations in 2012 and hence 350000 children remained without vaccination for two years, also due to Taliban terrorist attack on the vaccination teams, many team members died so there is a need for qualified staff which is very difficult to recruit, the problem of polio eradication is greater in the IDPs, which were settled in other areas of KP. (Hussain et al., 2016).

Negative Propaganda Against Vaccination

The religious clerics and terrorist Taliban showed, after the death of Osama Bin Laden in Abbottabad, that Americans traced Osama on behalf of the bogus hepatitis-B vaccine, even bought polio vaccine from CIA funds so it could not be used. This impacted the polio eradication program even further in FATA and KP. The vaccinator's team in that area got much harm and a survey suggested that only 25% of residents of that area believed in polio vaccine. (Hussain et al., 2016) . Reasons that why and how Pakistan became the modern-day polio hotspot (Nadeem, 2016) mostly include Illiteracy, religious misconception about vaccines, insecurities, terrorist attacks, malnutrition, discouraging perspectives, poor vaccine quality. (Nadeem, 2016) The need for SIAs (supplementary immunization activities) to reach all areas of the country and vast differences in the country's population density present challenges to the polio eradication campaign.(Hussain et al., 2016).

Overcoming Challenges

Public Information Pamphlets

The National Childhood Vaccine Injury Act of 1986 made it necessary for the individuals that while administering the vaccine they should provide a Public Health Service vaccine information pamphlet to the parents of the child (Davis and Jackson, 2021).

Public Awareness Campaigns

For the extension of polio eradication activities, the National Emergency Operations Center (NEOC), proposed a meticulous plan of action targetting the low polio transmission season (January-April) via OPV routine vaccination programs required to stop WPV transmission in Pakistan. NEOC aimed to reduce remaining immunity gaps by identifying and vaccinating continuously overlooked children. (Mehndiratta, Mehndiratta, and Pande, 2014). From Jan 2014 to Oct 2015 house-house supplementary immunizations utilizing primarily monovalent oral poliovirus vaccine type 1 and bivalent type 1 & 3 OPV, were conducted for the children less than 5 yrs. SIAs performed at fixed immunizations posts since November 2014 covered 1.7 million children in areas of FATA which were security-compromised (Mehndiratta, Mehndiratta, and Pande, 2014).

Polio Eradication Initiatives

Pakistan is still one of the 2 remaining countries facing the problem of active wild poliovirus transmission. WHO, UNICEF, and other partners of the Global Polio Eradication Initiative supported Pakistan's government to achieve polio-free status. Pakistan's polio eradication program implemented an intensive vaccination campaign schedule focused on operational improvements to achieve herd immunity in the core reservoirs of Karachi, KPK, and Quetta Block while keeping the rest of the country polio-free. (WHO) (Nadeem, 2016). By establishing resource centers in high-risk areas, targeting nomads and internally displaced persons (IDPs) through permanent transit posts (PTPs), the authorities have developed strategies to overcome the odds by increasing awareness in low-literate populations, through books, conducting workshops with enlightened religions clerics, holding health camps in impoverished districts. (Hussain et al., 2016).

Limitations of the Strategies Adopted

Complaints were received in 1991 about public awareness pamphlets that were too long to read so the

pamphlets were simplified (Hussain et al., 2016).

Louisiana State University Polio Pamphlet

The authors followed the guidelines to improve the patient reading skills by simplifying and reducing the CDC pamphlet content. In the LSU brochure, parents were advised and encouraged to vaccinate their children on time. 99% of the subjects said that they liked reading the LSU pamphlet as compared to the 63% who said the same for CDC. A large number of parents said that the LSU pamphlet is excellent in delivering polio-related information as compared to 3% who said LSU is poor than CDC (Hussain et al., 2016).

- From an economic perspective, polio eradication campaigns required a large staff and also proved to be very expensive, increasing the burden on health care systems (Nadeem, 2016).
- GNP (Gross national product) spent less than 2% on the health infrastructures, inefficiencies in finance management failed to achieve immunization targets (Davis et al., 1998).
- Inequality in sources distribution and immunization coverage at various provincial and district levels varied from 57% in Punjab to less than 45% in FATA and Baluchistan (Davis et al., 1998).
- Low-income rural neighborhoods have lower coverage when compared with well-developed areas of cities (Davis et al., 1998).
- Some EPI (Expanded Program on Immunization) centers were also reported to lack immunization registration records creating hurdles in identifying the areas and the number of children deprived of polio vaccination (Davis et al., 1998).
- Delayed payment and low salaries of the polio teams' workers also lead to an important factor in inefficient immunization coverage and failure of campaigns (J. A. S., 1915).

Future Strategies to Eradicate Polio from Pakistan

Unfortunately, Pakistan is still being marked as a country where poliovirus resides and certain crucial steps must be taken by the Pakistan government to make Pakistan polio-free (Hussain et al., 2016).

Polio Eradication End Game

The end game for the Global Polio Eradication Initiative (GPEI) has always been the immunization of every child on this planet against the deadly Poliovirus and this campaign has succeeded in eliminating the virus from the majority of the countries except only two countries (States et al., 2016). Pakistan and Afghanistan are the only countries in the world that are still not free of the poliovirus and eradicating the virus from these two states is the main focus of GPEI as of now (Hussain et al., 2016).

Goals of the Polio end Game Strategy 2019-2023

- The first and foremost goal of GPEI is stopping the transmission of the Wild poliovirus.
- The second main goal is building immunity of the masses by following active polio immunization schedules and making sure that all the children receive their doses of the vaccines on time.
- The third and last goal is to get certification that all the states in the world are completely free of all three types of the poliovirus (World Health Organization. Regional Office for South-East Asia, 2019).
- In the end, we need to transfer our focus and resources from poliomyelitis to other preventable diseases once we have succeeded in removing the poliovirus from the globe. Preparation for this transition, formerly known as "the legacy," has always been a key component of the approach of the end game according to which the major challenge faced by the world is to successfully and safely move the expertise, capacities, and insights of polio towards other global priorities for public health after the eradication of poliomyelitis from the world. (Cochi et al., 2014) .

After Eradication

It is important that every individual of a country should be vaccinated against the virus even after the elimination of the transmission of the virus in case it is accidentally reintroduced through leakage from a laboratory. We cannot stop immunization against polio even after achieving the polio-free status and need to keep protecting

our people from contracting the virus in future as well. This is the only way to prevent the reintroduction of the virus. (Zambon and Martin, 2018) In order to achieve complete eradication of poliomyelitis worldwide, the use of OPV is discontinued and replaced by E-IPV in the developing countries in order to prevent the recurrence of poliomyelitis epidemic through mutations in the Sabin strains present in the OPV recipients (Zambon and Martin, 2018) But in Pakistan and Afghanistan due to poor sanitary conditions we cannot discontinue OPV immunization because it is highly effective in blocking fecal to oral route transmission while IPV, on the other hand, is only efficacious in stopping oral to oral transmission (Hussain et al., 2016).

New Approaches in Terms of Immunization

It has been evident from the trials in many countries that the use of monovalent OPV instead of trivalent OPV for routine vaccination can reduce the risk of re-emergence of vaccine-derived paralytic poliomyelitis as there is no chance of interaction of the virus serotypes in monovalent OPV and also using E-IPV as a source of supplementary immunization also enhances the seroconversion rates of the vaccines manifold and provides increased immunogenicity. (Ehrenfeld, Modlin and Chumakov, 2009).

Five-Year Plans (2019-2023)

Pakistan-Afghanistan Hub

There is a need for a joint partnership between Afghanistan and Pakistan for the common purpose of eliminating the wild poliovirus circulating in their northern areas. They need to join their efforts in order to properly vaccinate the children of these areas (States et al., 2016; World Health Organization. Regional Office for South-East Asia, 2019).

Creating Awareness about the Importance of Vaccine in Backward Areas

Polio awareness campaigns that were already ongoing for the past few years faced a huge setback due to the outbreak of the corona virus in 2019. The world's attention was diverted from polio to corona and the number of polio cases increased again in 2019 and 2020. We are quite close to our goal and we cannot afford to hold back now so we need extensive polio awareness campaigns to correct the misconception of the locals about the safety of the vaccine and to ensure them that immunizing their kids would protect their future and would never lead to sterility which is the general misbelief of most of the illiterate population of Pakistan (World Health Organization. Regional Office for South-East Asia, 2019).

Focusing on Alternative Strategies for Polio Campaigns During a Pandemic

During the pandemic period, we cannot organize the massive polio campaigns or National polio-eradication days to prevent the large gathering of the people at one place, so we need to adopt some novel approaches instead. The health-care professionals can play their part by providing the drive-through vaccine services also the community pharmacists, on a smaller level, can encourage the people of the community to get their children vaccinated (Cochi et al., 2014; Zambon and Martin, 2018).

Development of a Modern Gene Sequencing Lab (AGCT)

Pakistan now has the latest genomic-sequencing laboratory situated in Lahore called “AGCT genomics” that focuses on gene-mapping of the wild poliovirus to trace its source and its transmission. They also test different samples of sewage water to determine the potentially dangerous areas of Pakistan in terms of polio-spread. They import both OPV and IPV vaccines as well as maintain the cold chain. Their services are quite efficient in preventing the circulation of the virus and it is expected that through their tireless efforts and all the other polio-workers, this virus would be eradicated from Pakistan by the end of 2022 (The Current tours Pakistan's Polio Lab,2019). According to NEAP Pakistan should also focus on providing security to vaccination teams, they should be provided the adequate supplies and vaccines required along with the proper training of the workers (Hussain et al., 2016). The expanded Program on Immunization (EPI) is also an important platform to achieve polio eradication. This EPI program will assist in obtaining the high degree of governmental participation and net investment that Pakistan currently lacks. (Hussain et al., 2016) .

Conclusion

The number of polio cases in Pakistan declined significantly in 2018 and we were quite close to eradicating the virus from our country once and for all, but all immunization efforts came to a halt at the end of 2019 due to the unexpected outbreak of the coronavirus , leading to a dramatic spike in the polio cases once again so we need new initiatives during this Covid-19 period. The best way to minimize the risk and consequences of polio infection in this period is to maintain strong population immunity levels through high vaccination coverage by the provision of drive-through vaccine services, the active engagement of community pharmacists and other health care workers in local polio-immunization programs., public awareness programs and strong disease surveillance in order to rapidly detect the virus and respond to the situation. Immunization campaigns are ongoing, and the whole world is expected to be free from the poliovirus by the end of 2022. However, even after the virus has been removed, it is necessary for every citizen of the country to be vaccinated against the virus if the virus is inadvertently reintroduced by contamination from a laboratory or some other source. The immunization campaigns cannot be stopped entirely even after reaching the polio-free status in order to protect our people from contracting the virus in the future as well. This is the only means of stopping the virus from being reintroduced. However, it is important to strictly regulate migration across the borders of endemic countries. Moreover, in order to better people's lives both qualitatively and quantitatively, the government should also turn its emphasis on investing more on countries' capital and GNP in the health sector.

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