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## Epidemiology of polio virus infection in Pakistan and possible risk factors for its transmission

Mahvish Kabir, Muhammad Sohail Afzal<sup>✉</sup>

Department of Chemistry, School of Science, University of Management and Technology (UMT), Lahore, Pakistan

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## ABSTRACT

End Polio Pakistan program still has to overcome many hurdles; unfortunately on 8th February 2016 first polio case of the year has surfaced in Karachi. It seems that battle against polio demands little bit more conviction and motivation. WHO has set a goal of polio eradication in Pakistan till 2018, in order to evaluate the success of this target; polio eradication campaign in Pakistan has been analyzed in different perspectives. Our analysis indicated that major obstacles in eradication are low literacy rate, poor health infrastructure, lack of planning, natural disaster, economic crisis, counter insurgencies and almost no protection for polio health workers. WHO has allocated new funds to tackle this problem, now there is a need to spend this money more effectively; with proper planning and honest deployment of funds.

## 1. Introduction

In 1988 the World Health Organization decided that till 2000 this disease will be eradicated from our planet [1]. The polio eradication program has achieved its goal partially with few failures.

Pakistan, being the only prevalent polio reservoirs, is a major hurdle in the success of this program. At present, the extended programs on immunization have been geared to succeed in the battle against polio in Pakistan. After the significant decline in polio cases from 198 in 2011 to only 54 in 2015, government officials are hopeful in successful eradication of polio by 2018 [2]. In an effort to highlight major hurdles in eradication of polio in Pakistan different factors have been analyzed in this review.

### 1.1. Virology

Poliomyelitis is a severe infectious disease of humans caused by a human enterovirus of the Picornaviridae family. The structure of virus is made of a single-stranded, positive-sense

RNA genome with a capsid of protein. The three serotypes of this virus are antigenically different. Polio virus can be passed on from one person to another by saliva or any other kind of oral contact and fecal excretions from an infected person [3]. In Pakistan mostly type 1 polio infections have been reported with few cases of type 3 infections [2]. Polio virus may attack human nervous system. Virus can attach to particular receptors (CD155 aka Pvr). At human body temperature, receptors provoke conformational changes to 135S particle, causing externalization of VP4 and N-term of VP1, followed by incorporation of these peptides in the cell membrane. Electrophysiology studies have shown that peptide insertion is responsible for the formation of pores and channels [4] genetic and molecular studies have proved that capability to form channels is linked with ability to discharge RNA in the cytoplasm to cause infection. Further studies highlighted that treatment with MbetaCD restrain RNA release after development of the 135S particles. These findings specify that the cholesterol level of the cell is significant during the course of genome delivery and that these entry pathways are separate from those involved in DIM integrity [5].

### 1.2. Vaccines

Vaccines to prevent polio have been in use for decades. There are two main types of polio vaccines. IPV is more

<sup>✉</sup>Corresponding author: Muhammad Sohail Afzal, PhD, Department of Chemistry, School of Science, University of Management and Technology (UMT), Lahore, Pakistan.

Tel: +92 321 5244808

E-mail: [sohail.ncvi@gmail.com](mailto:sohail.ncvi@gmail.com)

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expensive but effective in eradication of polio virus. IPV is been effectively used in U.S for more than fifteen years. OPV is relatively inexpensive and mainly used in countries with low income [6]. Vaccination will be required after polio will be officially eradicated as Vaccine-derived polioviruses (VDPVs) will continue to happen until all countries shift to IPV, it is extremely important to reduce the price of IPV vaccines so that low- and middle-income countries can use it effectively [7]. The Sabin oral polio vaccine is still used in Pakistan, it is made with a live but weakened virus, which has the benefit of passive immunity of other persons in community through the oral fecal route in households, schoolrooms, etc. although the Sabin oral polio vaccine can cause polio-like symptoms but Pakistan being a low income country with large population size has limited options, it is preferred as it is less costly as compared to IPV [8,9].

**Table 1**  
Epidemiology of polio cases in 2014 & 2015 in different district of Pakistan.

Province	District	2014	2015	
FATA	Khyber	76	11	
	South Waziristan	70	2	
	North Waziristan	24	1	
	FR Bannu	9	0	
	FR Peshawar	0	2	
	Total	179	16	
KPK	Bannu	11	0	
	Peshawar	29	12	
	Mardan	5	0	
	LakkiMarwat	3	1	
	Tank	7	2	
	Buner	3	0	
	Torghar	1	0	
	Nowshera	4	1	
	Charsadda	1	1	
	Karak	1	0	
	Swat	2	0	
	Kohat	1	0	
	Total	68	17	
Sindh	Karachi	23	7	
	Badin	1	0	
	Dadu	1	2	
	Larkana	1	0	
	Sanghar	2	0	
	Khiliaqat	1	0	
	Nosheroferoze	1	0	
	Khamber	0	1	
	Sukher	0	1	
	Khairpur	0	1	
	Total	30	12	
	Balochistan	Killa Abdullah	13	1
		Quetta	5	5
Zhob		1	0	
Khuzdar		1	0	
Killa Saifullah		1	0	
Pishin		1	0	
Chaghai		1	0	
Nasirabad		1	0	
Jafarabad		1	0	
Loralai		0	1	
Total		25	7	
Punjab		Chakwal	1	1
		Bhakar	1	0
	Sheikhupura	1	0	
	D.G khan	1	0	
	Rahim Yar khan	0	1	
	Total	4	2	

### 1.3. Epidemiology

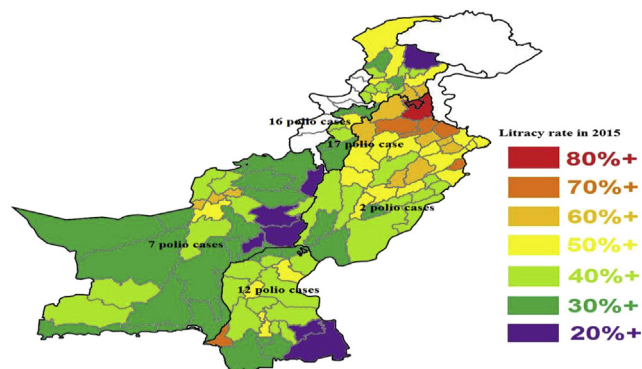
Polio has been successfully controlled and eradicated from all over the world except few failures. Unfortunately Afghanistan and Pakistan are the regions of extreme strategic importance but still struggling in battle against this virus. Incompetence to execute strategic approaches results in ongoing transmission of polio. Failure to eradicate polio virus in these last nurseries could cause as many as 200000 new cases per year, within a decade, all over the world [8]. By studying epidemiology of cases reported from different areas of Pakistan, we can develop a better understanding of hurdles in eradication of polio in Pakistan. Unfortunately in February 2016 a new polio case has been reported in Karachi [9]. Table 1 depicts a hope that positive initiatives by government have reduced the number of polio cases remarkably. The comparison of reported polio cases in 2014 and 2015 points out some alarming issues as well, like some districts which have zero polio cases in 2014 had polio cases in 2015. Roots of polio virus are present almost in all major cities of Pakistan and metropolitan cities like Karachi, Peshawar, and Quetta can transmit virus to other cities and remote areas. In 2014 & 2015, the total number of Polio cases in different Provinces of Pakistan was 306 and 54, respectively.

### 2. Factors/perspectives

In an effort to find out major hurdles in eradication of polio in Pakistan different perspectives have been analyzed.

#### 2.1. Low literacy rate

Pakistan is one of the most densely populated countries of the Asia. Currently, with a population size over 180 million it is ranked 6th in the world. Unfortunately, Pakistan has very low literacy rate according to UNESCO, it is approximately 55% [10,11]. These alarmingly low literacy rates are directly proportional to the rejection of polio vaccine by the people and unprofessional handling of the eradication program. Figure 1 shows that among all provinces Punjab has highest literacy rate and lowest number of polio cases when compared to large population size of the province. Most polio cases are reported from FATA and KPK in 2015, this ratio become even alarming if compared to population density of the province. In KPK, Sindh and Balochistan many areas have literacy rate below 20%, in FATA still there is no authentic documentation of number of schools or literacy rate [9,11]. A survey conducted in



**Figure 1.** Co-relation of low literacy rate and polio infection in Pakistan.

Quetta and Peshawar showed that better educated health workers have superior understanding and motivation regarding commitment to polio eradication program [12].

### 2.2. Malnutrition and polio

Pakistan has terrifyingly soaring levels of malnutrition; approximately, 24% of the population is suffering from malnutrition. Current data by the United Nations Food and Agriculture Organization declared that 37.5 million people are not taking adequate amount of nutrients and proper food portions in Pakistan [13]. In Pakistan, from 2011 to 2013 the predominance of reported cases of poliomyelitis was in vaccinated children from areas with relatively high levels of malnutrition. A research has been conducted in Aga Khan University on this aspect but any conclusion requires extensive studies across the nation [13,14]. Malnutrition and vitamin deficiency statistics also support this hypothesis that poor immunity from malnutrition could be one of the factors promoting polio outbreaks [13]. Punjab has lowest rate of vitamin deficiency 53% and only 2 polio cases are reported in previous year. KPK has alarmingly high rate of vitamin deficiency 78% and has highest number of polio cases (figure 2). Apparently Balochistan has 7 reported polio cases with vitamin deficiency rate of 81% but if you compare it with total population size of province, this number is quite alarming.

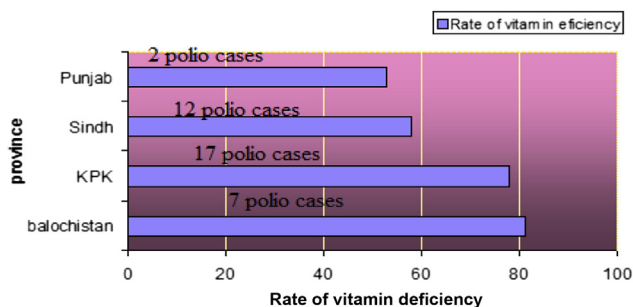


Figure 2. Correlation between vitamin deficiency and polio outbreaks in Pakistan.

### 2.3. Counter insurgencies

It was believed that Islamic insurgencies are a major hurdle in eradication of polio. 198 polio cases were reported in 2011, these alarming numbers are result of counter insurgency attack by America in Pakistan in May 2011 [15]. Similarly, in 2014 again counter insurgency attacks lead to the displacement of huge number of people from North of Pakistan. IDPs from North Waziristan were not properly documented; no record of vaccination of these IDPs was maintained (IVAP 2016). Figure 3 clearly depicts that Operation Neptune Spear in 2011 and operation Zarb-e-Azab in 2014 resulted in 198 and 306 polio cases respectively.

### 2.4. Terrorist regimes and polio

One of the major reasons of non cooperation with polio vaccinators is, it was believed that polio workers are government spies [15]. Terrorist groups not only do negative propoganda against polio vaccines but also use violence against polio workers. According to Pakistani media since 2012 in various attacks on polio workers 74 polio workers have been killed [16,17]. In an effort to protect the polio workers KPK Government provided police protection to polio workers in sensitive areas during vaccination campaigns. Often so called religious extremist groups give Fatwa's against vaccination but Islam has not change over the years and data analysis around the glob shows that religious Islamic scholars have supported the vaccination programs and there is been no direct link between Islamic preaching and terrorists [18].

### 3. Encouraging perspectives

The Bill & Melinda Gates Foundation donated US\$18 million to allow UNICEF staffing in Afghanistan, India, Pakistan, Chad, DRC, Nigeria, and HQ. Rotary International has announced US\$ 35 million to support the global endeavor to end polio in Pakistan and Afghanistan. The United Arab Emirates donated \$ 12 million to carry polio eradication activities in Pakistan in early 2016. Government of Pakistan is organizing awareness programs at district level and taking help from electronic media in creating awareness about polio [19].

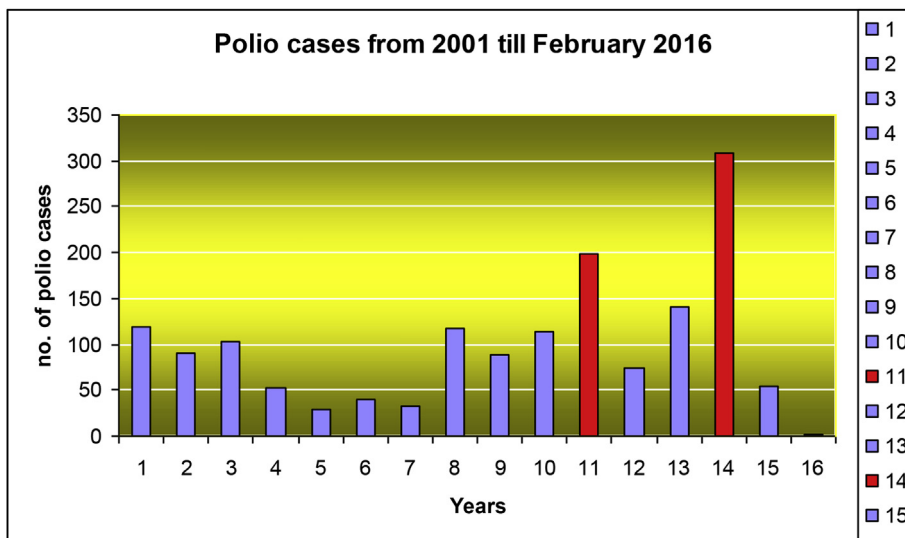


Figure 3. Effect of counter insurgencies on polio eradication campaign in Pakistan.

#### 4. Conclusion

This study demonstrated that failure of end polio Pakistan program is facing many hurdles. Some of the major factors that can be considered as main obstacles are low budget for education, health, poor infrastructure for training, lack of awareness programs and counter insurgency attacks without planning. It was also found that all Islamic school of thoughts support vaccination, the main reason of non cooperation is due to lack of trust on polio workers, as they are suspected as a source of intelligence for government. It is the need of hour that government should take all the necessary measures in order to eradicate polio from Pakistan till 2018.

#### Role of the funding source

There is no role of any funding agency in this study.

#### Conflict of interest statement

There is no conflict of interest.

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