

# A 12-Years Surveillance of Poliomyelitis and Acute Flaccid Paralysis in Fars Province, Southern Iran

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## Abstract

**Background:** Following the widespread use of poliovirus vaccine in the mid-1950s, the incidence of poliomyelitis declined rapidly in many industrialized countries. The aim of this study was to determine the surveillance of poliomyelitis and acute flaccid paralysis (AFP) in Fars Province, southern Iran to detect poliovirus wherever it may circulate.

**Methods:** From 1995 to 2006, in a cross-sectional study, all patients over 15 years of age with flaccid paralysis in Fars Province of Iran were enrolled. The surveillance medical officers visited every AFP case, took clinical histories, and performed clinical examinations. Two stool samples were collected from each reported case within 14 days of the onset of paralysis and sent to WHO-accredited laboratories for poliovirus isolation and intra-typic differentiation. AFP cases from which stool sample of wild poliovirus was isolated were classified as confirmed poliomyelitis. Those AFP cases whose cultures for poliovirus were negative were referred to an expert panel. Whenever possible, nerve conduction velocity tests, electromyography, and other diagnostic modalities such as brain and vertebral MRI were performed along with a detailed neurological examination at least three weeks after the onset of paralysis.

**Results:** The non-polio AFP rate was 227 (mean: 18.91 per year). Only one case of poliomyelitis was reported in the first year of surveillance. Other 226 cases had non-polio AFP. The most common cause of paralysis among these patients was Guillain-Barre syndrome (66%).

**Conclusion:** The non-polio AFP rate is almost in agreement with the estimated incidence of AFP in the population aged 0-15 years worldwide. Routine coverage with three doses of OPV with supplementary immunization activities has reportedly reached over 95% of all target children. The existing system must be closely monitored and actively supported to maintain and constantly improve performance.

**Keywords:** Poliomyelitis; Acute flaccid paralysis; Surveillance; Iran

## Introduction

Poliomyelitis is an acute viral infectious disease spread from person-to-person, primarily via the fecal-oral root.<sup>1</sup> Poliovirus is a highly contagious human pathogen, which spreads easily via human-to-human contact<sup>2</sup> but cannot naturally infect other species.<sup>3</sup> In endemic areas, wild polioviruses can infect virtually the entire human

population.<sup>4</sup> In the majority of individuals with a functioning immune system, polio infection is abortive, the virus being cleared from the body, and the polio infection being either asymptomatic or produces minor symptoms.<sup>5</sup> In about 3% of poliovirus infections, the virus enters the central nervous system. In 1–2% of infections, patients develop non-paralytic aseptic meningitis, with symptoms of headache, neck, back, abdominal and extremity pain, fever, vomiting, lethargy and irritability.<sup>6</sup>

In approximately 1 in 200 to 1 in 1000 cases, poliovirus infection leads to the development of paralytic disease, known as acute flaccid paralysis (AFP).<sup>7</sup> Depending on the site of paralysis, paralytic

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poliomyelitis is classified as spinal, bulbar, or bulbospinal. Two polio vaccines are used throughout the world to combat polio. The Salk vaccine, or inactivated poliovirus vaccine (IPV)<sup>3</sup> and the Sabin developed as an oral polio vaccine (OPV), using live but the weakened (attenuated) virus.<sup>8</sup>

The vaccines are used to protect both individual vaccine recipients and the wider community.<sup>9</sup> A global effort to eradicate polio began in 1988 and was led by the World Health Organization, UNICEF and The Rotary Foundation.<sup>10</sup> These efforts have reduced 99% of annual diagnosed cases from an estimated 350,000 cases in 1988 to fewer than 2,000 cases in 2006.<sup>11</sup> After smallpox, which was officially eradicated in 1979,<sup>12</sup> it represent the second time that mankind has ever completely eliminated a disease. The Americas were declared polio-free in 1994.<sup>13</sup> In 2000, polio was officially eradicated in 36 Western Pacific countries, including China and Australia.<sup>14,15</sup> Europe was declared polio-free in 2002.<sup>16</sup> Today, polio remains endemic in just four countries: Nigeria, India, Pakistan, and Afghanistan.<sup>11</sup>

Two main indicators are used to monitor the quality of AFP surveillance:<sup>1</sup> the reported rate of AFP not due to polio (i.e. non-polio AFP rate) to assess the sensitivity of detecting suspect cases (target: a rate of  $\geq 1$  non-polio AFP case per 100,000 children aged  $< 15$  years annually), and<sup>2</sup> the proportion of AFP cases from which two adequate specimens have been collected (target: two adequate stool specimens from  $\geq 80\%$  of AFP cases). The aim of this study was to determine the surveillance of poliomyelitis and acute flaccid paralysis (AFP) in Fars Province, southern Iran to detect poliovirus wherever it may circulate.

## Materials and Methods

This survey was carried out in Fars province with a mean population of 3,500,000, where 1,400,000 people are less than 15 years of age. AFP surveillance was introduced in Iran in 1993, and by 1994, the staff in all provinces were trained in AFP surveillance to send monthly case reports to the office. To monitor AFP surveillance performance, a reported non-polio AFP rate of 1 per 100,000 population aged  $< 15$  years is used to indicate a sensitive AFP Surveillance System. From 1995 to 2006, in a cross-sectional study, all the patients with flaccid paralysis and  $< 15$  years of age in Fars Province, southern Iran were investigated. The surveillance medical officers visited every AFP case, took clinical histories, and performed

clinical examinations. Two stool samples were collected from each reported case within 14 days of the onset of paralysis and sent to WHO-accredited laboratories for poliovirus isolation and intra-typic differentiation. Rectal swab was used for patients that were able to defecate. Stool samples or rectal swabs were carried to WHO-accredited laboratories in Tehran during 72 hours in sterile containers at a temperature of 4-8°C. The poliovirus laboratory at the Health School in Tehran Medical University serves as both the National Poliomyelitis Laboratory and the WHO Regional Reference Laboratory for poliomyelitis. It performs primary poliovirus isolation from stool specimens and intra-typic differentiation of poliovirus. The specimens were inoculated onto monolayers of A549 cells, green monkey kidney cells, and Vero cells and inspected daily for viral cytopathic effect. AFP cases from which wild poliovirus were isolated from at least one stool sample was classified as confirmed poliomyelitis. AFP cases, for which cultures for poliovirus were negative, were referred to an expert panel. Whenever possible, nerve conduction velocity tests and electromyography were performed along with a detailed neurological examination at least three weeks after the onset of paralysis. Also, according to initial differential diagnosis, other diagnostic modalities such as EMG, NCV, brain and vertebral MRI, biochemical assays, ABG, Wright test, lLumbar puncture, arterial blood gas, joint tap, thyroid function test, blood culture, serum creatin phosphokinase, bone x-ray, and CT scan were done. The surveillance medical officer compiled documents including hospital records, interviews with attending physicians, clinical examination, and epidemiological investigation. On the basis of clinical, epidemiological, and virological evidence the panel classified them as non-polio AFP.

## Results

This survey was performed in Fars province with a mean population of 3500000, where 1400000 people are less than 15 years of age. During 1995 to 2006, the non-polio AFP rate was 227 (mean 18.91 in each year), which is almost in agreement with the estimated incidence of AFP (1/100000) in the population aged 0-15 years worldwide. Only one case of poliomyelitis was reported in the first year of surveillance. Other 226 cases had non-polio AFP. The most common cause of paralysis among these patients was Guillain-Barre syndrome (66%). (Table 1)

**Table 1:** AFP surveillance of detected and diagnosed cases in Fars province, southern Iran

Year	Total cases of AFP	Cerebrospinal tumor	Guillain-Barre	Transverse myelitis	Traumatic neuritis	Poliomyelitis	Acute viral infection	Encephalitis	Others *
1995	21	1	11	1	0	1	6	0	1
1996	22	1	18	0	0	0	2	1	0
1997	21	1	18	0	0	0	0	0	2
1998	12	2	8	0	0	0	0	0	2
1999	15	0	9	0	1	0	0	0	5
2000	15	0	9	1	0	0	2	0	3
2001	22	0	10	0	1	0	6	1	4
2002	26	0	18	0	0	0	3	1	4
2003	14	0	8	0	0	0	2	0	4
2004	19	1	13	0	0	0	0	0	5
2005	19	0	12	0	0	0	1	1	5
2006	21	0	16	1	1	0	0	0	3
Total	227	6	150	3	3	1	22	4	38

**Others:** \*Multiple sclerosis, Osteomyelitis, Hip dislocation, Transient ischemic attack, Hemolytic uremic syndrome, Arthritis-brucellosis, Aseptic meningitis, Hypothyroid-muscular dystrophy, Femur necrosis. **Source:** FARS CDC of Shiraz Medical University, 2007

## Discussion

The number of AFP cases reported globally increased substantially from 17,365 cases in 1997 to 24,875 cases in 1998, mainly due to rapidly improving AFP surveillance in India. The global non-polio AFP rate increased from 0.7 per 100,000 in 1997 to 1.1 in 1998. In the African region, the non-polio AFP rate more than doubled from 0.16 in 1997 to 0.42 in 1998, but has still not reached a satisfactory level. The proportion of AFP cases with two adequate specimens increased globally from 63% in 1997 to 67% in 1998. Only the Western Pacific (86%) and European regions (78%) have reached the levels of stool specimen collection necessary for certification.<sup>17</sup> On May 1, 1999, 6,227 poliomyelitis cases with onset during 1998 were reported worldwide. This number exceeds the 5,185 cases reported in 1997 by 17%. The observed increase is paradoxical in view of the intensified global immunization efforts and therefore requires careful interpretation. The increase in cases reported does not reflect lack of progress in polio

eradication, but is caused primarily by substantial improvements in the quality of AFP surveillance, particularly in India. As reporting is becoming increasingly complete, a higher percentage of polio cases is identified and reported, while the absolute number of cases has probably decreased significantly. Poliovirus transmission is now largely confined to the remaining major foci of transmission in southern Asia, western Africa, central Africa, and the Horn of Africa. At the end of 1998, poliovirus was suspected or known to circulate in 50 countries, including seven major reservoir countries-Bangladesh, Democratic Republic of Congo, Ethiopia, India, Nepal, Nigeria, and Pakistan-and 7 countries in conflict- Afghanistan, Angola, Liberia, Sierra Leone, Somalia, Sudan, and Tajikistan. Reservoir countries in southern Asia accounted for  $\geq 80\%$  of polio cases reported globally in 1998.<sup>17</sup>

In 1988, the Regional Committee for the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO) adopted a resolution to eradicate poliomyelitis from the region by 2000. Since then, substantial progress has been made in vaccination and surveillance and, by the end of the year, 19 of the 23 EMR countries are expected to have interrupted poliovirus transmission. During 1999, National Immunization Days (NIDs) were conducted in 20 of the 23 countries of the region. Iran and Tunisia conducted targeted sub-national campaigns in provinces at risk for poliovirus importation and/or with suboptimal vaccination coverage, but NIDs have not been considered necessary in Cyprus. In 2000, several countries that have been polio-free have scaled down the scope of supplementary vaccination activities from NIDs to sub-national or local campaigns. During 1999-2000, NIDs and other supplementary vaccination activities have been intensified in countries with persistent poliovirus circulation (Afghanistan, Egypt, Iraq, Pakistan, Somalia, and Sudan). In 1999, each of these countries either conducted two pairs (four rounds) of NIDs (Afghanistan, Egypt, and Iraq) or one pair of NIDs and one pair of large-scale sub-national campaigns (Pakistan, Somalia, and Sudan). During 2000s, each of these six countries are going to conduct two pairs of NIDs and additional mopping up or sub-national campaigns. The quality of campaigns in these remaining countries where polio is endemic has been improved substantially through house-to-house vaccination, greater emphasis on high-risk areas, improved planning and supervision, additional financial resources, and increased technical consultation.<sup>18</sup>

Campaigns are coordinated among groups of contiguous countries within EMR. Coordination with the European region has led to elimination of the poliovirus reservoir in the border areas of Iran, Iraq, Syria, and Turkey. Cross-border coordination will continue in Afghanistan, Pakistan, and Iran. Increasing attention is being focused on collaboration with the regional office of WHO for Africa to coordinate eradication activities among countries of the Horn of Africa and countries that border western and southern Sudan.<sup>18</sup>

All member countries have established acute flaccid paralysis (AFP) surveillance. Fifteen countries (Bahrain, Egypt, Iran, Iraq, Jordan, Lebanon, Libya, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, and Yemen) achieved or exceeded the WHO-established minimum AFP reporting rate indicative of a sensitive surveillance system (1 non-polio AFP case per 100,000 children aged <15 years) during 1999. Among the eight remaining countries, the annualized non-polio AFP reporting rates during 2000 have exceeded one in Afghanistan, Kuwait, Somalia, and Sudan. The regional average reporting rates for non-polio AFP in 1999 and 2000 are 1.1 and 1.3 (annualized), respectively. During 1999 and 2000, two adequate stool samples were collected from 67% and 71% of the reported cases with AFP in EMR, respectively. During 1999, nine countries (Bahrain, Cyprus, Iraq, Jordan, Kuwait, Oman, Palestine, Syria, and Tunisia) achieved the WHO-recommended target of collecting two adequate stool specimens from at least 80% of those with AFP. During 2000, an additional four countries (Egypt, Lebanon, Libya, and Saudi Arabia) achieved this target.<sup>18</sup>

Compared with the same period in 1999, the number of confirmed cases of polio reported through September 2000 in the EMR has decreased by approximately 50% (from 619 to 314) despite substantial improvements in AFP surveillance. Compared with 13 EMR countries in 1999, 16 have reported no cases during 2000. However, during 1996-2000, six countries (Afghanistan, Egypt, Iraq, Pakistan, Sudan, and Somalia) have reported cases with indigenous strains of wild poliovirus. In 1999, Iran and Syria reported cases associated with imported poliovirus strains. Intensive control measures composed of multiple NID rounds and mopping up campaigns have led to cessation of the polio outbreak in Iraq.<sup>18</sup>

Since late 1999, wild poliovirus transmission in Egypt has been localized to a few districts in four

governorates. The latest person with virologically confirmed polio in Egypt had the onset in late May 2000. Expansion of surveillance in southern and central Somalia has led to identification of an outbreak of polio caused by wild poliovirus types 1 and 3 in Mogadishu, where, since January 2000, 38 cases of virologically confirmed polio have been identified. During 1999-2000, Pakistan continued to report the largest number of cases and has contributed more than 60% of the total number of virologically confirmed cases in the region. However, from January through September 2000, the number of virologically confirmed cases has declined 46% in Pakistan compared with the same period in 1999.<sup>18</sup> The Regional Commission for Certification of Poliomyelitis Eradication has reviewed national documentation of polio-free status from nine countries with high-quality AFP surveillance that have not had any reported cases of polio for several years. The commission has favorably reviewed reports from Bahrain, Iran, Jordan, Kuwait, Oman, Saudi Arabia, Syria, and Tunisia.<sup>18</sup>

In 1995, the World Health Organization (WHO) European Region (EUR), comprising 51 member states (including Israel and the Central Asian Republics), accelerated efforts toward polio eradication. Since 1995, National Immunization Days (NIDs) were conducted in 18 contiguous countries of WHO Eastern Mediterranean (eight countries: Afghanistan, Iran, Iraq, Jordan, Lebanon, Pakistan, Palestine, and Syria) and European regions (10 countries: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkey, Turkmenistan, and Uzbekistan) as part of Operation MECACAR (Eastern Mediterranean, Caucasus, and Central Asian Republics). Reported coverage levels were greater than 95% in 1997 with two doses of oral poliovirus vaccine (OPV), similar to levels achieved during previous years.<sup>2</sup> Beginning in the Autumn of 1997 with "mopping-up" vaccination, coordinated activities in countries of the two regions continued as "Operation MECACAR Plus"; NIDs were conducted in April and May 1998.<sup>19</sup>

Surveillance of suspected poliomyelitis cases was conducted in Albania from 1980 through 1995. A total of 93 cases were reported, two of which were clinically defined as poliomyelitis cases according to WHO criteria. Poliovirus was isolated from six subjects defined as contact vaccine-associated cases. Characterization of isolates by both antigenic and molecular methods showed that, in all cases, the

disease was associated with type 2 or 3 polioviruses of vaccine origin with retro-mutations known to be associated with loss of Sabin attenuated phenotype. Infection occurred despite the fact that all patients had records of previous immunization with oral polio vaccine (OPV), suggesting a failure of vaccination. Four of the five patients from whom poliovirus could not be isolated were classified as possible recipient vaccine-associated poliomyelitis on the basis of serology data (presence of antibodies against all three polioviruses) and the temporal association between the latest dose of vaccine received and onset of paralysis. Virological investigation on healthy contacts of the poliomyelitic patients yielded the isolation of a further 12 Sabin-like polio reverting viruses, mostly type 2 and 3. A detailed study of the non-polio acute flaccid paralysis (AFP) cases and their healthy contacts revealed the presence of several enteroviruses, namely Echo, Coxsackie and, in three cases, type 2 or 3 Sabin-like polioviruses.<sup>20</sup> Poliovirus persists in India not because virus transmission was missed through slipshod surveillance, but because of challenges eliminating the virus in areas in which it is known to exist.<sup>21</sup>

Francis erroneously concludes that continued polio transmission in India is linked to surveillance failure and that introduction of a new surveillance "quality indicator" based on compatible cases will help address the issue. The risk of these assertions lies in the diversion of attention from the real challenges of polio eradication protection of children through immunization to surveillance, which, in India, is

operating at a higher level of sensitivity than in any other country in Asia.<sup>22</sup>

Due to the changed situation in the last few years, eradication of poliomyelitis from Iran requires that particular efforts be made to implement polio immunization and surveillance programs and to monitor the immune status of the population by serological surveys.

In Fars province of Iran, the quality of AFP surveillance has been on certification level standards since 1995. The review team findings provide substantial evidence that the AFP surveillance reporting system is in place and is sensitive enough to pick up any AFP case caused by circulating or imported wild poliovirus. The routine immunization program provides adequate population immunity to limit any potential outbreak of polio due to importation of wild poliovirus. Routine coverage with three doses of OPV with supplementary immunization activities has reportedly reached over 95% of all target children. The existing system must be closely monitored and actively supported to maintain and constantly improve the performance.

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## References

- Cohen JI. Harrison's Principles of Internal Medicine (Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, Isselbacher KJ, eds.), 16th ed., McGraw-Hill Professional; 2004; p. 1144.
- Kew OM, Sutter RW, de Gourville EM, Dowdle WR, Pallansch MA. Vaccine-derived polioviruses and the endgame strategy for global polio eradication. *Annu Rev Microbiol* 2005;59:587-635. [16153180] [10.1146/annurev. micro.58.030603.123625]
- Ryan KJ, Ray CG, eds. Sherris Medical Microbiology, 4th ed., McGraw Hill; 2004; pp. 535-7.
- Sybil P. Parker, editor in chief. McGraw-Hill concise encyclopedia of science & technology. New York: McGraw-Hill; 1998.
- Yin-Murphy M, Almond JW. Picornaviruses: The Enteroviruses: Polioviruses. In: Baron S, et al., eds. Baron's Medical Microbiology, 4th ed., Univ of Texas Medical Branch; 1996.
- Leboeuf C. The late effects of Polio: Information for health care providers. Commonwealth Department of Community Services and Health; 1992.
- Frauenthal HWA, Manning JVV. Manual of infantile paralysis, with modern methods of treatment: Pathology. Philadelphia: Davis; 1914; pp. 79-101
- Sabin AB, Boulger LR. History of Sabin attenuated poliovirus oral live vaccine strains. *J Biol Stand* 1973;1:115-8. [10.1016/0092-1157(73)90048-6]
- Fine P, Carneiro I. Transmissibility and persistence of oral polio vaccine viruses: implications for the global poliomyelitis eradication initiative. *Am J Epidemiol* 1999; 150:1001-21. [10568615]
- Mastny L. Eradicating Polio: A Model for International Cooperation. Worldwatch Institute; January 25, 1999. Retrieved on 2007-02-02.
- Centers for Disease Control and Prevention (CDC). Update on vaccine-derived polioviruses. *MMWR Morb Mortal Wkly Rep* 2006; 55:1093-7. [17035927]
- Small pox. WHO Factsheet. Retrieved on 2006-09-23.
- Centers for Disease Control and Prevention (CDC). Certification of Poliomyelitis Eradication -- the

- Americas, 1994. *MMWR Morb Mortal Wkly Rep* 1994;**43**:720-2. [7522302]
- 14 General News. Major Milestone reached in global polio eradication: Western Pacific Region is certified Polio-Free. *Health Educ Res* 2001;**16**:110.
  - 15 D'Souza RM, Kennett M, Watson C. Australia declared polio free. *Commun Dis Intell* 2002;**26**:253-60. [12206379]
  - 16 Europe achieves historic milestone as region is declared polio-free, Press release, European Region of the World Health Organization, 2002-06-21. Retrieved on 2007-02-02.
  - 17 Progress toward global poliomyelitis eradication. *Wkly Epidemiol Rec* 1997;**74**:165-172. [9200968]
  - 18 Center for Disease Control and Prevention. Progress toward poliomyelitis eradication--Eastern Mediterranean Region, 1999-September 2000. *JAMA* 2001;**285**:161-2. [11236751] [10.1001/jama.285.2.161]
  - 19 Center for Disease Control and Prevention (CDC). Progress toward poliomyelitis eradication -- Europe and Central Asian Republics, 1991-September 1997. *MMWR Morb Mortal Wkly Rep* 1997;**46**:994-1000. [9380015]
  - 20 Diamanti E, Ibrahim B, Tafaj F, Mezini E, Dodbiba A, Dobi V, Catone S, Genovese D, Simeoni P, Fiore L, Genovese F, P. Simeoni and L. Fiore. Surveillance of suspected poliomyelitis in Albania, 1980-1995: suggestion of increased risk of vaccine associated poliomyelitis. *Vaccine* 1998;**16**:940-8. [9682341] [10.1016/S0264-410X(98)80025-X]
  - 21 Grassly NC, Fraser C, Wenger J, Deshpande JM, Sutter RW, Heymann DL, Aylward RB. New strategies for the elimination of polio from India. *Science* 2006;**314**:1150-3. [17110580] [10.1126/science.1130388]
  - 22 Bahi S, Ram M, Durrani S, Wenger J. Surveillance of acute flaccid paralysis in India. *Lancet* 2007;**370**:130. [17630028] [10.1016/S0140-6736(07)61078-2]