Full Length Research Paper

Performance of acute flaccid paralysis surveillance system in Zambia: 2000 to 2009- *Analysis of secondary data*

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Acute Flaccid Paralysis (AFP) surveillance was adopted by World Health Organization (WHO) following the World Health Assembly (WHA) Resolutions in May 1988, to monitor progress towards poliomyelitis eradication in all member countries. It was introduced in Zambia in 1993, but active AFP surveillance started in 1998. Since then, health workers collect AFP surveillance data, but there is no documented evidence of the review of the performance of the system and epidemiological analysis of the data. A retrospective descriptive analysis was conducted on secondary AFP surveillance data for the period 2000-2009, consisting of all children aged <15years and performance evaluated using WHO-specified core AFP global surveillance indicators. During this period, a total of 1,452 cases were investigated. Completeness of data from case-based forms was very inadequate. No wild polio viruses were detected in stool samples and the non-polio AFP rate ranged from 1.8 -3.3/100,000 and stool adequacy from 65% - 96%. There was low Non-Polio Entero virus (NPEV) rate. Although high level surveillance performance was achieved during this period, there were a lot of gaps in the national AFP surveillance data base. Addressing identified gaps could achieve optimal standards recommended by WHO and provide a good model for poliomyelitis eradication.

Key words: Acute flaccid paralysis, Poliomyelitis eradication, core indicators, completeness of data, wild polio virus, Non-polio AFP rate, non-polio entero virus rate.

INTRODUCTION

Poliomyelitis is a highly contagious viral disease caused by infection with the poliovirus serotypes 1, 2 and 3. The poliovirus infects mostly children below the age of five years, and in up to 1% of those infected the virus invades the central nervous system leading to muscle weakness and irreversible paralysis (usually in the lower limbs), often progressing to breathing problems, and death (Heymann, 2008). In May 1988 during the 41st World Health Assembly (WHA) meeting, it was resolved (resolution no.41.28) to eradicate polio from the world ex-

clusively by trivalent Oral Polio Vaccine (tOPV), marking the launch of the Global Polio Eradication Initiative (GPEI) spearheaded by the WHO, and member states including Zambia. They adopted a number of strategies to ensure the success of the initiative (SA EPI Field guide, 1998; WHO 2000) by the year 2000, a goal that was later pushed to 2005, 2010, 2012 and then to 2018. The global eradication of polio involves both halting the incidence of the disease and the worldwide eradication of the virus that causes it - poliovirus. WHO (2000) has outlined four (4) key strategies to achieve global polio eradication and certification; (a) high immunization coverage with at least three doses of oral polio vaccine (OPV) in infants aged <1 year; (b) supplemental doses of

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OPV during national immunization days; (c) Sensitive surveillance and investigation of AFP cases and (d) mopping-up vaccination in areas or among populations at high risk of poliovirus transmission.

According to CDC (2010), the number of polio-endemic countries has decreased from 125 countries in 1988, to four countries (Nigeria, Pakistan, India and Afghanistan) by 2010 by implementing the 4 strategies. As we get closer and closer to the end game of the Wild Polio Virus (WPV) transmission, surveillance of AFP becomes the most important strategy of the Polio Eradication Initiative (PEI). AFP surveillance is the intelligence network that underpins the entire eradication initiative. Without this investigative framework, it would be impossible to pinpoint where and how wild polioviruses are circulating or to verify when it has been eradicated, thus referred to as the "campus" or "golden standard" for eradication (WHO, 2003; WHO, 1998).

AFP surveillance helps to evaluate the program by monitoring the absence of WPV worldwide and help make the final decision that WPVs has been eradicated. As such, AFP surveillance will remain long after most of the PEI activities are discontinued (WHO, 1998). Eradication requires that sensitive surveillance systems capable of identifying cases of polio be in place in every country. AFP is a clinical syndrome characterized by a sudden onset of weakness of a limb described as flaccid (reduced tone), including Guillain Barre Syndrome in a child below 15 years of age, for which no obvious cause (such as severe injury or birth trauma) is found, or any case of paralytic illness (regardless of age) in which a clinician suspects polio. The World Health Organization (1996) adopted AFP surveillance globally as a key strategy for monitoring the progress of the polio eradication initiative, given that AFP mimics the clinical presentation of poliomyelitis. AFP cases with fever at the onset of paralysis, aged <5 years, and asymmetrical paralysis who are unvaccinated are suspected poliomyelitis cases and should be prioritized for investigation (WHO, 2003; WHO 1998).

Data from the AFP surveillance system are required to certify eradication. Heymann (2004), states that AFP Surveillance allows new cases to be identified where none had been before and can detect importations of wild poliovirus. This is reiterated in the South Africa EPI Field guide (1998). When a patient meeting the AFP case definition is seen at a health facility, health care practitioners conduct comprehensive investigations to rule out entero-viruses, including polioviruses as the cause of the paralysis. The investigation involves collection of two stool samples, 24 hours apart and transported to the virology laboratory within 72 hours. An AFP case where two adequate stool samples are submitted for analysis and no poliovirus is isolated is classified as a non-polio case and is discarded. The last indigenous polio cases in Zambia were detected in 1995 and the country was awarded a polio free status in 2005.

However the country remains at risk of wild poliovirus importation from the remaining polio-endemic countries.

AFP surveillance indicators

The WHO has set minimum performance indicators that should be used to evaluate the performance of AFP surveillance, monitor progress towards the given targets and to ensure that it is conducted to accurately guide the polio eradication initiative. AFP surveillance is a 100% sensitive system with poor specificity (WHO, 2003; WHO, 1996). The World Health Organization (2003;1998) states that a country's surveillance system should be sensitive enough to detect at least two (2) cases of non-polio AFP for every 100,000 children less than 15 years of age. This is the operational standard, while the certification standard is 1 case per 100,000 children less than 15 years of age. This is an indicator of the sensitivity of the AFP surveillance system in a country, and illustrates the ability of a country to detect a case of poliomyelitis if wild poliovirus was to be imported into the country.

The other core indicator is adequate collection of two stool specimens within 14 days of the onset of paralysis, target being: >80% of AFP cases have adequate stool specimens. In this study, the performance of the AFP surveillance system was evaluated using these two indicators.

The Polio Eradication Initiative (PEI) in Zambia was introduced and led by the polio eradication technical committee in 1993, but active surveillance began in 1998 following WHO guidelines. Since then, health workers routinely collect AFP surveillance data, but there has not been a documented in-depth epidemiological analysis of the data and review of the performance of the system. This could lead to failure of the system to promptly detect WPVs from neighboring countries, such as Angola, Democratic republic of Congo or any other endemic country. This could result in long spells of undetected polio virus circulation, leading to reestablished polio virus infections and consequently resurgence of poliomyelitis. Regular analysis of data generated from an AFP surveillance system is important in evaluating and improving the performance of the system. This ensures optimal performance of the system and guarantees timely detection of wild poliovirus importation, according to WHO (2003). In addition, as the world approaches polio eradication, the use of case-free periods as an indicator of the cessation of disease transmission becomes increasingly imprecise due to the high proportion of subclinical infections (Eichner and Dietz, 1996).

The objectives of this paper therefore were, to review performance of the AFP surveillance system between 2000 and 2009, discuss the epidemiological distribution of cases tested at the national polio laboratory in the period under review and identify components in the AFP surveillance system that require strengthening. Findings

of this study will be used to strengthen the AFP surveillance system, thus enable timely detection of imported WPVs leading to prompt response and curtail further spread of polio viruses, which were last detected in Zambia in 1995.

METHODS

Study setting and design

Zambia is a landlocked country covering an area of 752,612 square kilometres (about 2.5% of Africa). It shares borders with eight (8) neighbouring countries, Democratic Republic of Congo (DRC) and Tanzania in the north, Malawi and Mozambique in the east; Zimbabwe and Botswana in the south; Namibia in the southeast and Angola in the west. The country is divided into ten provinces, with an estimated population of 13,046,508 million (2010 estimates) of whom 6,394,455 (49%) are male and 6,652,053 (51%) are female; 7,978,274 (61%) resided in rural areas and 5, 068, 234 (39 %) in the urban areas.

Forty eight percent (6.2 million) of the total population is aged less than 15years, under 5years constitutes 20% and 4% is under 1year.

A retrospective descriptive analysis was conducted on secondary AFP surveillance data for Zambia for the period 2000-2009, consisting of all children aged <15 years investigated from health facilities as AFP. AFP surveillance performance was evaluated using WHO-specified core AFP global surveillance indicators:

1. Non-polio AFP rate in children < 15 years of age. (Target $\geq$ 2/100,000)

$$\text{Non-polio AFP rate} = \frac{\text{Number of reported non-polio AFP cases < 15 years of age} \times 100,000}{\text{Total number of children < 15 years of age}}$$

2. % Stool adequacy: Reported AFP cases with 2 stool specimens collected $\leq$ 14 days since onset of paralysis (Target $\geq$ 80%)

The demographic characteristics and the results of primary isolation and identification of polio and other enteroviruses in stool samples sent to the WHO Polio Laboratory for cases were analysed using ordinary percentages and rates. All the cases that are investigated in the country are entered in the national AFP data base at the National Virology laboratory and WHO country office.

Data were analyzed using the Epi Info statistical software (version 3.5.1; Centers for Disease Control and Prevention, Atlanta, United States). Descriptive analyses were conducted to describe the epidemiology of AFP and to generate statistics based on the standard WHO-specified performance indicators for AFP surveillance.

RESULTS

The current study reports the results of surveillance for non-polio AFP cases that were investigated between January 2000 and December 2009. Zambia investigated 1,452 AFP cases during this period. The highest number of cases was recorded during the June to October period. The lowest number of cases were recorded in 2006 (101) and the highest in 2009 (206). Northern province recorded the highest number of silent districts, while central and western provinces had the lowest number of districts that did not report cases. The highest number of districts reporting AFP cases were recorded in 2008 (68/72) and 2009 (66/72); 94% and 92% respectively. Six hundred and sixty-two (662) were male (46%) and 790 (54%) were female. The age variable was divided into 3 categories; 0-5, 6-9 and10-15 years. Only 326 cases had the age variable indicated in the data base and majority of cases 204/326 (63%) were in the 10-15 years age group. Sixty-six percent of cases (961/1,452) were true AFP cases and 699/757 (92%) were flaccid and sudden. Asymmetric paralysis represented 714/1,327 (54%) and seventy five percent (297/342) of cases showed progression of paralysis within 3 days of onset. The rest (1,054) were unclassified for this variable.

Fever at onset of paralysis was not indicated from 2000 to 2006. Data from 2007 showed that 318/449 (70.8%) of cases had fever at onset of paralysis and 655/967(68%) were admitted to hospital. Upon arrival at the virology laboratory, 709/723 (98.1%) were classified to be in good condition and proportion of stool specimens where non-polio entero-virus was isolated was 0.2% (143/1,439). Thirteen of the samples were not classified in this regard. The non-polio AFP rate ranged from 1.8 -3.3/100,000, with an increase from 2.3 in 2000 to 3.3 by the end of 2009, while the stool adequacy ranged from 65% - 96%; Figures 1 and 2 respectively. Although there had been a remarkable improvement, it had been fluctuating over time, with an initial decline between 2002 and 2004, though above the operational target, followed by 2006. In 2007, five (5) out of the nine (9) provinces did not attain the operational target. The two core indicators were however achieved in all provinces in 2008 and 2009.

Fifty eight percent (543/936) of AFP-cases had three polio-vaccine doses, followed by 24% (226/936) with four doses. Thirty two (3.4%) cases were recorded as not having received any polio vaccination. Only nineteen percent (274/1,452) of cases were followed up after 60 days of onset of paralysis. Of these, 26 (9.5%) had residual paralysis, 228 (83%) had no residual paralysis, 6 (2.2%) were lost to follow up and 14 (5.1%) died before follow up. The final classification revealed no confirmed poliomyelitis cases, 2(1.6%) were polio-compatible, 1,381 (98%) were non-polio and one was not an AFP case. Data on the differential diagnosis of AFP cases was not captured in the data base, making it difficult to determine the major leading cause of AFP. Completeness of data in the data base was generally unsatisfactory.

Figure 1. NON-POLIO AFP RATE BY YEAR.
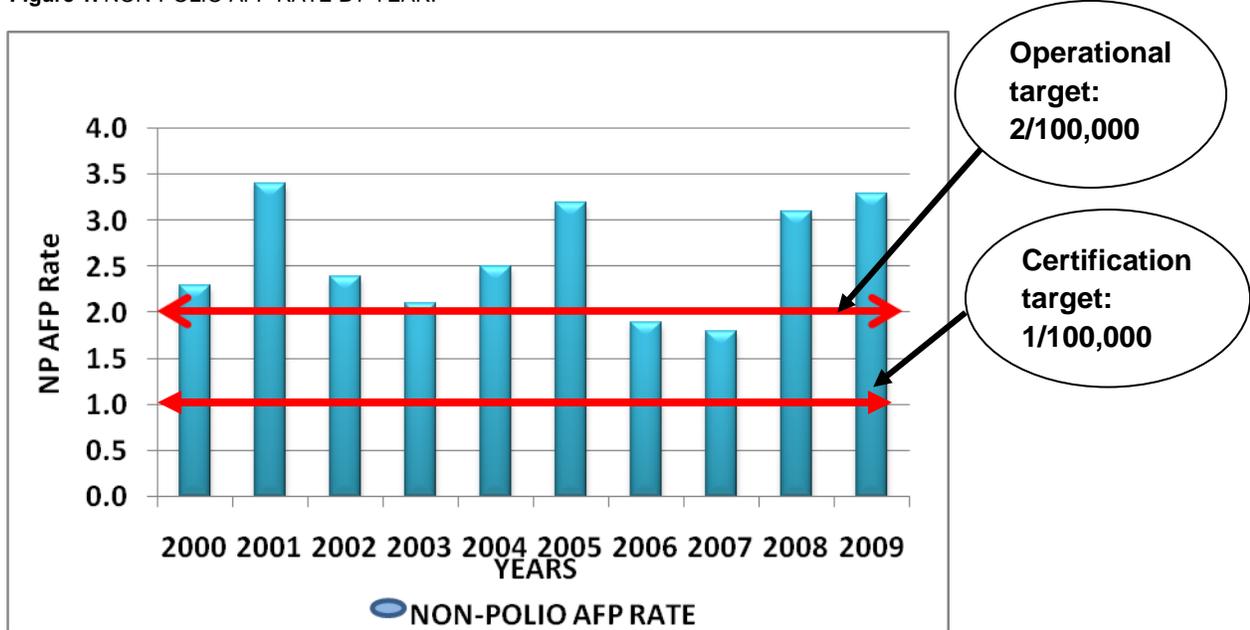
Figure 1. shows the national non-polio AFP rate attained from 2000 to 2009.

Figure 2. Percentage Stool Adequacy By Year.
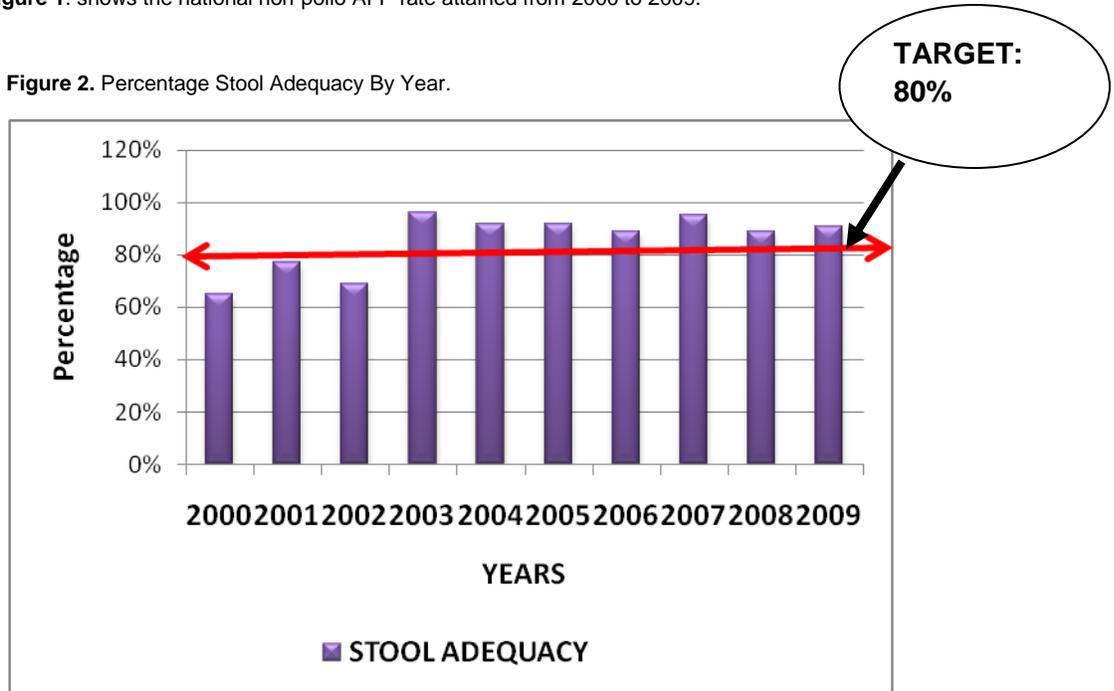
Figure 2. Shows the national stool adequacy percentages attained during the period under review by year.

DISCUSSION

In this study, majority of cases were in the ten to fifteen years age group. This is contrary to results from other countries; India, Nigeria and Italy (CDC, 2000-2001; Singh, 2004; Tal-hatu, 2006) which showed a higher prevalence in children below the age of five years. This could be because all AFP cases investigated were non-polio cases. Poliomyelitis is usually common below the age of five years. The majority of cases were detected in the period June to October.

According to the American Academy of pediatrics (2006), this could be related to the epidemiological progress of entero-virus infections, which in temperate cli-

mate countries spread mainly during summer and autumn. As for the gender of investigated AFP cases, the prevalence was higher among girls than among boys. This is in variance with results in other studies, such as, a survey conducted in Italy by D'Errico et al (2008) which reported 15 AFP cases among boys compared to 12 cases among girls. Similarly, a study by Oostvogel et al (1998) in the Netherlands reported 34 AFP cases in boys in comparison with 18 cases in girls.

Results from this study also revealed that majority of stool samples arrived at the Laboratory within the specified period, showing that there was a good system in transporting samples.

Additionally, the results show that the proportion of specimens where non-polio entero-virus (NPEV) was isolated was very low, 143/1,439 (0.2%) The country failed to meet the WHO-specified target of at least 10%. These results coincide with studies done elsewhere which showed low figures, such as in Pakistan and India which reported 8.5% and 3.4% respectively (Kapoor, 2001). To the contrary, higher figures were recorded in Egypt (Salwa et_al., 2009) and Nigeria (Oderinde, 2007) reporting 17.6% and 14.6% respectively. This indicator evaluates the integrity and viability of stool specimens received by the laboratory and also assesses how well the laboratory performs in the routine isolation of entero-viruses.

The variations observed in the non-polio entero-virus isolation may be attributed to factors such as differences in the specificity and sensitivity of laboratory methods and test kits, stool specimen collection, handling and transportation procedures. The low NPEV isolation in this study could be attributed to failure to adhere to standard procedures in the collection, handling and shipment of stool specimens. The implication of this low NPEV rate is that circulating wild polio viruses may be missed by the surveillance system. There is need to ensure standard procedures are followed in the collection, handling and shipment of stool specimens. This can be achieved through regular and consistent clinician sensitization and training.

Results also show that the non-polio AFP detection rate was achieved and sustained way before 2005 when the country was awarded a polio free status. The WHO target was met in the years 2000 to 2005, 2008 and 2009. The increase in the AFP rate during the 2000 to 2005 period could be due to sustained increased morale among health workers to detect and investigate cases, since active surveillance started in 1998. The increase in 2008 and 2009 could be attributed to an internal peer surveillance review conducted in May, 2008 in Lusaka and Copperbelt provinces, which accelerated active surveillance and Clinician sensitization on AFP. Although the national figures were high, disaggregating the rate by province showed low figures at this level. It was only Western province that attained the target throughout the 10 year period.

Central, Luapula, Northern, North-western, Southern and Copperbelt provinces attained the target in 6 to 9 years of the 10 year period, while others (Eastern and Lusaka) could only meet the target in 3 and 4 years respectively. Hence, looking at the cumulative national performance tends to mask the underperforming sub-national levels, and these areas may possibly become pockets of transmission where polio virus circulation could go undetected if the virus is imported into the country. Efforts should therefore be made to strengthen the sub-national AFP surveillance system.

Globally, AFP case reporting increased by 10%, from 62,434 cases in 2005 to 68,576 cases in 2006, mainly as a result of increased reporting from India, Nigeria, and Pakistan. In 2005, the global Advisory Committee on Polio Eradication (ACPE) endorsed a new minimum operational target for non-polio AFP rate of two cases per 100,000 persons aged <15 years for all polio-endemic countries and countries at high risk for WPV importation (CDC, 2008; CDC, 2005). All four polio-endemic countries and 12 of the 13 (i.e., all except Kenya) countries in which polio was reintroduced in 2006 reached this new operational non-polio AFP target rate in 2006. All countries, including Kenya reached this target in 2010 (CDC, 2008).

Maintaining surveillance sensitive enough to detect poliovirus is critical in guiding the eradication of remaining indigenous poliovirus, in enabling rapid response to importations and in certifying the interruption of transmission. In 2008, all WHO regions maintained AFP surveillance at or above certification level while all polio-endemic regions and the majority of re-infected countries showed improvement in AFP surveillance levels compared with 2007 statistics when there was a slight decline in polio-free regions. In polio-endemic regions, 15 countries did not reach certification-quality AFP surveillance. In polio-endemic WHO regions – the African (AFR), Eastern Mediterranean (EMR) and South-East Asian Regions (SEAR) – most countries recorded AFP – reporting levels of 2 per 100 000: double that of certification levels. In AFRO, 91% of countries achieved this level, compared with 93% in EMR and 97% in SEAR (CDC, 2008).

The proportion of adequate stool specimens was maintained above the WHO-specified national target of at least 80% from 2002 through 2009. This performance was also reflected at the sub-national levels, with most of the provinces maintaining the stool adequacy rate above the target. This indicates timely detection and investigation of cases. Ninety-eight percent (709/723) samples were classified as being in good condition at the virology laboratory. Laboratory analysis is critical to the confirmation of the poliovirus, therefore the stool specimens that are sent to the laboratory should be of sufficient quality to enable the laboratory identify the poliovirus or to rule out its presence with a high degree of confidence. Since no poliovirus was isolated during the

study period with such high stool adequacy rates, it can be ascertained that there was no wild-poliovirus circulating in the country during this period.

The final diagnosis for AFP cases in the present study was not captured in the data base; making it difficult to determine the leading cause of AFP in Zambia, they were simply categorized as AFP. This is a matter of concern. Studies from other countries have however shown Guillain Barre Syndrome as the commonest cause of AFP (Marx et_al, 2000; Derrico et al., 2007; 2008). A study conducted by Davarpanah et al (2008) in Shiraz province, in central Iran reported a similar result. Despite the fact that the final clinical diagnosis was not reported, laboratory findings refuted the probability of the occurrence of poliomyelitis in the period under review. Acute flaccid paralysis is a clinical syndrome with a broad array of possible differential diagnoses, hence accurate diagnosis of the cause of AFP is important for guiding therapy and prognosis. The majority of cases in this study had fever at onset of paralysis. Similarly, fever was a major symptom in 53% AFP cases associated with NPEV in India (Kapoor A, 2001). The presence of fever in almost two third cases in the present study could be due to the fact that most of the time cases were reported from hospital where the paralysis had reached its peak. The clinical significance of fever at the onset of paralysis along with rapid progression of asymmetrical paralysis helps in the determination of neuropathies caused by NPEV. The legs are usually more affected than the arms.

Vaccine coverage among AFP cases indicates that fifty- eight percent (543/936) of AFP-cases had three polio-vaccine doses, followed by 24% (226/936) with four doses.

Thirty two (3.4%) cases were recorded as not having received any polio vaccination. The low coverage for fully immunized children with polio vaccine may leave room for susceptible children who may help to sustain transmission of poliovirus in the community. It is important to note that lowered immunization coverage may also have serious consequences in countries that use OPV, as was demonstrated by outbreaks of poliomyelitis due to circulating vaccine derived polioviruses (cVDPV) in Nigeria (WHO, 2009), Hispaniola, (Dominican Republic and Haiti), the Philippines (Kew et al, 2002) and Madagascar (Rousset et al, 2003). Consequently, high coverage of polio vaccination is not only important in the period until the eradication of the wild polioviruses from human circulation, but for as long as live OPV is in use.

In the present study, eighty-three percent of cases followed up had no residual paralysis after 60 days, giving confidence with some degree of certainty that the polio virus was not at play, despite the fact that majority of cases had fever at onset of paralysis. The presence of residual paralysis at 60 days follow-up is further evidence that the cause of paralysis is most likely poliovirus. The importance of this re-visit is even greater for cases with

inadequate stool specimen, whose lab results are negative. Within ninety days of onset of paralysis, all suspected cases must be classified as confirmed polio, polio-compatible or discarded (i.e. non-polio) by the National Polio Expert Committee (NPEC). Given that cases in which wild poliovirus are isolated by the laboratory are automatically confirmed, only those with inadequate specimens are reviewed by the NPEC. Every case that is classified as polio-compatible should have an explanatory note.

This is so because of zero evidence versus inadequate specimen and residual paralysis compatible with polio clinically (WHO, 1998; 1996). In this study, only two AFP cases were compatible with poliomyelitis, while forty-eight cases (3.4%) were not classified. Polio compatible cases are generally considered to result from failures of the AFP surveillance system; they show that the system may not be robust enough to exclude the existence of wild poliovirus circulation with certainty. This result therefore shows that the AFP surveillance system in Zambia was relatively good and that it was unlikely that polio viruses could have been missed. A study done in India reported that clusters of polio compatible cases tended to occur in areas with continuing wild poliovirus transmission, suggesting that these were actually missed polio cases (Salwa et_al., 2009). It is therefore important to monitor polio compatible cases for clustering by geographical area and by time. Understanding the patterns of occurrence of compatible cases can help to pinpoint weaknesses in the AFP surveillance system and indicate what corrective measures should be taken In order to reduce the number of compatible cases, it is necessary to minimize the time between the onset of paralysis, case notification and investigation (Kohler et_al., 2003).. The EPI-Surveillance section should ensure adequate and complete documentation on the case investigation forms and strengthen the follow-up of stool specimens submitted to the laboratory and the documentation of the laboratory findings onto the AFP surveillance database.

This study had a number of limitations. First, there were a lot of gaps in the data base for AFP cases reported from 2000 to 2009 in the following areas; patient information, clinical history, immunization history, follow up examination, final clinical diagnosis, sites of paralysis and final classification. Furthermore, the results of the decision made by the national expert committee who reviewed AFP cases which were clinically compatible with polio with residual paralysis at 60 days were not recorded for many patients. Analysis of sites of paralysis could not be done due to insufficient data in the data base. Despite its limitations, the current study may have a number of implications on health care policy.

First, the performance of the non-polio AFP surveillance program was evaluated in the target population for ten consecutive years, so gaps identified need to be addressed in order to keep track of the polio eradication initiative. Secondly, the many gaps in the data

base for a number of variables, including the final diagnosis of AFP cases and the main cause of AFP among children aged <15 years old need to be addressed. This calls for a more concerted effort at the point where AFP cases are detected and investigated to ensure health workers are aware of the procedures involved in the process and all areas are adequately covered on the case investigation form. Thus need for more training and sensitization for health workers.

No similar study has been performed in Zambia before to enable comparison in the performance of the system.

CONCLUSION

The study indicated that the AFP surveillance system was efficient in the ten year period under review, meeting most of the WHO established epidemiological and laboratory indicators. The system has its strengths in timely transportation of stool specimen, stool specimens arriving in the lab in good condition and good laboratory performance standards.

In addition to maintaining these best practices, the two core AFP surveillance indicators; proportion of stool adequacy and non-polio AFP rates have to be strengthened to better enhance the overall performance especially at the sub-national level. Due to the risk of poliovirus importation from endemic countries prior to global eradication, long term surveillance is required to provide a high degree of confidence of freedom from poliovirus infection in Zambia.

Efforts should also be made to follow up all the AFP cases in order to establish proper diagnoses for the cause of the AFP leading to proper care. In this regard, clinicians, surveillance officers and health workers involved in the AFP surveillance activities need to be sensitized and build their capacity through clinical meetings and motivate them to detect, investigate, collect, transport, report and conduct 60-days follow up to fully meet the WHO standards for the eradication goals. AFP surveillance remains the golden standard of poliovirus surveillance and all efforts should be made to maintain it at high level of performance and improve it when necessary.

It is vital to maintain sensitive surveillance beyond the period required for WHO certification, both to support global progress towards polio eradication, and to enable effective public health response in the event of the importation or re-emergence of polio. This should be coupled with good immunization coverage for oral polio vaccine to prevent outbreaks in case of Wild polio virus importation or re-emergence of poliomyelitis.

ACKNOWLEDGEMENTS

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