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Full Length Research Paper

Towards a Polio-Free Ghana: Evaluating Progress in the Eastern Region's Fight Against Poliomyelitis

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Poliomyelitis is a highly-infectious viral disease affecting children under 15 years. One in 200 infections leads to irreversible paralysis and in 5 to 10% of such case, patients die from paralyzed breathing muscles. Ghana is at the verge of polio certification and the only reported case of wild polio virus in the Eastern Region was in 2003. We reviewed AFP data in the Eastern-Region to assess the progress towards interruption of polio virus transmission and identified opportunities for surveillance improvement. We reviewed records and conducted secondary data analysis of all AFP cases reported to the Region from 1997 to 2010. We assessed data quality, calculated AFP surveillance indicators, and described AFP cases by person, place, time and polio vaccination status. Completeness of case-based- forms was 90%. Of 306 AFP-cases reported, one wild polio virus was recorded; 59.2% were males aged < 5 years; 26.5% had right lower limb paralysis; 14% occurred in October and 52.6% had received 4 doses of oral polio-vaccine. The non-polio AFP rate ranged from 0.12 to 4.3/100,000 population and stool adequacy from 60 to 100%. The period prevalence of non-polio entero-viruses was 8.5% (26/306). There is sustained progress towards interruption of polio virus transmission in the region. However, opportunity remains to improve the completeness of case-based forms and the non-polio AFP rate.

Key words: Acute flaccid paralysis, poliomyelitis, surveillance, eradication, vaccination, Ghana.

INTRODUCTION

Poliomyelitis is a crippling viral disease caused by poliovirus serotypes 1, 2 and 3. It is a highly infectious disease, which affects mainly children under five years. The virus is transmitted through contaminated food and water, and multiplies in the intestine, from where it can invade the nervous system. Many infected people have no symptoms, but do excrete the virus in their faeces, hence transmitting infection to others. Initial symptoms of polio include fever, fatigue, headache, vomiting, stiffness in the neck, and pain in the limbs. One in 200 poliomyelitis infections leads to irreversible paralysis usually in the lower extremities. Among those paralyzed, 5 to 10% die when their breathing muscles become immobilized. The morbidity and mortality from polio can be prevented through vaccination.

In 1988, the World Health Assembly Resolution 41.28 earmarked polio for eradication and established the polio

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eradication programme as a global initiative to rid the world of poliomyelitis (World Health Assembly, 1988). Significant progress has been made as polio cases have decreased by 99.6%, from an estimated 350 000 cases in 1988 to 1349 reported cases in 2010 (Schoub et al., 2001; Bonu et al., 2004; http://en.wikipedia.org/wiki/Poliomyelitis_eradication#cite_ref). The reduction is the result of the global effort to eradicate the disease through the use of the oral poliovirus vaccine (OPV). Serotype 2 appears to have been eliminated globally but serotypes 1 and 3 still persist in several African countries and Asia. Since poliovirus is not the only agent that causes acute flaccid paralysis (AFP), a broad surveillance case definition that captures all AFP is used including Guillain Barre Syndrome, transverse myelitis and transient paralysis associated with non polio enterovirus (NPEV) infections among children aged less than 15 years and all cases of suspected poliomyelitis among persons of any age.

The AFP surveillance system in Ghana was established in 1996. It is part of the general frame-work of the Integrated Disease Surveillance and Response (IDSR) system which operates within the decentralized government health service delivery.

The AFP surveillance system is used to monitor and document the progress towards interruption of polio transmission with the following objectives:

i) To detect, investigate and report all AFP cases using case-based forms.
ii) To collect 2 stool specimens >24 h apart from each AFP case within 14 days of onset of paralysis.
iii) To conduct follow-up examination of all AFP cases after 60 days of onset of paralysis and report to national level.

The core AFP surveillance indicators are as follows:

i) Non-polio AFP Rate per 100, 000 population of children under 15 years of age (target ≥2.0).
ii) Percentage of AFP cases with two adequate stool specimens collected at least 24 hours apart and within 14 days of onset of paralysis (target ≥80%).

The AFP surveillance system in Eastern Region was established in 1997. The system has similar objectives and procedures as the national level surveillance system. All the 21 districts in the region report on AFP surveillance activities on weekly and monthly basis. The AFP surveillance system is incorporated into the integrated disease surveillance and response system in the region with reasonable patronage of health and non health workers.

AFP surveillance, with its more sensitive case definition, is used to monitor and document the presence or absence of wild polio virus. Ghana has remained polio- free since 2009 and is at the verge of polio certification. The only reported case of wild polio virus in the Eastern Region was in 2003. We therefore reviewed and analyzed the 1997 to 2010 AFP data in the Eastern Region to assess the progress towards interruption of polio virus transmission based on surveillance indicators. We also identified opportunities for surveillance improvement.

METHODOLOGY

Study area

Eastern Region of Ghana had an estimated population of 2,354,538 with a growth rate of 1.4% in 2010. It is the sixth largest region with a land area of 19,323 km^2, thus representing about 8% of the total land area of the country (Figure 1).

The region is bounded on the East by the Volta Region, South by Greater Accra region, West by Central Region and on the North by Ashanti Region. It has 21 districts, with the largest number of public health facilities in the country. All the public health facilities have AFP focal persons who report weekly to the district-level that in turn reports monthly to the regional-level on AFP and other diseases under surveillance. When a case of AFP is identified by a clinician at the health facility or by a community-based surveillance volunteer, the sub-district or district level surveillance focal person is notified, who then conducts a detailed investigation of the case. The investigation entails completing an AFP case investigation form in triplicate, followed by initiation of the process of collection of 2 stool specimens 24 to 48 h apart, and transporting the specimen to the polio laboratory, Noguchi Memorial Institute for Medical Research (NMIMR) in the capital, Accra. Stool samples are transported to the polio laboratory under reverse cold chain in a surveillance vehicle within three days of dispatch accompanied by one copy of the filled AFP case investigation form.

The condition of the stool samples was assessed in the laboratory for adequacy in terms of quantity, appropriate storage temperature, and whether there was any leakage. The stools are analyzed for the presence of any polio virus; if virus is present, whether it was the wild type and also sequencing of the virus. Also, the laboratory examines for non-polio enteroviruses. The results of AFP stools analysis are communicated to the district through the National Disease Surveillance Department.

The detailed information is entered into a database which is analyzed to determine whether the surveillance indicators are being met. For all AFP cases in which viruses were isolated or samples were inadequately collected, a 60-day follow up examination is carried out to find out if the case has residual paralysis. A National Polio Expert Committee meets quarterly to classify all AFP cases and advise on surveillance gaps that need to be addressed. Since the inception of the surveillance system in eastern region, only one wild polio case has been detected and numerous non- polio enteroviruses. The oral polio vaccination coverage (OPV3) has consistently been above the target of 90% (Table 1).

Study design

This was a fourteen-year retrospective review of secondary data on all reported AFP cases, undertaken in June to July 2011. We reviewed AFP surveillance electronic data-set in Microsoft Excel, case-based forms and case investigation forms from 1997 to 2010 at the Eastern Regional Disease Control Unit of the Ghana Health Service. Key data elements extracted were age, sex, district, date of birth, date of onset of paralysis, OPV doses, date of investigation and stool collection, stool adequacy, laboratory result and 60 days follow up results. Data on the case based forms were reviewed for

Figure 1. Map of Eastern Region.

Table 1. Trend of OPV3 coverage, Eastern Region, Ghana, from 2008 to 2010.

Year	2008	2009	2000	2010
OPV3 Coverage %	93.2	92.9	94.2	96.4

missing data points, validated, and used to update the electronic database for all the AFP cases reported. The MS Excel data base was imported into SPSS version 16 and analyzed. Univariable analysis of key socio demographic, case- investigation and administrative data by person, place and time were expressed as frequency-distributions, percentages and crude rates. We identified AFP-cases with wild polio virus isolated and calculated three periodic AFP surveillance indicators using the case investigation data. Of the three indicators, the non-polio enterovirus prevalence was obtained by pooling all NPEVs isolated during the period under study and divided by the total number of AFP cases reported (306); the non-polio AFP rate was obtained by dividing the reported non polio AFP cases with the number of expected AFP cases in children <15 years as pre-determined for the region based on annual population data, and the percentage stool adequacy was obtained as the proportion of AFP cases with stools meeting WHO criteria out of the total number of AFP cases investigated during each year.

Ethical issues

This project was conducted as part of health system process improvement and service-based learning in the Eastern Region. Official consent was obtained from the Regional Director of Health Services and the Deputy Director for Public Health supervised the work. The Head of Disease Control and the Regional Disease Surveillance Officer collaborated in the study. We protected the confidentiality of the AFP case-patients through the use of de-identified and coded data.

RESULTS

Ninety six percent (294/306) of the AFP case based forms reviewed were completely filled with a few missing data on date of birth, date of investigation, and laboratory result as obtained from laboratory staff feedback. Between 1997 and 2010, there were 306 reported cases that met the WHO case definition for AFP, of which one was due to confirmed wild polio virus serotype P1.The non- polio AFP rate (NPAFPR) was above the national target of 2/100,000 population of children below 15 years from 2000 to 2003, then it declined to 1.54/100,000 in 2007. Between 2008 and 2009, the required AFP target

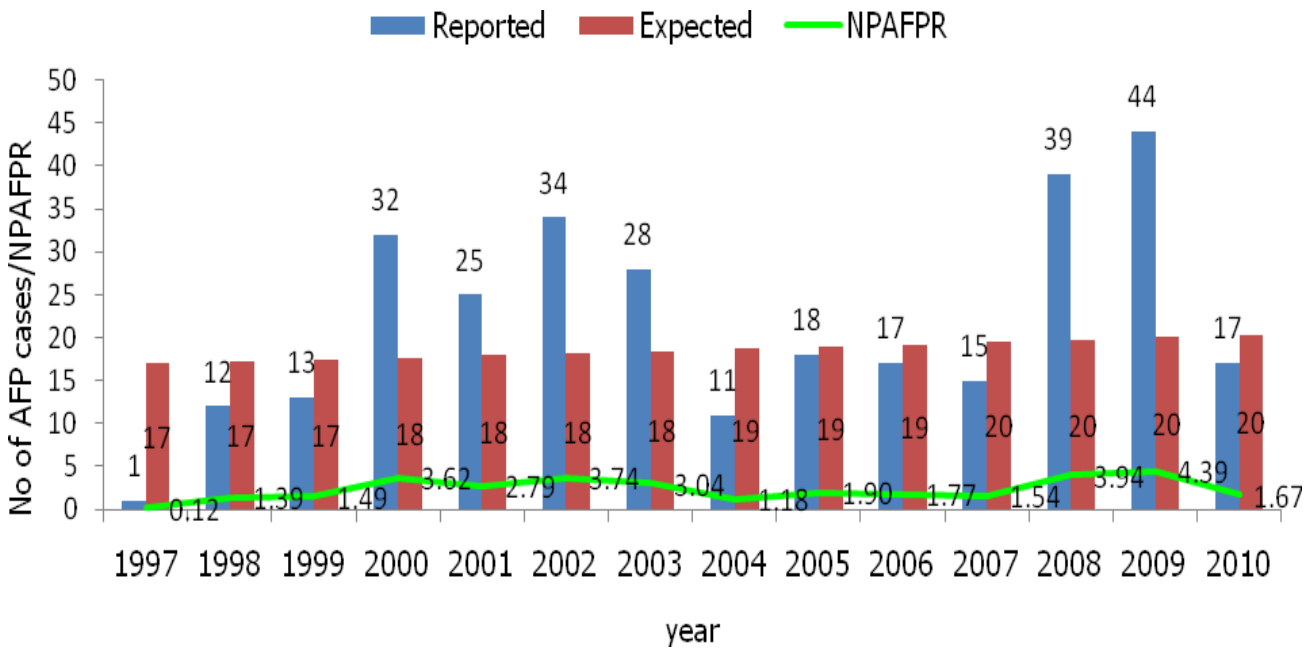

Figure 2. AFP cases and non-polio AFP rate, Eastern Region (1997 - 2010).

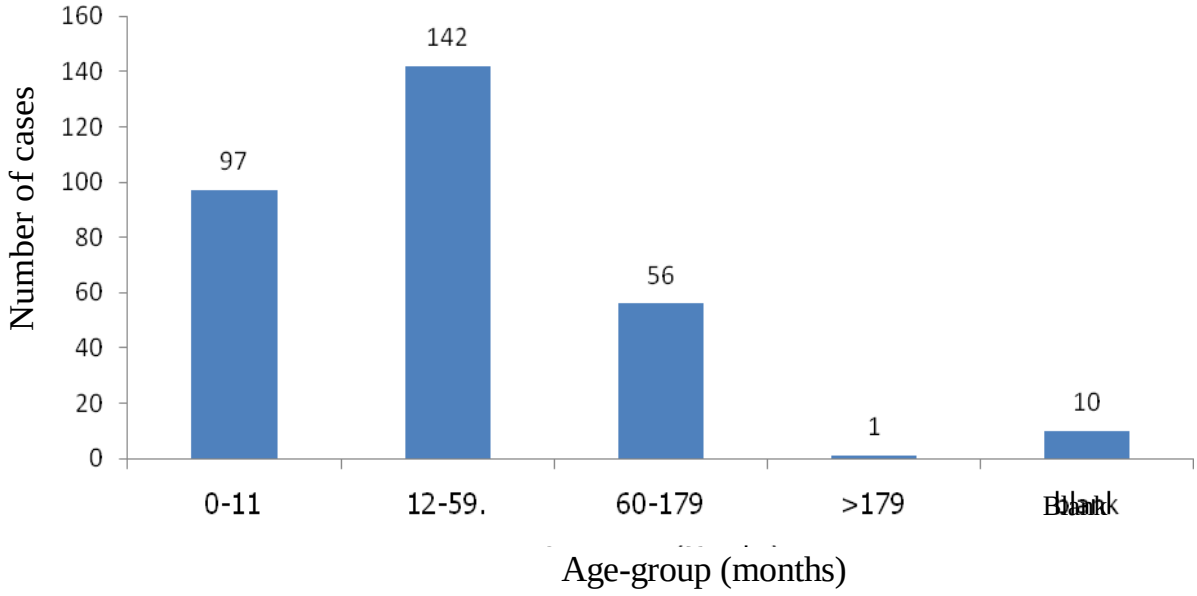

Figure 3. Age group distribution of AFP cases, Eastern Region (1997-2010).

was exceeded, but was followed by another sharp decline in 2010. The highest NPAFPR was recorded in 2009 (4.39) and the least in 1997 (0.12) (Figure 2). The rate of AFP cases reported followed the same trend as the NPAFPR.

Most of the AFP cases were males (181/306) and almost half (46.4%) of the AFP cases were between the ages of 12 and 59 months (Figure 3).

The percentage stool adequacy target of 80% was achieved during most of the years plateauing at 100% from the year 2009. The lowest percentage stool adequacy (50%) was recorded in 1999 (Figure 4). However, only in 31.1% of the AFP cases were two stool samples collected between 24 and 48 h apart within 14 days of onset of paralysis.

The prevalence of non polio enteroviruses among the

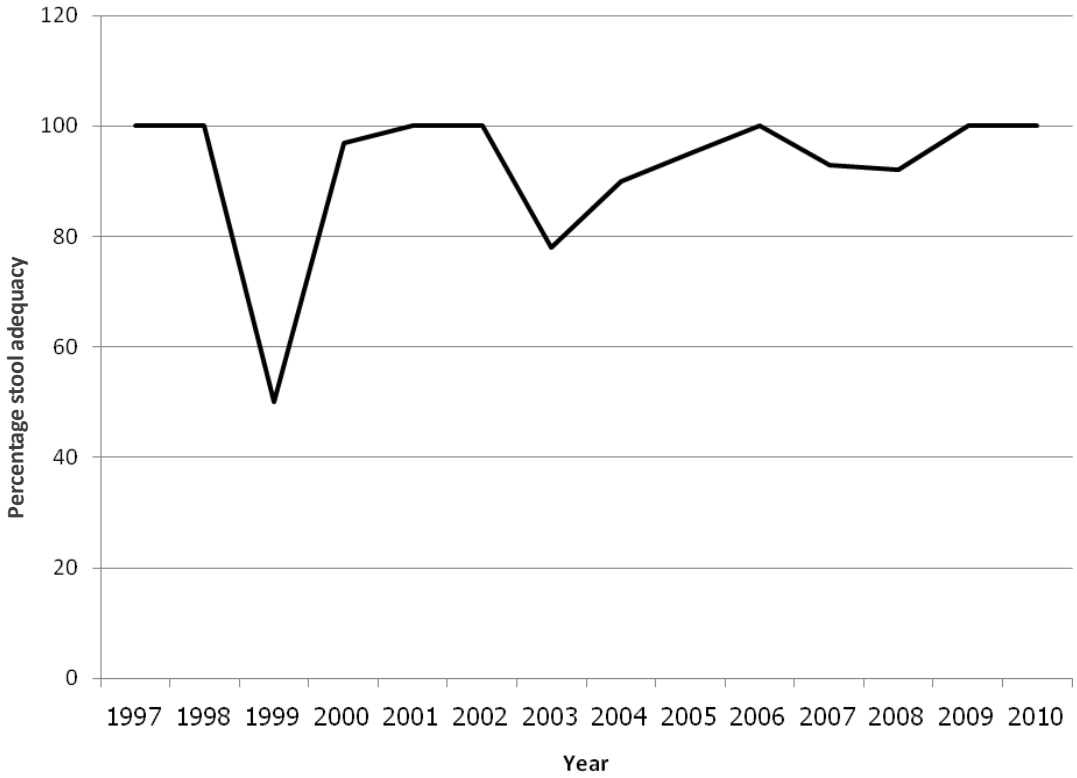

Figure 4. Percentage of AFP Stool Adequacy, Eastern Region (1997-2010).

AFP cases was 8.5 (26/306). All the 306 AFP cases were followed up for 60 days. Residual paralysis was found in 25% of them, 42% were free from paralysis, 12 (3.9%) died and 29.1% were lost to follow-up. The commonest site of paralysis was the right lower limb (81/306) (26.5%) and this was found mostly in males (42/81) (52%). The coverage for 4 doses of oral polio vaccine was 52.6%. Majority of the cases were found between the rainy season in Ghana (April to November) compared to the dry season (December to March) (Figure 5). Of the 21 districts, Suhum Kraboa – Coaltar reported the highest number of AFP cases (32/306), while Akyeamansa reported the least. Only 25% of the districts achieved the required target of collecting 2 stool samples between 24 and 48 h apart within 14 days on onset of paralysis.

DISCUSSION

The primary mission of the acute flaccid paralysis surveillance as a strategy of the World Health Organization-led polio eradication initiative is to detect, investigate, report, disseminate and inform prompt implementation of control measures. Since the inception of the AFP surveillance system in the Eastern Region of Ghana in 1997, only one paralytic poliomyelitis case had been detected of the 306 AFP cases identified through the system. However, the importation or reintroduction of poliovirus from endemic countries remains a threat, since the region is one of the major transit points to neighboring countries like Nigeria. This underscores the importance to continue and sustain surveillance for AFP in children less than 15 years until global eradication and certification is achieved. A recent situation in the country where after over 5 years of being polio-free, 8 cases of wild-polio virus were suddenly identified in the Northern region, lends credence to the need for continued surveillance in the Eastern Region even in the absence of wild polio virus isolation. Countries or regions with previous history of interruption of polio transmission have been known to have importation of the virus from yet polio endemic countries as was the case in Ivory Coast (CDC, 2009- 2010a, b). Also, the WHO's documentation _facts sheet on poliomyelitis' (CDC, 2009) and Park (2000) observed that the polio virus may infect the central nervous system in a very small percentage (<1%) of cases resulting in varying degree of paralysis, and possible death. This observation also depends on the offending serotype (Nathanson and Martin, 1982) and implies that there might be more circulating polio viruses with no clinical symptoms hence the need for continued surveillance with great attention to stool quality in order to isolate any remaining wild polio viruses in the region. The serotype detected in the only case of paralytic polio reported

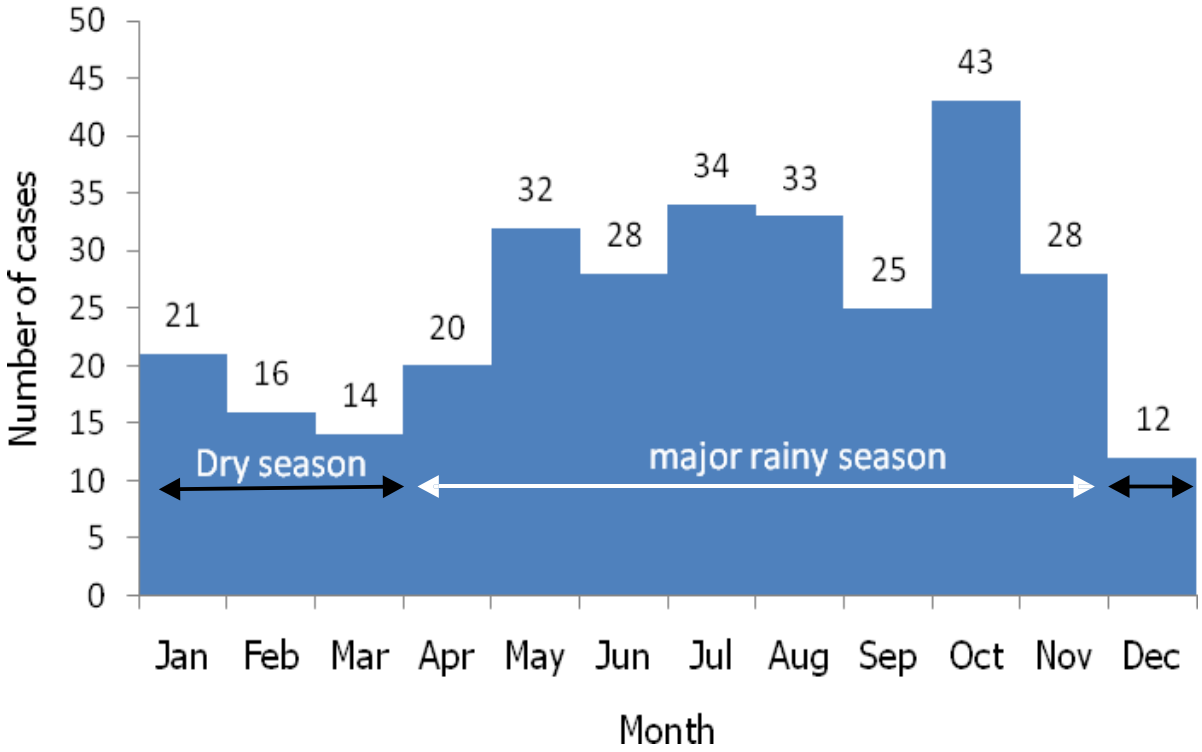

Figure 5. Cumulative monthly distribution of AFP cases, Eastern Region (1997-2010).

in the Eastern Region was P1, which is most neurovirulent.

The non polio AFP rate remained above the accepted national target of 2/100,000 population of children less than 15 years of age during half of the period under review with a median of 1.98/100,000, excluding the year of inception. However, this performance indicator which reflects the quality of the surveillance system by its ability to identify the rather common circulating entero-viruses was below the target during 1998, 1999, 2004 to 2007, and 2010, which constitutes another half of the period reviewed. This observation, with the exception of the performance in 2010, could be attributed to two factors; firstly, the challenges of starting a new complex surveillance system in the region and the learning curve for regional, district and community level staff during 1997 to 1999. Secondly, the 2005 to 2007 nationwide reductions in the number of national immunization days (NIDs) with the concomitant drop in opportunities and resources for AFP active case search during those years. The 2010 drop in this indicator could be due to system fatigue given that the last and only wild polio-virus in the region was isolated over 7 years ago coupled again with the drop in the NIDs after the 2008 to 2009 surge that responded to the finding of 8 wild polio-virus cases in northern Ghana.

Another core indicator of surveillance quality is the percentage of stool adequacy, which is defined as percentage of AFP cases with two adequate stool specimens collected at 24 to 48 h apart and within 14 days of onset of paralysis. To a large extent, it determines the chance of isolating the common entero- viruses including polio when present. This indicator, with a national target of 80%, gradually increased over the years, reaching a plateau at 100% from 2009. Possibly reflecting the effectiveness of the stool management trainings conducted for surveillance officers in the region periodically. The periodic prevalence of non polio enterovirus (NPEV) determined from the isolation of these viruses in AFP stool samples is a complementary surveillance indicator also used to evaluate the integrity and viability of stool specimen dispatched to the laboratory for viral isolation. It is expected that at least 10% of all stool specimens dispatched to the laboratory should yield NPEV. Our study showed that percentage of enterovirus isolation in the region for the period was 8.5%. This observation is close to the findings reported in a similar study conducted in Bahawalpur, Pakistan, where NPEV isolation was 8.5% (Ameer and Abdul, 2007). It is however lower than the 34, 17.6 and 14.6% reported in India (Kapoor et al., 2001; Deivanayagam et al., 1994), Egypt (Afifi et al., 2009) and Nigeria (Oderinde et al., 2007), respectively. The variations observed may be attributed to factors such as differences in the specificity and sensitivity of laboratory methods and test kits; inter-observer reliability; stool specimen collection,

handling and transportation; and the level of sanitation and hygiene in the societies.

While the percentage stool adequacy exceeded the required target, the NPEV isolation in the region remained below target. The relative inconsistence in these two complementary AFP surveillance indicators might suggest a closer look at the actual practices of regional and district surveillance officers especially with respect to timeliness and procedural authenticity of stool collection from AFP cases. This is borne out by the rather low rate of AFP investigation and stool collection within 14 days of onset. Also, the very low number of districts achieving this for early AFP case investigation with stool collection confirmed the need for action.

Most of the AFP cases (78.1%) were under five years of age and predominated by males. This proportion was lower than the 90% reported in India (Singh et al., 2004). Similarly, another study in Ibadan, southwestern Nigeria, also reported a lower prevalence (74.3%) among this age group of children (Tal-hatu and Temiloluwa, 2006), while a much lower prevalence of 37% was reported in Marches region, Italy (Marcello et al., 2008). It is however crucial to observe proper sanitary conditions in the home and environments with many children under five years to avoid fecal contamination of food and water which serve as vehicles for polio infection.

Most of the AFP cases were found in three districts - Suhum Kraboa Coatar, Birim South and New Juaben, with relatively populated peri-urban settlements. Although poor sanitation could be one of the reasons for this observation, there could be other factors yet to be known.

The majority of the AFP cases were noted between May and November and peaked in October, which is consistent with the pattern of occurrence of AFP during the rainy seasons in the tropical countries. Over the past years, national immunization days had run parallel with active case search for AFP cases, and that could account for the increase in AFP cases at the beginning and end of the year. Moreover, in the last quarter of 2008, there were series of outbreak of poliomyelitis in the northern part of Ghana, which also resulted in the organization of a series of ―mop up‖ polio immunization campaigns in some of the regions in Ghana, including the Eastern Region.

In 2008, and up to July 2009, Eastern Region recorded most of the AFP cases compared to the notified cases over the past years. This could be explained by the enhanced surveillance in the country as a response to the 2008 polio outbreak in the Northern Region. In the process, there was an improved ―community awareness of polio and the subsequent ―mop up campaign‖ provided resource opportunity for intensified active AFP surveillance.

It was realized that about a quarter of the AFP cases after the 60 day follow up developed residual paralysis, in which 62% were asymmetrical, and 4% of all the AFP cases died. Males, who were the majority, however had the right leg mostly affected. Poliomyelitis is most often recognized by the acute onset of flaccid paralysis. The paralysis of poliomyelitis is characteristically asymmetric. The legs are affected more often than the arms. A similar finding was also reported by Chin (2000).

WHO recommends only three doses of oral polio vaccine (OPV) but over half of the AFP cases in our study had received 4 OPV doses. However, another 30.7% had unknown vaccination status and 2.6% had zero OPV doses. There have been reports of unsuccessful vaccination and of suboptimal sero conversion with three doses of OPV in India and Africa (John, 1972). The antibody response to five doses of OPV in India was roughly equal to the response to two doses in the United States and Europe (Oduntan et al., 1978). In many countries, wild polioviruses were eliminated only after young children received an average of 10 to 15 doses of OPV (John, 1976). To ensure an effective immunity among infants in the region, routine immunization should be intensified to augment the massive patronage during national immunization days.

A few of the case based forms of the AFP cases were incompletely filled; date of birth, date of investigation of AFP cases and inadequate laboratory data feedback were observed. A similar finding was also observed by Hockstra et al. (2000) in AFP data analysis in China. This could affect data analysis and interpretation for any meaningful action in the near future.

Conclusions

Overall, AFP surveillance has remained an effective strategy in monitoring and documenting the progress towards polio eradication in the Eastern Region of Ghana since its inception in 1997. Analysis of data from the past 14 years has shown that there has been consistent absence of wild polio virus isolation in the region after the one and only case that was identified in 2003. The trend of the key WHO recommended AFP surveillance indicators reflect good quality surveillance with some opportunity for improvement in the completion of case- based forms and closer support and monitoring of timeliness and procedural authenticity of case- investigation practices of surveillance focal persons at regional and district levels. Frequency and intensity of active AFP case search in the region is essentially driven by the supplemental mass immunizations activities (NIDs) with most cases of AFP identified during the period of these NIDs mostly among children aged <5 years. Despite high oral polio vaccine (OPV) coverage and non isolation of wild polio virus in the region for over seven years now, it is essential to maintain high quality AFP surveillance and continued routine and supple- mentary immunization activities until polio eradication is achieved and certified in Ghana and the world as a whole.

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