

Analysis of meningitis outbreak data, Jaman North District, Brong Ahafo Region, Ghana

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SUMMARY

Background: Descriptive analysis of meningitis outbreak in Jaman North districts of Brong Ahafo Region.

Design: Descriptive secondary data analysis

Data Source: records of meningitis cases were extracted from case-based forms and line list.

Main outcome measure: The source and pattern of outbreak

Results: A total of 367 suspected cases with 44 confirmed were recorded from Jaman North during the period of January to March 2016. The mean age of those affected was 58 ± 13 years. The case fatality rate was 0.82% and the proportion of males to females was 1:1.3 (160/207). The age group most affected was 15-29 years (54.7%) and the least was 45-49 years (3.0%). *Streptococcus pneumoniae* formed 77.3% of confirmed cases whilst *Neisseria meningitides* was 20.5%. Cases with *Neisseria meningitides* came from a border town in La Côte d'Ivoire.

Conclusion: A protracted propagated meningitis outbreak occurred; and the predominant bacteria strain among confirmed cases was *Streptococcus pneumoniae*. Cases were mainly females and the most vulnerable group were people aged 15-29 years.

Keywords: *Streptococcus pneumoniae*, *Neisseria meningitides*, meningitis outbreak, Jaman North District, Ghana

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INTRODUCTION

Meningitis disease is prevalent globally and is of major public health concern.^{1,2} Most meningitis outbreaks are caused by bacterial infection and the commonest strains are *Neisseria meningitides*, *Streptococcus pneumoniae* and *Haemophilus influenzae* Type b.³ It is estimated that over 1.2 million cases of bacterial meningitis occur worldwide each year.⁴ Case-fatality rates and incidence of bacterial meningitis vary by region, country, pathogen, and age group.

However, case fatality rate could reach as high as 70%, and one out of five survivors (20%) of bacterial meningitis could be left with permanent disability including hearing loss, neurologic disability, or loss of function of a limb.⁴ In Africa, meningitis is endemic.

The extended African meningitis belt stretches from Senegal to Ethiopia. Frequent outbreaks have been recorded in the meningitis belt.⁵ Again, due to the porous nature of the African borders, there is a high probability of outbreaks spreading from one country to another. Enhanced surveillance in ten countries in the African meningitis belt revealed that 341,562 suspected cases, with 15,001 confirmed cases among these were recorded from 2004 to 2013.⁶

The burden of meningitis in Ghana cannot be underestimated. During the 1996/97 outbreak, Ghana recorded more than 17,000 meningitis cases with 1,200 (7.1%) deaths and all regions reported confirmed cases.⁷ In 2016, another outbreak was recorded in the country affecting 59 districts in nine regions. In all, 2,184 confirmed cases of the meningitis with 93 deaths were recorded.⁸

The Brong Ahafo Region recorded the highest number of cases (974) and deaths 89 (CFR = 9.1%) in the 2016 meningitis outbreak in Ghana. The hardest hit districts in Brong Ahafo were Tain and Jaman North districts which share border with La Côte d'Ivoire.⁹

During the outbreak response, data was collected in the Jaman North district. The outbreak data was analysed to determine the pattern, magnitude, and source of the outbreak to inform immediate control measures and prevent future outbreaks.

METHODS

Study Setting

Jaman North District (JND) is a border district and one of the 21 districts in the Brong Ahafo region with Sampa as its capital. JND has a population of about 95,000 with about 17,000 under five years and almost 4,000 under one year.¹⁰ The JND shares local boundaries with Tain District to the north-east, Jaman South District to the south, and Berekum District to the south-east. Internationally, it shares borders with La Côte d'Ivoire to the north-west.

The district has 22 functional health facilities. The health service providers include public and private sectors, religious health institutions and traditional practitioners. Sampa Government Hospital and Fountain Care Hospital in the district are over-stretched as they serve the health needs of residents and nationals from adjoining towns of neighbouring La Côte d'Ivoire.

Lying within the equatorial region, the district experiences a mean annual rainfall ranging from 1200mm to 1780mm. Relative humidity is generally high (70-80%) during rainy season (April to October). The major natural vegetation is the savanna woodland consisting of widely dispersed short trees and elephant grasses/shrubs that cover about 70% of the land area. The average annual temperature is generally high (26 degree Celsius) with dusty weather conditions which render inhabitants susceptible to Streptococcus and Meningococcus infections.¹¹

As housing is mainly through individual efforts, the rate of population increase has outstripped housing development leading to high occupancy rate of between 4-5 people per habitable room. Most houses are in dilapidated conditions with no drainage facilities, running water, and toilet facilities. Houses are generally not well maintained. Whereas increasing number of developers are using cement blocks and iron sheets in constructing their houses, a significant number of mud houses with thatched roofs are still found in major urban towns like Sampa, Goka, Duadaso and Jamera.

Ventilation is therefore very poor in most of these houses and this also predisposes inhabitants to meningitis infections. The district has a good network of roads, but the nature of the roads is very poor making transportation very uncomfortable. The district has no single tarred road which leaves most of the roads developing potholes in the rainy season and becoming dusty during the dry season.

Study design

The study was a descriptive secondary data analysis of outbreak data. The study basically focused on the analysing the Jaman north district 2016 meningitis outbreak data. The precise data source used in this study was the line list. References were made to the case based forms and the laboratory results, whenever the need arose.

Study population

The study population was records of suspected meningitis patients who reported at the various health facilities in the district for medical attention during the outbreak period captured in the line-listing, case-based and laboratory forms.

Case and Outbreak definitions used in data abstraction

Suspected Meningitis

A case of suspected meningitis was defined as any person with sudden onset of fever ($>38.5^{\circ}\text{C}$ rectal or 38.0°C axillary) and one of the following signs: neck stiffness, flaccid neck (infants), bulging fontanelle (infants), convulsion, or other meningeal signs.¹²

Confirmed Meningitis

A case of confirmed meningitis was defined as any person with meningeal signs and isolation of a causal pathogen (*N. meningitidis*, *Streptococcus pneumoniae* [Spn], *Haemophilus influenzae* type b[Hib]) from the CSF by culture, PCR, or rapid diagnostic test.¹²

Alert Threshold

The alert threshold was defined as an attack rate of 3 suspected cases per 100,000 inhabitants per week in a district or sub district with population between 30,000 and 100,000; or as 2 cases in 1 week, or a higher incidence than in a non-epidemic year (in populations < 30000).¹² Crossing this threshold triggers the reinforcement of surveillance.

Epidemic Threshold

The epidemic threshold was defined as an attack rate of 10 cases per 100,000 inhabitants in 1 week in a district or sub district, or 10 per 100,000 if considered at high risk of an epidemic (in populations ≥ 30000); or as 5 cases in 1 week, or a doubling of incidence in a 3-week period

(in populations <30000).¹² Crossing this threshold triggers the launch of vaccination campaigns when the predominance of *N. meningitidis* is confirmed and the use of a specific antibiotic treatment protocol.

Data analysis

Frequencies and relative frequencies were generated for categorical variables such as sex, age groups, date of onset, bacterial strain and sub district distribution. An epidemic curve was drawn from the line list, sub-district case fatality rates were computed and distribution of the type of strain. Results were presented in tables and graphs. Microsoft Excel 2010 was used for the analysis.

Ethical consideration

Approval was obtained from Regional Health Directorate and Jaman North District Health Directorate. The significance of the study and data collection approach was also made known to them. Identifiers were removed from the data and data collected was protected by use of password.

RESULTS

General characteristics of meningitis cases

The total number of suspected cases recorded during this outbreak from January to March, 2016 was 367 cases with a case fatality rate of 0.82%. The male to female ratio was 1:1.29. The mean age was 58±13 years. The age group with the highest incidence was 15-29 years (87/367) and the lowest age group was 45-49 years (11/367) (Table 1).

Table 1 Distribution of cases by age and sex, January to March 2016

Age groups	Frequency (%)		
	Male (%)	Female (%)	Total
0-4	9 (2.5)	4 (1.1)	13 (3.5)
5-9	10 (2.7)	5 (1.4)	15 (4.1)
10-14	10 (2.7)	12 (3.3)	22 (6.0)
15-19	30 (8.2)	57 (15.5)	87 (23.7)
20-24	33 (8.9)	37 (10.1)	70 (19.1)
25-29	25 (6.8)	21 (5.7)	46 (12.5)
30-34	10 (2.7)	13 (3.5)	23 (6.3)
35-39	8 (2.2)	17 (4.6)	25 (6.8)
40-44	9 (2.5)	15 (4.1)	24 (6.5)
45-49	5 (1.4)	6 (1.6)	11 (3.0)
50+	11 (3.0)	20 (5.4)	31 (8.4)
Total	160(43.6)	207 (56.4)	367 (100)

Sampa was the sub-district which recorded the highest number of cases (58.6%) whereas Duadaso recorded the least number of cases (4.9%). There were also 10 cases which came from La Côte d'Ivoire, Banda, Tain and Jaman South. Out of the 3 deaths, 2 were from Goka and the remaining one from Adadiem sub-districts. (Table 2).

Source of outbreak

Jaman North District recorded its first confirmed meningitis case and death on the 28th January, 2016 at Sampa Government Hospital. The patient was an 18 year old male who was a resident of Jenini in the Adadiem sub-district which shares a common boundary with La Côte d'Ivoire.

Lumber puncture and the Pastorex test were conducted at Sunyani Regional Hospital. The test result revealed that the index case died of meningococcal meningitis.

Table 2 Distribution of cases and deaths by sub-districts, January to March 2016

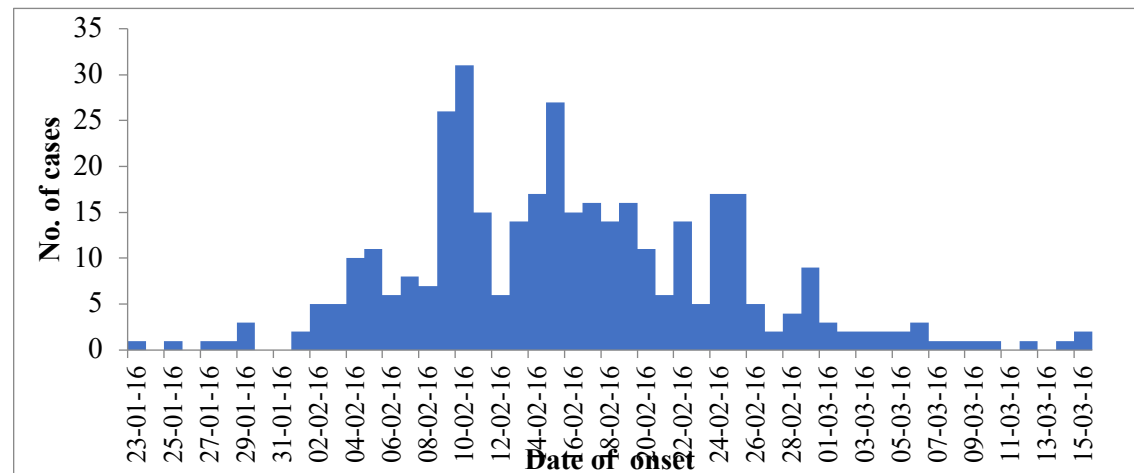
Name of Sub-district	No. of cases	No of deaths	No. of confirmed cases	Case fatality rate
Adadiem	30	1	7	14.3%
Duadaso	18	0	5	0
Goka	39	2	6	33.3%
Sampa	215	0	21	0
Seketia	21	0	2	0
Suma	34	0	2	0
Cases outside district	10	0	1	0
Total	367	3	44	6.82%

Upon investigation, the team discovered that this index case first reported at Adadiem Health Centre on 27th January, 2016 and was treated as malaria. When the patient went home and realized that he was still not feeling well, he reported back to the clinic for further care the following day. The patient was referred to Sampa Government Hospital the same day where he died. The district then intensified sensitization and health education on the meningitis disease.

The district started recording more cases especially in epidemiological Week 5 when it exceeded the epidemic threshold. The next case after the index case was recorded on 31st January 2016 and the number of cases rose rapidly thereafter. The dates of onset with the highest number of cases (31 cases) were recorded on 10th February 2016. Cases plateaued from 2nd to 5th March, 2016. After this, there was a rise and cases plateaued again from 7th to 10th March, 2016. The number of cases reduced and ended with two cases on 15th March 2016. A sporadic, protracted propagated outbreak was observed (Figure 1).

The index case and the first death were documented on 28th January 2016 in epidemiological week 4. The district reached both alert and epidemic thresholds in epidemiological week 5. The last case was recorded on 15th March 2016. All the 6 sub-districts reached alert and epidemic thresholds.

The highest numbers of cases were received in the epidemiological week 7 whereas the lowest number of cases



were seen in week 4. The outbreak eventually ended on epidemiological week 11 (Figure 2).

Figure 1 Epi-curve of Meningitis outbreak in Jaman North District, 28th February to 15th March 2016

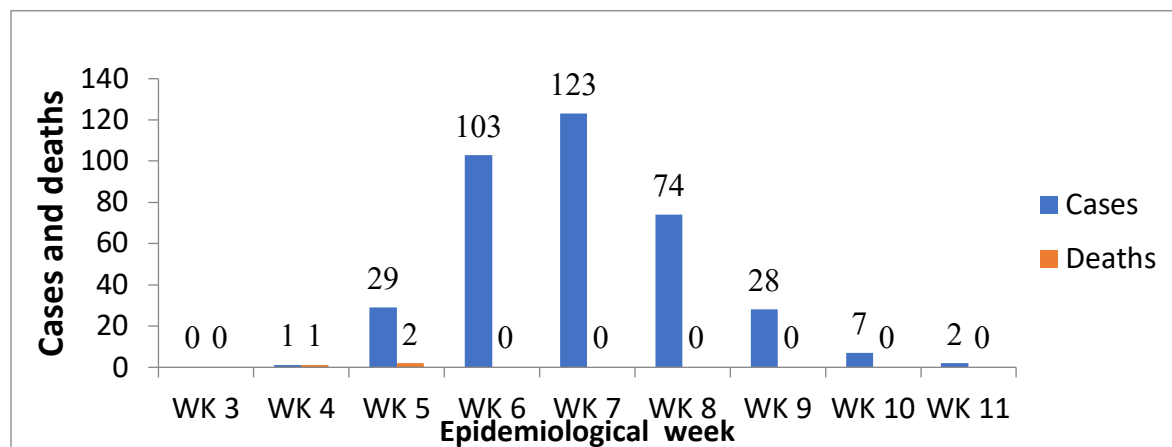


Figure 2 Weekly trend of cases and deaths in Jaman North District from January to March 2016

Causative Agent and Laboratory Findings

The district recorded 44 confirmed cases which were made up of different bacterial strains. Out of the 44 confirmed cases, about 77% were *Streptococcus pneumoniae* whereas 20.3% turned out to be *Neisseria meningitides* and one person (2.3%) was confirmed as having both *Streptococcus pneumoniae* and *Neisseria meningitides*. Records of cases with bacterial strain *Neisseria meningitidis* traced them to a border community in La Côte d’Ivoire, where indigenes travel to Ghana weekly on market days and also access health services in Ghana.

DISCUSSION

We analysed the 2016 meningitis outbreak data for Jaman North District, Brong Ahafo region to determine the pattern of the outbreak, magnitude of the outbreak and source of the outbreak to avert future occurrences.

The total number of cases recorded in the district during the outbreak period of January to March 2016 were 367 cases with a case fatality rate of 0.82%. All the three deaths were late referrals from the sub-district facilities. The study revealed that the cases were initially managed as malaria cases.

Since signs and symptoms of meningitis normally mimic malaria, patients are initially treated for malaria.¹³ Referrals to the next higher level for intensive care are normally done when patients are not responding to treatment. The delay could be attributed to both the health workers and the patient’s relatives.

Sampa was the sub-district which recorded the highest number of cases (215) whereas Duadaso recorded the least number of cases (18).

There were also 10 cases which came from La Côte d'Ivoire, Banda, Tain and Jaman South. Out of the 3 deaths, 2 came from Goka and the remaining from Adadiem sub-districts. Sampa weekly Monday market is the most popular, well attended and well observed market day in the district. Ivoirians patronize this market in their numbers every Monday.

According to the Jaman North port health daily report, every Monday more than 250 Ivoirians cross the Ghana-La Côte d'Ivoire border to Sampa market to buy and sell. Cases recorded in Sampa during the outbreak are likely to be attributed to the continuous influx of Ivoirians into Ghana during these market activities. Human movement and close interaction which take place during the process of buying and selling could have fostered the spread of the disease through droplet infection. Hence the need to intensify cross-border surveillance in border districts like Sampa.

More females were affected than males. This is in consonance with the 2016 meningitis national outbreak report, in which more females were affected than males.¹⁴ This finding could be attributed to the fact that, in our part of the world, when a close relative is not well, women are normally assigned the responsibility of being by the bed side of such sick relatives at the hospital. The mode of transmission of meningitis from a host to a susceptible host is airborne through droplets nuclei.¹⁴ Close persons usually contract the disease through contact with nose and mouth discharges from the patient. Since women are usually closer to these patients, they are more likely to get the disease.¹⁵

The modal age group was 15-29 years (54.8%). Perhaps because they are the most active age group and mostly mobile, they were prone to get the infection. It was also discovered that two senior high schools were highly affected during this outbreak and that could be the reason why the youngsters dominated in the number of cases recorded in this age brackets. The lowest age groups were 0-14 years (13.4%). The reason could be ascribed to the introduction of the Pneumococcal Conjugate Vaccine (PCV) into the routine EPI services by Ghana Health Service in 2012.

The protracted propagated nature of the outbreak was due to the fact that, while most of the cases were emanating from the local communities, there was also an influx of cases from external sources. It was revealed that during this outbreak period, our immediate neighboring country La Côte d'Ivoire, which is in the meningitis belt was also experiencing a similar outbreak. More than 15 deaths had been recorded in the Boudouqou region, which shares a

direct border with Jaman North District, in Ghana. Records on contact tracing revealed that the third NM W135 confirmed case in the district was a native and resident of Tomosie, a community in La Côte d'Ivoire. Considering the cross-border nature of the outbreak, Jaman North District health directorate requires training on handling cross-border health emergencies for health staff. This would equip them on how to handle cross-border health emergencies as a border district.

Again, though Tain district, the first district in the region to be hit by the 2016 meningitis outbreak and shares boundary with Jaman North reported *Streptococcus pneumoniae* meningitis cases, Jaman North's first three confirmed cases were all *Neisseria meningitidis*. This shows a likelihood of the first cases being epidemiologically linked with the La Côte d'Ivoire cases. This finding is similar to the WHO report of the 2012 outbreak of meningitis reported in 14 countries in the Africa meningitis belt. Ghana and Côte d'Ivoire were also affected by this outbreak. The bacteria identified in these countries was also *Neisseria meningitidis*.⁵

The district recorded 44 confirmed cases which were made up of the four bacterial strains; 32 *Gram positive diplococci*, five *Gram negative diplococci*, two *Strep pneumoniae*, four *Neisseria meningitidis* and one person with both *Strep pneumoniae* and *Neisseria meningitidis*. The high number of *Streptococcus pneumoniae* cases in the district could be attributed to the dusty conditions and dry weather which cause cracks in the mucosa making it susceptible to bacteria that might enter the throat and invade the blood stream through these cracks. This dry climate in sub-Saharan Africa characterised by high concentration of dust has been found to promote the occurrence of pneumonia and bacterial meningitis.¹⁰

Some limitations of the study include the use of secondary data. Further interpretation of some of the recorded data could not be done. However, clarification was sought from the district on some of the issues that came up.

CONCLUSION

Sporadic, protracted propagated outbreak occurred JND with low case fatality rate. Predominant bacteria strain among confirmed cases was *Streptococcus pneumoniae*. The outbreak could have been a cross-border outbreak in which women were mostly affected. The most vulnerable group was people aged 15-29 years.

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