Analysis of meningitis surveillance data 2014-2018, Bawku Municipality, Ghana

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KEYWORDS: Meningitis, surveillance, secondary, data analysis, Bawku municipality

ABSTRACT

Introduction: Meningitis is a major public health threat in Ghana with a case fatality rate between 36% and 50%. The Bawku Municipality lies within the Meningitis belt. We analyzed meningitis surveillance data in the Municipality to determine the incidence of meningitis cases by person, place, and time, and to identify the commonest causative agents. **Methods:** We conducted a secondary data analysis of meningitis surveillance data in the Bawku Municipality in the Upper East Region of Ghana from 2014-2018. We extracted data from the Municipal Health Information Management System 2 (DHIMS2) and linelist from the District Disease Control Unit using a checklist. We performed descriptive data analysis using Microsoft Excel version 2016 and reported frequencies and proportions. We calculated the incidence of suspected cases and expressed per 100,000 population. **Results:** A total of 98 suspected cases were recorded in the Bawku municipality between 2014 and 2018. Of the 98 suspected cases, 38 (38.8%) were laboratory confirmed. A large proportion were males [52.0%, (51/98)] and were within 1-15 years [45.9% (45/98)] and 16-30 years (38.8%, 38/98). An outbreak occurred in 2017. The majority of the cases (90.8%, 89/98) were recorded between January and May. Neisseria meningitis (Nm W135) 81.6%(31/38) was the most prevalent etiological agent isolated followed by Streptococcal pneumonia 18.4% (7/38). The overall case-fatality rate (CFR) was 6.1% (6/98). **Conclusion:** There was a seasonal trend of meningitis cases over the period. Neisseria meningitis W135 was the commonest cause of meningitis and affected persons aged 30 years and below. Control measures at the municipality should target the commonest causative agents and younger populations. Keywords: Meningitis; surveillance; secondary; data analysis; Bawku municipality.

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Introduction

Meningitis is an epidemic-prone disease that affects a large proportion of the global population. Streptococcus pneumonia and N. meningitidis Y/W 135 constitute the common cause of meningitis [1] and can be spread through sneezing, coughing, or close contact with an infected person [2]. The causative organism varies with age, immune function, immunization status, and geographic region, and reliable therapy for meningitis is based on these factors [3]. In order to address periodic outbreaks involving pneumococcal meningitis, Ghana introduced a 13-valent pneumococcal conjugate vaccine (PCV13) into its national infant immunization program in 2012 as a 3-dose schedule at ages 6, 10, and 14 weeks, respectively [4] Meningitis manifests symptoms such as fever, headache, muscle pains, neck stiffness, photophobia, vomiting, and diarrhoea. The long-term effects of meningitis include loss of hearing, seizures, brain damage, learning disability, and these have been documented among Ghanaian patients [5].

The African meningitis zone comprising several countries extending from Ethiopia in East Africa through Ghana in West Africa bears much of the disease burden [6]. Every year over millions of people living within the African meningitis zone are exposed to the disease and this has been attributed to the weather conditions prevailing in these settings. This epidemic which is one of the preventable diseases remains a public health concern in Africa as reported by studies in certain parts of Ghana [6-8].

Global mortality proportions vary from 2% to 30% [9] and in Ghana, it is estimated between 36% and 50% [8]. The high mortality rate in Ghana could be due to late case reporting, delayed laboratory confirmation results due to inadequate transport and laboratory logistics among others, and several outbreaks involving multiple virulent bacterial such as *Streptococcus pneumonia* infections, N. meningitidis Y/W 135, etc.[2,6]. Case fatality rates are estimated to be as high as 50% in the absence of immediate management [4].

Case management depends on early diagnosis and prompt treatment of cases with appropriate antibiotics is recommended. Meningitis continues to pose a major public health threat in Ghana and exerts a huge economic burden on the households of infected people. There have been large-scale epidemics that occurred in 1996/1997 which affected 19,000 people with 1,200 deaths in Northern Ghana which includes the Bawku Municipal [10]. Anecdotal reports suggest that several outbreaks of meningitis have been recorded in the northern part of Ghana. For instance, the Upper East region detected three outbreaks which were reported in 2010 and 2012, and 2014 [11].

Bawku Municipality is one of the fifteen districts/municipalities reporting meningitis cases in the Upper East region that contribute to the regional and national surveillance data in the District Information Management Systems 2 (DHIMS 2). However, little is known about the situation of meningitis in the municipality. Frequent analysis of the municipality´s surveillance data is key for understanding the dynamics of the disease and also helps in improving prevention and control strategies. We analyzed meningitis surveillance data from 2014 to 2018 in the Bawku Municipality to determine the incidence of meningitis cases by person, place and time, and to identify the commonest causative agents. This will help stakeholders to identify opportunities to improve the meningitis surveillance and intensify prevention and control measures in the municipality.

Methods

Analysis Design

This was a cross-sectional study that used secondary data analysis of five-year (2014 to 2018) meningitis surveillance data in the Bawku Municipality of the Upper East Region. We obtained and extracted meningitis surveillance data from the District Health Information Management System-2 (DHIMS-2) and the Integrated Disease Surveillance and Response (IDSR) case-based forms at the Bawku Municipal Health Directorate (BMHD). The study was conducted between June and August 2019.

Study site

The Bawku Municipality is one of the 15 Municipal and District Assemblies (MMDAs) in the Upper East Region of Ghana. It is located in the North-Eastern corner of the region and has an international boundary with Burkina Faso to the north, and other districts such as the Binduri to the west, Garu-Tempane to the east. The municipality is part of the Savannah Agro-climatic zone of the country characterized by a bilateral season of pronounced dry (November - April) and wet seasons (May - October) [12]. The two seasons are influenced by two alternating air masses. First is the warm, dusty, and dry Harmattan, air mass, which blows from the northeastern direction across the whole municipality from the Sahara Desert and is followed by the wet (rainy) season. These conditions collectively predispose the area to cerebrospinal meningitis incidence in almost endemic proportions.

Case definition

We adopted the case definition prescribed in the Technical Guidelines for Integrated Disease Surveillance and Response in Ghana[12]. Three case definitions have been noted in the IDSR; suspected, probable, and confirmed. However, data from the municipality were either classified as suspected or confirmed. *Suspected meningitis case*: "Any person with sudden onset of fever (>38.5 °C rectal or ≥ 38.0 °C axillary) and one of the following signs: neck stiffness, bulging fontanelle, convulsions, altered consciousness or other meningeal signs". *Confirmed meningitis case*: Isolation or identification of causal pathogen (Neisseria meningitides, Streptococcus pneumoniae, Haemophilus influenzae b) from the Cerebrospinal fluid of a suspected or probable case by culture, Polymerase Chain Reaction or agglutination test."

Data collection

We extracted meningitis data from DHIMS-2 and the IDSR case-based forms using a data collection checklist. Data extracted covered meningitis cases recorded from 2014 to 2018.Th e variables extracted included sex, age, district of residence, year of reporting, date of reporting, epidemiological week, etiological factors, laboratory results of Cerebrospinal Fluid (CSF), and outcome of confirmed cases.

Data validation

Data quality check was conducted by comparing figures in DHIMS-2 to those on the IDSR case-based forms.

Data Analysis

The data were entered, cleaned, and analyzed using Microsoft Excel version 2016. We re-categorized continuous variables like age to aid analysis. Descriptive statistics such as frequencies and proportions were presented. Fischer Exact test was performed to compare differences in the proportion of confirmed cases among groups at P<0.05. The incidence and case fatality rates were calculated using the same analogy by Stephen et al.[6]. The number of cases suspected for a period or sub-district was divided by the size of the population in which the cases or deaths of meningitis occurred, or the population at risk. The value obtained was expressed per 100,000 population. Further, the incidence of meningitis was expressed in months and years to depict monthly and annual trends of cases. We estimated the weekly incidence of meningitis and compared it with the alert and epidemic thresholds as stated in the IDSR[13]. All the variables were expressed in proportions and presented in tables and graphs.

Ethical consideration

The analysis of the meningitis surveillance data is part of the operations of the IDSR and no formal ethical approval was required. The National Surveillance Department of the Ghana Health Service, the Regional, and the Municipal Directorates of Health Services gave approval to conduct this analysis on the meningitis surveillance data as part of its mandate. Data held on computers were encrypted with a password which was made available only on a need-to-know basis.

Results

Characteristics of meningitis cases

Median age was 17 years. The most affected age categories were 1-15years (45.9%) and 16-30years (38.8%) (**Table 1**). Averagely, the meningitis prevalence was low among persons of 31 years and above. South Natinga Sub-district had the highest proportion of cases, representing 42.9% (42/98) while a significant proportion of 40.8% (40/98) was reported from communities of neighboring districts. The Fischer Exact test found a significant difference in proportion of confirmed cases in terms of age group (p=0.002), and lumbar puncture (p=0.003) (**Table 1**).

Annual Trend of Meningitis Cases

The highest meningitis incidence rate was recorded in 2016 with 34.0/100,000 population (36 cases per 105,849) and in 2017 with 32.4/100,000 population (37 per 114,257). The case fatality rate peaked in 2016 with 11.1%(4/36) while 5.4%(2/37) was recorded in 2017. There was no available record of surveillance data for the year 2015 (**Table 2**).

Monthly Trend of Cases

The incidence of cases by month depicts a seasonal trend as shown in **Figure 1**. A total of 89 cases (90.8%) were reported between January and May in the period under review. As shown in **Figure 1**, 58.3% and 64.9% of suspected cases reported in 2016 and 2017 respectively, occurred in March. The pattern changed in 2018, same rate (20%) suspected cases was reported in January, February, March. and October.

Weekly Trend of Meningitis Cases

The number of cases recorded in 2017 exceeded the epidemic thresholds. Most of the cases occurred between epi weeks 10 and 13, peaking at week 13 with 22 cases. A missed outbreak was observed in 2017 (**Figure 2**).

Etiological Agents and outcome of Meningitis

Of 98 suspected cases, 38 (38.8%) were laboratory (via CSF specimen) confirmed positive for bacterial meningitis. Neisseria meningitis (Nm W135) 81.6%(31/38) and Streptococcal pneumonia 18.4%

(7/38) were the commonest causative agent. The case-fatality rate (CFR) was 6.1% (6/98) and the highest CFR was for Nm W135 12.9% (4/31) (**Table 3**).

Discussion

We conducted a secondary data analysis of meningitis surveillance data (2014-2018) to determine the incidence of meningitis cases, identify the commonest causative agents, and opportunity to strengthen the system in the Bawku Municipality. The present study recorded ninty-eight suspected cases of which 38.8% were laboratory confirmed and a case-fatality rate (CFR) of 6.1% in the Bawku municipality between 2014 and 2018. The incidence was relatively higher in males and in persons aged 1-15 years and 16-30 years. There was a seasonal trend of meningitis cases and an outbreak occurred in 2017. Neisseria meningitis (Nm W135) was the most prevalent etiological agent isolated followed by Streptococcal pneumonia.

Our analysis found a missed outbreak in 2017 with a record of six (6) deaths that were not detected for immediate response. The anecdotal report revealed that meningitis outbreaks normally occur in the dry season and hot temperature, making these conditions favorable for the transmission of this infection [11]. We found that the age group of 1-15 years were the most affected. This age group seems to have low immunity which might have accounted for their vulnerability in our view which might have accounted for this incidence. This could also be due to the increased likelihood of this group of people participating in activities in overcrowded places like schools, and playgrounds. A similar study in the Northern region of Ghana found that the annual national prevalence of meningococcal meningitis was higher among children aged 1- 15 years [6], and the proportion slightly differs from our findings which could be due to different demographic characteristics and age categorization.

In this study, the South Natinga sub-district recorded the highest incidence of meningitis cases between 2014 to 2018. This is the center of Bawku with a higher population and the population concentration may be a factor for the higher occurrence compared to other sub-districts. We found that majority of the cases 40.8% reported at the municipality came from neighboring districts and this was anticipated because Bawku has a well-resourced hospital and good health care services and could be the first point of call for several communities in the Upper East Region.

We found a decrease in cases in 2018 as compared to the previous year. The decline in cases could be attributable to enhanced vaccination coverage and effective public education on control measures that were implemented before the meningitis season. Similar results have also been observed following mass vaccination campaigns in a study done in Mali, Burkina Faso, and Niger[14]. This suggests that control measures should focus on education and vaccination especially before the onset of the dry season. A study conducted to assess the impact of vaccination on invasive pneumococcal infection among children showed a significant decline in the level of pneumococcal infections following a vaccination program[15, 16].

The monthly trend of cases in the municipality demonstrates strong seasonality with most peaks occurring between January and May each year during the dry weather. Most of the cases occurred in the dry/harmattan season, with the peak incidence in March The epidemic/action threshold in the municipality triggered an immediate response. This marked the specific level or investigation finding that signals an action beyond confirming or clarifying the problem. The actions that were taken included communicating laboratory confirmation to affected health centers, implementing an emergency response such as an immunization activity, community awareness campaigns, or improved infection control practices in the healthcare setting. This finding is similar to an observation made in a study in Ghana where there were outbreaks between March and June [8]. The study by Nuoh et al.[1] produced similar results with most cases occurring between January and April each year during the dry weather and beginning to decline by May each year with the onset of the rains.

A significant proportion of the CSF specimen for culture and sensitivity testing returned negative. This can be attributed to the common practice of antibiotic use before presenting to the hospital or commencing treatment at the hospital before the specimen´s collection. It could also be that collected specimens were not appropriately stored and/or inadequate for laboratory investigation. Neisseria meningitis W135 and Streptococcal pneumonia were the common etiological agents in the Bawku municipality. Similar results have also been observed in the Upper West region of Ghana where Streptococcus pneumonia and N. meningitidis Y/W 135 constituted all of the organisms isolated with 18.4% and 81.6% respectively [12,13]. This also agrees with another study in the North East region of Ghana which reported Streptococcus pneumonia and N. meningitidis Y/W 135 in specimens collected from most cases suspected of meningitis [8]. This could be because the environmental conditions in the three northern regions (Upper East, Upper West, and North East) favour the transmission of these isolates.

Although there have been series of immunization campaigns targeting Streptococcus pneumonia and N. meningitidis Y/W 135, a number of factors such as potency of vaccines, different stereotypes of isolates detected in outbreaks, and the immigration of non-immune subjects have affected management of meningitis in Bawku and other districts in the meningitis belt of Ghana [2,6,8]. Also, the different stereotypes in outbreaks make targeted vaccination interventions very difficult. Moreover, their virulent nature increases patient risk of dying, as it has been reported that a significant proportion of Streptococcus pneumonia and N. meningitidis Y/W 135 infected cases in outbreak situations will die [6].

One key limitation of this study was data quality. We were unable to study cases reported to the municipal health directorate in 2015 due to poor record-keeping. The absence of records in 2015 was as a results of administrative challenges regarding records management and not necessary no case was reported. Through a series of engagements, records keeping and routine data validation have improved. Also, the National Diseases Surveillance Department of the Ghana Health Service has implemented Surveillance Outbreak Response Management and Analysis System (SORMAS) which captures priority diseases including meningitis nationwide. We also found missing variables in existing records and data discrepancies between the data that was entered into DHIMS-2 and the MHD line list making it difficult to estimate the actual morbidity and mortality due to meningitis. We did not exclude cases with missing variables in the analysis since they were useful in case count. However, the poor data quality issues noted may have caused a mixed classification of cases, which could result in under- or over-estimation of confirmed cases. This might have affected the treatment or management regime prescribed for those patients[8]. Despite these limitations, a lot of inferences have been deduced from this analysis as well as some recommendations made to improve data quality at the municipality.

Conclusion

Meningitis surveillance is still regarded as the best tool for the monitoring and control of the disease in the municipality. Most of the cases were reported among persons from 1-15 years in the municipality. The incidence of meningitis in the municipality occurred seasonally between January and May each year. There was a missed outbreak of meningitis in the Municipality in 2017 with six deaths. The Neisseria meningitides was the prevalent etiological agent isolated in CSF samples in the laboratory. We recommend that health authorities should embark on intensive health education on meningitis before the onset of the dry season and improve the commitment to the testing of all suspected cases to avoid missed cases. Meanwhile, the local health facilities should be well-resourced by the government to adequately manage the influx of cases from neighboring districts.

What is known about this topic

- Meningitis is a major public health threat in Ghana
- The case fatality rate of meningitis ranges between 36% and 50%.
- The Bawku Municipality lies within the Meningitis belt

What this study adds

- The Neisseria meningitides was the prevalent etiological agent isolated in CSF samples in the laboratory
- There was a missed outbreak of meningitis in the Municipality in 2017 with six deaths
- Meningitis surveillance is still regarded as the best tool for the monitoring and control of the disease in the municipality

Competing interests

The authors declare no competing interests.

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Authors' contributions

RWA and ABAY conceptualized the study and designed the study protocol. RWA did the data collection, cleaning, analysis, and interpretation. RWA and ABA contributed to data analysis and interpretation. MY facilitated data acquisition. RWA, ABAY, ABA, DAB, EK and RGI contributed to the original draft and revising of the manuscript. All the authors read and approved this final manuscript.

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References

1. Nuoh RD, Nyarko KM, Nortey P, Sackey SO, Lwanga NC, Ameme DK, Nuolabong C, Abdulai M, Wurapa F, Afari E. Review of meningitis surveillance data, upper West Region, Ghana 2009-2013 . Pan Afr Med J [Internet]. 2016 Oct 1 [cited 2024 Sep 21];25 (Supp 1): 9. https://doi.org/10.11604/pamj.supp.2016.25.1.6180 PubMed | Google Scholar

2. Brouwer MC, McIntyre P, Prasad K, Van De Beek D. Corticosteroids for acute bacterial meningitis . 2015 Sep 12 [last updated 2018 Nov 8; cited 2024 Sep 21]. In: Cochrane Database of Systematic Reviews [Internet]. Hoboken (NJ): John Wiley & Sons, Ltd. c2000-2024. https://doi.org//10.1002/14651858.CD004405.pub5 Download pdf to view full text. Art. No.: CD004405. PubMed | Google Scholar

3. Agrawal S, Nadel S. Acute bacterial meningitis in infants and children: epidemiology and management . Pediatric Drugs [Internet]. 2012 Aug 31 [cited 2024 Sep 21];13(6):385-400. https://doi.org/10.2165/11593340-000000000-00000 Google Scholar

4. Aku FY, Lessa FC, Asiedu-Bekoe F, Balagumyetime P, Ofosu W, Farrar J, Ouattara M, Vuong JT, Issah K, Opare J, Ohene SA, Okot C, Kenu E, Ameme DK, Opare D, Abdul-Karim A. Meningitis outbreak caused by vaccine-preventable bacterial pathogens – Northern Ghana, 2016 . MMWR Morb Mortal Wkly Rep [Internet]. 2017 Aug 4 [cited 2024 Sep 21]; 66(30):806-810. https://doi.org/10.15585%2Fmmwr.mm6630a2 PubMed | Google Scholar

5. Ali M, Moses A, Nakua EK, Punguyire D, Cheabu BSN, Avevor PM, Basit KA. Spatial epidemiology of bacterial meningitis in the Upper West Region of Ghana: Analysis of disease surveillance data 2018-2020 . Clinical Infection in Practice [Internet]. 2022 Aug 5 [version of record 2022 Aug 9; cited 2024 Oct 14];16:100160. https://doi.org/10.1016/j.clinpr.2022.100160 PubMed | Google Scholar

6. Chang Q, Tzeng YL, Stephens DS. Meningococcal disease: changes in epidemiology and prevention . CLEP [Internet]. 2012 Sep 19 [cited 2024 Sep 21]; 4(1): 237-45. https://doi.org/10.2147/clep.s28410 PubMed | Google Scholar

7. Kaburi BB, Kubio C, Kenu E, Ameme DK, Mahama JY, Sackey SO, Afari EA. Evaluation of bacterial meningitis surveillance data of the northern region, Ghana, 2010-2015 . Pan Afr Med J [Internet]. 2017 Jun 30 [cited 2024 Sep 21];27: 164. https://doi.org/10.11604/pamj.2017.27.164.11036 PubMed | Google Scholar

8. Stephen A, Kandoh E, Bukari A. Analysis of bacterial meningitis surveillance data, 2011-2015, east mamprusi district, ghana . IJTDH [Internet]. 2018 Jan 12 [cited 2024 Sep 21];28(3):1-11. https://doi.org/10.9734/IJTDH/2017/38252 Download Stephen2832017IJTDH38252.pdf. Google Scholar

9. Zunt JR, Kassebaum NJ, Blake N, Glennie L, Wright C, Nichols E, Abd-Allah F, Abdela J, Abdelalim A, Adamu AA, Adib MG, Ahmadi A, Ahmed MB, Aichour AN, Aichour I, Aichour MTE, Akseer N, Al-Raddadi RM, Alahdab F, Alene KA, Aljunid SM, AlMazroa MA, Altirkawi K, Alvis-Guzman N, Animut MD, Anjomshoa M, Ansha MG, Asghar RJ, Avokpaho EFGA, Awasthi A, Badali H, Barac A, Bärnighausen TW, Bassat Q, Bedi N, Belachew AB, Bhattacharyya K, Bhutta ZA, Bijani A, Butt ZA, Carvalho F, Castañeda-Orjuela CA, Chitheer A, Choi JYJ, Christopher DJ, Dang AK, Daryani A, Demoz GT, Djalalinia S, Do HP, Dubey M, Dubljanin E, Duken EE, El Sayed Zaki M, Elyazar IR, Fakhim H, Fernandes E, Fischer F, Fukumoto T, Ganji M, Gebre AK, Gebremeskel A, Gessner BD, Gopalani SV, Guo Y, Gupta R, Hailu GB, Haj-Mirzaian A, Hamidi S, Hay SI, Henok A, Irvani SSN, Jha RP, Jürisson M, Kahsay A, Karami M, Karch A, Kasaeian A, Kassa GM, Kassa TDD, Kefale AT, Khader YS, Khalil IA, Khan EA, Khang YH, Khubchandani J, Kimokoti RW, Kisa A, Lami FH, Levi M, Li S, Loy CT, Majdan M, Majeed A, Mantovani LG, Martins-Melo FR, Mcalinden C, Mehta V, Melese A, Memish ZA, Mengistu DT,

Mengistu G, Mestrovic T, Mezgebe HB, Miazgowski B, Milosevic B, Mokdad AH, Monasta L, Moradi G, Moraga P, Mousavi SM, Mueller UO, Murthy S, Mustafa G, Naghavi M, Naheed A, Naik G, Newton CRJ, Nirayo YL, Nixon MR, Ofori-Asenso R, Ogbo FA, Olagunju AT, Olagunju TO, Olusanya BO, Ortiz JR, Owolabi MO, Patel S, Pinilla-Monsalve GD, Postma MJ, Qorbani M, Rafiei A, Rahimi-Movaghar V, Reiner RC, Renzaho AMN, Rezai MS, Roba KT, Ronfani L, Roshandel G, Rostami A, Safari H, Safari S, Safiri S, Sagar R, Samy AM, Santric Milicevic MM, Sartorius B, Sarvi S, Sawhney M, Saxena S, Shafieesabet A, Shaikh MA, Sharif M, Shigematsu M, Si S, Skiadaresi E, Smith M, Somayaji R, Sufiyan MB, Tawye NY, Temsah MH, Tortajada-Girbés M, Tran BX, Tran KB, Ukwaja KN, Ullah I, Vujcic IS, Wagnew FS, Waheed Y, Weldegwergs KG, Winkler AS, Wiysonge CS, Wiyeh AB, Wyper GMA, Yimer EM, Yonemoto N, Zaidi Z, Zenebe ZM, Feigin VL, Vos T, Murray CJL. Global, regional, and national burden of meningitis, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016 . The Lancet Neurology [Internet]. 2018 Nov 13 [cited 2024 Sep 21];17(12):1061-82. https://doi.org/10.1016/S1474-4422(18)30387-9 Erratum in: Correction to Lancet Neurol 2018; 17: 1061-82 . The Lancet Neurology [Internet]. 2021 Nov 17. [cited 2024 Sep 21];20(12):e7. https://doi.org/10.1016/S1474-4422(21)00381-1 Google Scholar

10. MOH (GH). Press Statement: Meningitis situation in Ghana- DR. Franklin Asare Bekoe [Internet]. Accra (GH): MOH (GH); c2024[cited 2024 Oct 14].

11. Opare J, Awoonor-Williams J, Odoom J, Afari E, Oduro A, Awuni B, Asante D, Opare O, Akweongo P. Bacterial meningitis: a review in the upper east region of ghana 2010-2014 . IJTDH [Internet]. 2015 Aug 14 [cited 2024 Sep 21];10(3):1-11. https://doi.org/10.9734/IJTDH/2015/19398 Download Opare1032015IJTDH19398.pdf. Google Scholar

12. Douti NB, Abanyie SK, Ampofo S, Nyarko SK. Solid waste management challenges in urban areas of ghana: a case study of bawku municipality . IJG [Internet]. 2017 Apr 18 [cited 2024 Sep 21];8(4):494-513. https://doi.org/10.4236/ijg.2017.84026 Google Scholar

13. Ministry of Health (GH). Technical Guidelines for Integrated Disease Surveillance and Response in Ghana [Internet]. Accra (GH): Ministry of Health (GH); 2002 Apr [cited 2024 Sep 21]; 222 p. Download Integrated-Disease-Surveillance-and-Response-Ghana-Guidelines.pdf

14. Novak RT, Kambou JL, Diomandé FV, Tarbangdo TF, Ouédraogo-Traoré R, Sangaré L, Lingani C, Martin SW, Hatcher C, Mayer LW, LaForce FM, Avokey F, Djingarey MH, Messonnier NE, Tiendrébéogo SR, Clark TA. Serogroup A meningococcal conjugate vaccination in Burkina Faso: analysis of national surveillance data . The Lancet Infectious Diseases [Internet]. 2012 Jul 18 [cited 2024 Sep 21];12(10):757-64. https://doi.org/10.1016/S1473-3099(12)70168-8 PubMed | Google Scholar

15. Diallo AO, Soeters HM, Yameogo I, Sawadogo G, Aké F, Lingani C, Wang X, Bita A, Fall A, Sangaré L, Ouédraogo-Traoré R, Medah I, Bicaba B, Novak RT, for the MenAfriNet Consortium. Bacterial meningitis epidemiology and return of Neisseria meningitidis serogroup A cases in Burkina Faso in the five years following MenAfriVac mass vaccination campaign . Hozbor DF, editor. PLoS ONE [Internet]. 2017 Nov 2 [cited 2024 Sep 25];12(11):e0187466. https://doi.org/10.1371/journal.pone.0187466 PubMed | Google Scholar

16. Manzo LM, Ousmane S, Ibrahim DD, Zaneidou M, Testa J, Mainassara HB. Bacterial meningitis in Niger: an analysis of national surveillance data, 2003-2015 . Pan Afr Med J [Internet]. 2018 Jul 30 [cited 2024 Sep 25];30:235. https://doi.org/10.11604/pamj.2018.30.235.15937 PubMed | Google Scholar

Table 1: Patient characteristics of meningitis cases, Bawku Municipality, 2014-2018			
Characteristic	**No. of cases suspected**	**No. of cases confirmed**	**Fischer Exact, p-value**
	N=98 (%)	n=38 (%)	
Sex			0.356#
Male	51 (52.0)	22 (57.9)	
Female	47 (48.0)	16 (42.1)	
Age			0.002*
1-15	45 (45.9)	26 (68.4)	
16-30	38 (38.8)	7 (18.4)	
31-45	9(9.2)	4 (10.5)	
46+	6 (6.1)	1 (2.6)	
Sub-district			0.875
Mognori	2 (2.0)	1 (2.6)	
Kuka East	4 (4.1)	1 (2.6)	
North Natinga	4 (4.1)	1 (2.6)	
South Natinga	42 (42.9)	18 (47.5)	
Urban West	5 (5.1)	1 (2.6)	
Outside	40 (40.8)	16 (42.1)	
Urban East	1 1.0)	0 (0.0)	
Outcome			0.148
Alive	92 (93.9)	34 (89.5)	
Dead	6 (6.1)	4 (10.5)	
Lumbar puncture			0.003*
Done	86 (87.8)	38 (100.0)	
Not done	12 (12.2)	0 (0.0)	
# Chi-Square test, *significant at p<0.05			

Table 2: Incidence and case fatality rate of meningitis, Bawku Municipality, 2014-2018					
Year	**Mid-Year population**	**No. of Cases**	**No. of Deaths**	**Incidence/100,000**	**Case Fatality Rate (%)**
2014	100,981	15	0	14.9	0.0
2015	104,602	0	0	0.0	0.0
2016	105,849	36	4	34.0	11.1
2017	114,257	37	2	32.4	5.4
2018	116,912	10	0	8.6	0.0

Table 3: Etiological agents and outcome of meningitis, Bawku Municipality, 2014-2018				
Isolate/causative agent	**No. of cases**	**Alive**	**Dead**	**Case fatality rate**
	N=98 (%)	n=92(%)	n=6 (%)	N=6 (%)
Neisseria meningitides (*Nm W135*)	31 (31.6)	27 (29.3)	4 (66.7)	12.9
Streptococcus pneumonea	7 (7.1)	7 (7.6)	0 (0.0)	0.0
Negative	54 (55.1)	52 (56.5)	2 (33.3)	3.7
Not stated	6 (6.1)	6 (6.5)	0 (0.0)	0.0

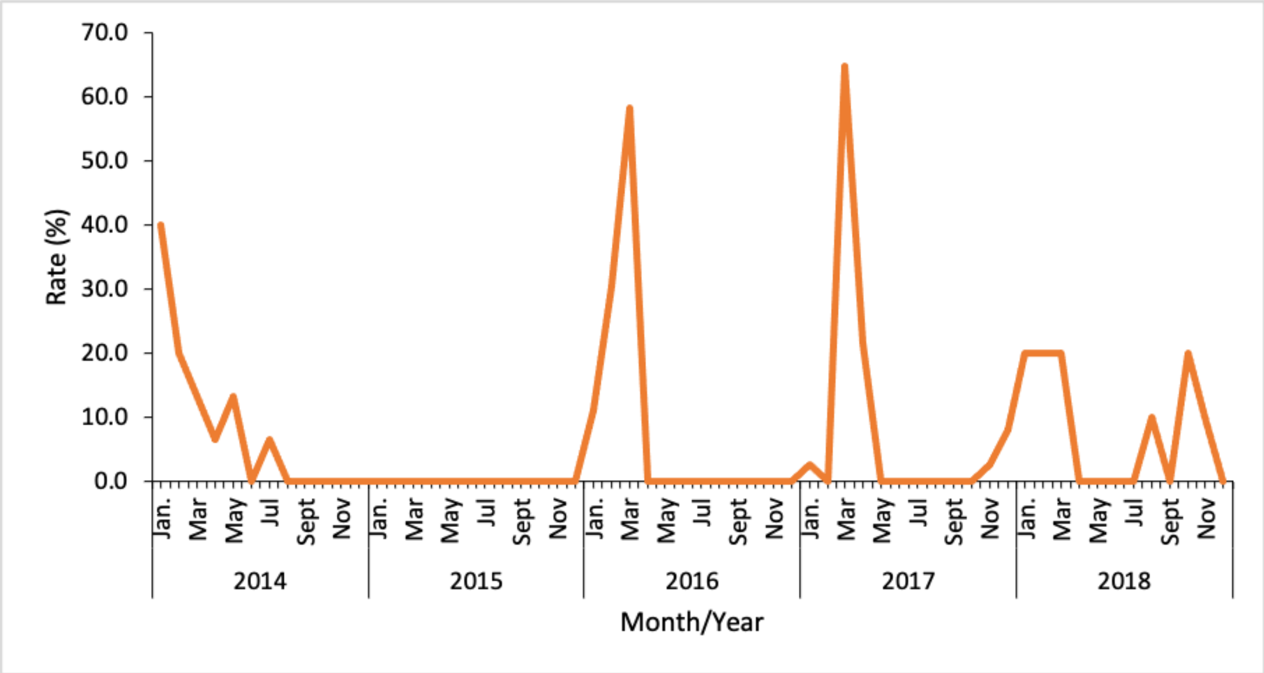

Figure 1: Monthly meningitis cases, Bawku Municipality, Ghana, 2014-2018

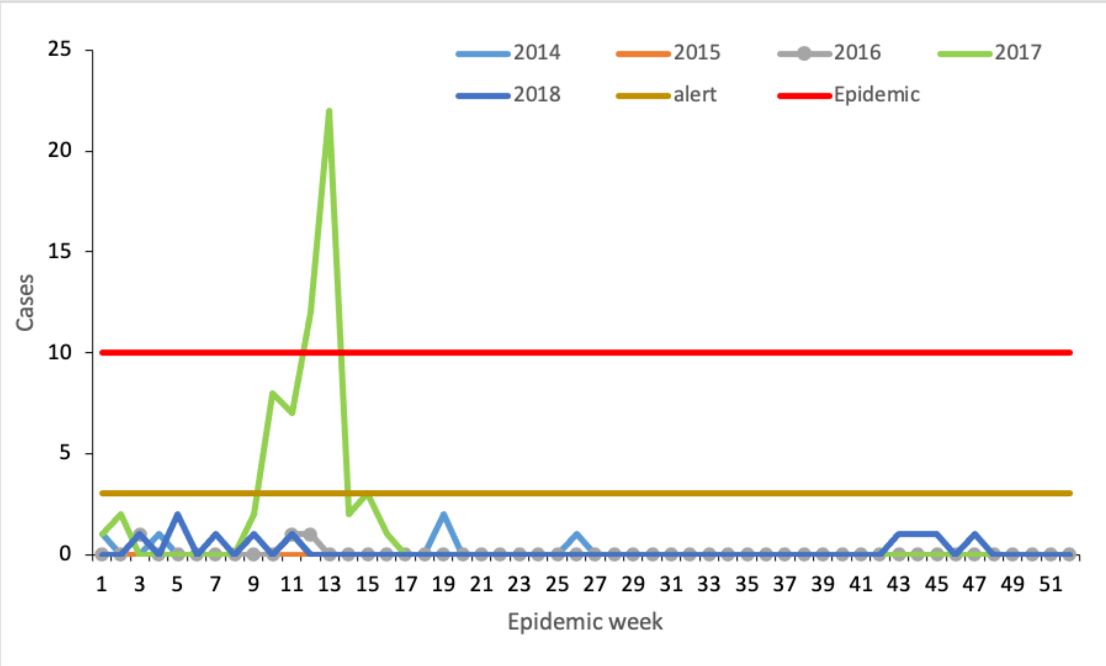

Figure 2: Weekly threshold of meningitis cases, Bawku Municipality, Ghana, 2014-2018