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Review

Current meningitis outbreak in Ghana: Historical perspectives and the importance of diagnostics

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ABSTRACT

Bacterial meningitis continues to be one of the most dreaded infections in sub-Saharan Africa and other countries that fall in the "meningitis belt" due to recurrent nature of the infection and the sequel of deliberating effects among survivors even after treatment. Ghana has had recurrent epidemics in the past but has been free from high mortality levels. Whereas reasons for the low reported number of deaths in the past are unclear, we hypothesize that it may be due to increased vaccination from expanded program on immunization (EPI) and consequent herd immunity of the general population. As at the end of February, 2016, 100 individuals were reported to have died out of 500 recorded cases. The infection may cause severe brain damage and kills at least 1 out of 10 individuals if quick interventions are not provided. The Ghana Health Service (GHS) and the Ministry of Health (MoH), together with other local and international stakeholders are working intensely to control the spread of the infection in affected communities with treatment and other health management programmes. This review presents a quick overview of meningitis in Ghana with emphasis on *S. pneumoniae* (responsible for about 70% of cases in the recent epidemic) together with some recommendations aimed at ensuring a "meningitis-free Ghana".

Contents

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1. Introduction

Meningitis is an inflammation of the protective membranes covering the brain and spinal cord (meninges). This inflammation could be as a result of viral, bacterial, or fungal infection of the fluid surrounding the brain and spinal cord. Although bacteria and viruses are most often implicated, meningitis caused by parasites and fungi, as well as non-infectious meningitis have also been reported (CDC, 2014).

Bacterial meningitis is mainly caused by *Streptococcus pneumoniae, Neisseria meningitidis* (commonly known as Meningococcal meningitis) and *Haemophilus influenzae* type B. The infection is reported to affect over 26 countries in sub-Saharan Africa which fall within what has become known as the 'meningitis belt' (WH Organization, 2015). Outbreaks of meningitis in developing countries pose an enormous public health challenge to their already burdened healthcare delivery systems. In Ghana for example, between 1994 and 1996, about 17,000 persons were infected with bacterial meningitis, of which about 1000 (5.8%) individuals were reported to have died (GhanaWeb, 2016).

In addition, like most other countries within the meningitis belt, Ghana experiences sporadic outbreaks of meningitis almost every year (Fig. 1); however, the current outbreak in Ghana has had significant impact and media attention since the last quarter of 2015. As at the end of January 2016, according to the Ghana Health Service (GHS), more than 400 suspected cases in Ghana had been reported, of which almost 90 individuals (22.5%) were reported dead, while a number of unconfirmed cases have been hospitalized (GhanaWeb, 2016). The disease began in the Northern region of Ghana and spread to the Brong-Ahafo, Ashanti, and Eastern regions. At the time of drafting this paper, cases had just been reported in 9 out of the 10 regions of Ghana. Current figures indicate that the Brong-Ahafo is the worst hit, accounting for about 70% of all cases (Fig. 2). Of the confirmed cases, *S. pneumoniae* has been identified as the leading causative organism, although *N. meningitidis* (strain NM W, which causes cerebrospinal meningitis (CSM) and *N. meningitidis* type C) have also been isolated (GhanaWeb, 2016).

A number of factors is associated with the development of bacterial meningitis. First, low levels of complement-mediated killing via antibodies facilitate the progression of bloodstream infection; hence infants and young children are most susceptible after maternal antibodies have waned. Second, close contact with infected persons through activities such as kissing, sneezing, coughing, sharing of personal belongings (e.g. cutlery and fomites), as well as crowded living settings: a scenario commonly observed in many developing countries such as Ghana (Ferraro et al., 2014) facilitates spread of the causative organisms (Ferraro et al., 2014; Atkinson et al., 2011). Furthermore, smoking or exposure to second hand smoke has been linked with a high risk of pathogen carriage and transmission (MacLennan et al., 2006).

As with most infections, some exposed persons in the population remain asymptomatic, whereas others develop fulminant disease and may even die if not quickly treated. The dichotomy between frequent asymptomatic carriage and occasional devastating meningitis is in part attributable to the variability of the biochemical composition of the capsular polysaccharide that characterizes serogroup (El-Nawawy et al., 2015). For symptomatic individuals some of the overt manifestations include seizures, severe headache, stiff neck, cold extremities and confusion. Others also show signs of high fever, nausea and vomiting, photophobia and rashes (Tunkel and Scheld, 1995).

Although bacterial meningitis in the sub-Saharan African belt occurs the entire year, most cases are recorded during the Harmattan season, characterized by low humidity, extreme temperature variations, as well as windy and dusty conditions (Codjoe and Nabie, 2014). The harsh weather conditions during the Harmattan easily cause damage to the mucous membranes of the oral cavity through dry air and strong dust winds, thereby creating propitious conditions for the easy transmission of the bacteria responsible for bacterial meningitis. Moreover, low absolute humidity and dust may enhance meningitis bacteria invasion by damaging the mucosal barrier directly or by inhibiting mucosal immune defenses (Sultan et al., 2005). While it is unclear why the number of cases in Ghana have increased this year, challenges associated with serotyping the specific *S. pneumoniae* involved in the current outbreak, harsh weather conditions, frequent movement of individuals from the affected areas to other parts of the country and as well, the emergence of a more virulent strain of the meningitis-causing bacteria, could account for the change observed in the epidemiology of the infection. Given the increased frequency of cases caused by *S. pneumoniae* in the ongoing outbreak in Ghana, this review focuses on pneumococcal meningitis.

2. Epidemiology of meningitis in Ghana

Apparently, studies on Cerebrospinal Meningitis (CSM) could be traced back to the year 1900, the time in which the first major outbreak was recorded in Cape Coast, Ghana (Waddy, 1957). The subsequent meningitis outbreak was in 1906–1908 during the dry season in the northern part of Ghana which accounted for some 20,000 deaths (Browne, 1945). The epidemics were recorded every 8–12 years ever since (Grene and Waddy, 1954). A major landmark of the meningitis epidemics was the W-135 strain associated with the returnee Hajj pilgrims (Taha et al., 2000).

Epidemiological occurrence of *S. pneumoniae* meningitis in Ghana has strong resemblance to those associated with meningococcal meningitis outbreaks. Previous epidemiological studies in Northern Ghana reported 51 deaths (46%) out of 117 pneumococcal cases over the period of 1998–2003 (Leimkugel et al., 2005). The study reported a total of 76 pneumococcal isolates, from which fifty-eight (76%) belonged to serotype 1, forming the dominant strain. Non-serotype 1 isolates included 14, 3, 7F, 8, 12F, 6A, 10F, and 38 (Leimkugel et al., 2005).

In addition, a recent study by Dayie and colleagues reported the prevalence of *S. pneumoniae* meningitis in two major cities in Ghana i.e., Accra and Tamale, as 34% and 31%, respectively (Dayie et al., 2013). The dominant serotypes reported by that study were 19F, 6B, 23F, and 6A. However, serotypes 19A and 6B emerged as the penicillin resistant isolates in the sample. In addition, 23% of the samples were non-typable in Accra, while 12% were non-typable in Tamale (Dayie et al., 2013).

Current vaccines being used for the Ghanaian population are the pneumococcal conjugate vaccines (PCVs). PCV-13 covers close to half of the serotypes while PCV-23 covers 55% of the samples (Dayie et al., 2013). Several studies have investigated the impact of climate change on the epidemiology of meningitis (Codjoe and Nabie, 2014; Sultan et al., 2005) as well as the seasonality of the meningitis epidemics. Such studies revealed that the epidemics