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The actual and potential costs of meningitis surveillance in the African meningitis belt: Results from Chad and Niger

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ABSTRACT

Background: The introduction of serogroup A meningococcal conjugate vaccine in the African meningitis belt required strengthened surveillance to assess long-term vaccine impact. The costs of implementing this strengthening had not been assessed.
Methodology: The ingredients approach was used to retrospectively determine bacterial meningitis surveillance costs in Chad and Niger in 2012. Resource use and unit cost data were collected through interviews with staff at health facilities, laboratories, government offices and international partners, and by reviewing financial reports. Sample costs were extrapolated to national level and costs of upgrading to desired standards were estimated.
Results: Case-based surveillance had been implemented in all 12 surveyed hospitals and 29 of 33 surveyed clinics in Niger, compared to six out of 21 clinics surveyed in Chad. Lumbar punctures were performed in 100% of hospitals and clinics in Niger, compared to 52% of the clinics in Chad. The total costs of meningitis surveillance were US$ 1,951,562 in Niger and US$ 338,056 in Chad, with costs per capita of US$ 0.12 and US$ 0.03, respectively. Laboratory investigation was the largest cost component per surveillance functions, comprising 51% of the total costs in Niger and 40% in Chad. Personnel resources comprised the biggest expense type: 37% of total costs in Niger and 26% in Chad. The estimated annual, incremental costs of upgrading current systems to desired standards were US$ 183,299 in Niger and US$ 605,912 in Chad, which are 9% and 143% of present costs, respectively.
Conclusions: Niger's more robust meningitis surveillance system costs four times more per capita than the system in Chad. Since Chad spends less per capita, fewer activities are performed, which weakens detection and analysis of cases. Countries in the meningitis belt are diverse, and can use these results to assess local costs for adapting surveillance systems to monitor vaccine impact.

1. Introduction

The African meningitis belt, stretching from Senegal to Ethiopia, has the highest rates of meningitis in the world (see Fig. 1 in Online Appendix for a map of countries in the African meningitis belt). The phased introduction since 2010 of MenAfriVac®, a new meningococcal conjugate vaccine, has reduced serogroup A meningococcal meningitis incidence [1] and provided indirect protection [2,3]. High quality surveillance remains important to detect shifts in epidemiological patterns and for vaccine effectiveness estimates. Consequently, upgrading the existing enhanced surveillance (ENS) system to a more informative and systematic case-based surveillance (CBS) system is recommended [4].

Both ENS and CBS work within the global strategy of the Integrated Disease Surveillance and Response Framework (IDSR) [5], which has the objective of harmonizing and making more efficient disease surveillance in the African region. Specifically for meningitis, a major goal of ENS is identification of epidemics for initiation

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of vaccination campaigns. Most countries in the African meningitis belt have since early 2000 used ENS. ENS uses summary reports of basic information on meningitis cases collected at district level, which are sent to national level without disaggregation by individual patient. Some countries in the region have now moved to CBS, which aims to have a more detailed case report form sent for each case. The CBS system includes performance of LP and collection and analysis of cerebrospinal fluid (CSF) specimens for each suspected meningitis case throughout the year. Lumbar puncture (LP) may be limited to a fraction of cases during an epidemic, or to only outside of the epidemic season, with other cases counted based on clinical presentation. CBS also links clinical and laboratory data with a unique case identification number, allowing for more sophisticated analyses. CBS allows for assessment of risk groups (e.g., age, sex), evaluation of vaccine failures (by collecting vaccination status), determination of incidence, including stratified by etiology, and other evaluations.

However, the establishment of systematic CSF collection and analysis of all suspected meningitis cases through CBS demands increased resource utilization [4]. Previous studies on surveillance costing have shown that over the period 2002–2005 the cost to implement the IDSR framework in Eritrea, Burkina Faso and Mali was on average US$ 0.16, US$ 0.04 and US$ 0.02 per capita, respectively [6]. However, no previous evaluations have quantified either the absolute costs of ENS or CBS in the meningitis belt or the marginal costs beyond ENS. Because meningitis surveillance in the meningitis belt has unique aspects, studies specific to this area are needed for informed decision-making.

The objectives of this study were to estimate the costs of existing meningitis surveillance in two countries of the African meningitis belt, one using primarily ENS and limited CBS (Chad), and the other primarily CBS (Niger), and to determine the incremental cost of upgrading these systems to meet defined CBS operational standards. The two countries were selected partly because of already established institutional links and also because between them several of the WHO recommended surveillance strategies were represented in their national surveillance plans of action. The inclusion of two countries with substantially different surveillance system designs and investments allowed us to explore a range of cost implications faced by meningitis belt countries in moving toward robust CBS. In addition, the study aimed to add to the existing limited literature on costing of disease surveillance, particularly for meningitis [6–8]. Study design considerations benefited from previous costing studies as well as earlier studies on meningitis surveillance [9,10].

2. Methods

The study estimated the costs of meningitis surveillance in 2012 in Niger and Chad from the perspective of public health service delivery, whether financed from local or external sources. A micro-costing approach, also called the ingredients or bottom up approach, was used, which entails determining quantities of resources and their respective unit costs [11]. Cost and process data were collected retrospectively between September 2013 and February 2014. We included opportunity costs, such as personnel time devoted to surveillance and infrastructure costs, which may not be included in surveillance budgets. Cost data were denominated in local currency and converted into 2012 US$ at a rate of 1 US$ = 511 CFA [12]. As noted below, similar but not identical methodology was used in each country, based on available data and differences in existing systems. This limited our ability to conduct a strict comparison between the two countries. Nevertheless, we consider it important to present data from each country to compare the costs of different types of systems within the meningitis belt.

Table 1
Study sample.

Study sample	Niger	Chad
Regions	7	4
Districts	10	7
Clinics	33[a]	21
District hospitals (all performing CBS)	8[b]	
Regional hospitals (all performing CBS)	2[c]	
National hospitals (all performing CBS)	2[c]	
District laboratories	8[b]	6
Regional hospital laboratories	2	1
National hospital laboratories	2	
National laboratory of reference	1	1
Surveillance offices from the MoH	22	13
Partner organizations	2	4

[a] Selected randomly representing 15% of the clinics within each district.
[b] Two districts did not have district hospital nor laboratory.
[c] Part of the pediatric meningitis network.

2.1. Sampling

Purposive sampling was used to ensure inclusion of sites from different geographic areas with recent meningitis cases. Data were collected using similar structured questionnaires in both countries. Districts and facilities were classified according to urban/rural status (based on the possibility that costs differed in urban centers compared to other areas) and ENS/CBS system. A major difference between countries was that we included clinics and hospitals for Niger, but only clinics for Chad (Table 1). We use the term "clinics" to refer to primary health care centers and the broader term "health facilities" to refer to both clinics and hospitals.

2.2. Cost classifications

Resources used in meningitis surveillance were classified into personnel (e.g. salaries), transportation (e.g. vehicles), laboratory (e.g. microscopes) and office (e.g. buildings), and comprised recurrent and capital costs (Table 1 in Online Appendix). This classification was adapted from the SurvCost tool [6,13], a spreadsheet-based tool developed in Excel to estimate the cost of resources involved in disease surveillance. SurvCost organizes resources into seven categories and includes cost calculation formulas.

The classification of surveillance functions was built on existing frameworks [5,14]. Surveillance functions were classified as core functions (detection, reporting, laboratory investigation, data analysis and follow-up) and support functions (training, supervision, information, education and communication, and coordination). We excluded the cost of responses that occurred based on surveillance data, as we did not consider this part of the core surveillance function.

2.3. Current cost calculations

The methodological differences between the studies of Niger and Chad are summarized in Table 2 of Online Appendix. Although both countries followed the ingredients approach, country cost calculations differed in that Niger aggregated costs by resources used for surveillance [6,15], whereas Chad stratified costs by activity performed [16–18]. Niger's costs were estimated as:

$$C_i = Q_i \times P_i \times \%\,\text{all surv}_i \times \%\,\text{mening surv}_i$$

The cost of the resource '*i*' (personnel, transportation, laboratory and office resources – Table 1 of Online Appendix) was calculated by multiplying its quantity by price by the percentage of all activities devoted to overall surveillance (of all diseases), and by the percentage to meningitis surveillance out of overall surveillance.