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Expansion of syndromic vaccine preventable disease surveillance to include bacterial meningitis and Japanese encephalitis: Evaluation of adapting polio and measles laboratory networks in Bangladesh, China and India, 2007–2008

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ABSTRACT

Background: Surveillance for acute flaccid paralysis with laboratory confirmation has been a key strategy in the global polio eradication initiative, and the laboratory platform established for polio testing has been expanded in many countries to include surveillance for cases of febrile rash illness to identify measles and rubella cases. Vaccine-preventable disease surveillance is essential to detect outbreaks, define disease burden, guide vaccination strategies and assess immunization impact. Vaccines now exist to prevent Japanese encephalitis (JE) and some etiologies of bacterial meningitis.

Methods: We evaluated the feasibility of expanding polio–measles surveillance and laboratory networks to detect bacterial meningitis and JE, using surveillance for *acute meningitis-encephalitis syndrome* in Bangladesh and China and *acute encephalitis syndrome* in India. We developed nine syndromic surveillance performance indicators based on international surveillance guidelines and calculated scores using supervisory visit reports, annual reports, and case-based surveillance data.

Results: Scores, variable by country and targeted disease, were highest for the presence of national guidelines, sustainability, training, availability of JE laboratory resources, and effectiveness of using

Abbreviations: AES, acute encephalitis syndrome; AFP, acute flaccid paralysis; AMES, acute meningitis-encephalitis syndrome; BNG, Bangladesh; CHN, China; CSF, cerebrospinal fluid; ELISA, enzyme-linked immunosorbent assay; GFIMS, Global Framework for Immunization Monitoring and Surveillance; Hib, *Haemophilus influenzae* type b; IBD, invasive bacterial disease; IND, India; JE, Japanese encephalitis; MOH, Ministry of Health; Nm, *Neisseria meningitidis*; PCR, polymerase chain reaction; PM, polio–measles; PCV, pneumococcal conjugate vaccine; SEARO, South-East Asia Regional Office; Sp, *Streptococcus pneumoniae*; SPSS, Statistical Package for the Social Sciences; UNICEF, United Nations Children's Fund; USCDC, United States Centers for Disease Control and Prevention; VPD, vaccine-preventable disease; WHO, World Health Organization.

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polio–measles networks for JE surveillance. Scores for effectiveness of building on polio–measles networks for bacterial meningitis surveillance and specimen referral were the lowest, because of differences in specimens and techniques.
Conclusions: Polio–measles surveillance and laboratory networks provided useful infrastructure for establishing syndromic surveillance and building capacity for JE diagnosis, but were less applicable for bacterial meningitis. Laboratory-supported surveillance for vaccine-preventable bacterial diseases will require substantial technical and financial support to enhance local diagnostic capacity.
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1. Background

Strong systems for vaccine-preventable disease (VPD) surveillance are essential for making evidence-based decisions concerning the introduction of new vaccines. To provide a strategic approach for enhancing VPD surveillance and immunization program monitoring, the World Health Organization (WHO) and other global partners developed a Global Framework for Immunization Monitoring and Surveillance (GFIMS) [1]. One principle of the framework was to link epidemiologic and laboratory surveillance systems for all VPDs and leverage the investment for poliomyelitis surveillance.

Since 1985, identification of poliomyelitis cases has relied on active surveillance for acute flaccid paralysis (AFP) and laboratory testing of stool specimens for polioviruses [2–4]. Beginning in the early 1990s, many countries expanded viral VPD surveillance to facilitate measles case detection by adding a rash-fever syndrome case definition. Measles diagnostic testing capacity has been developed within poliovirus reference laboratories, and a network of sub-national laboratories. This polio–measles surveillance infrastructure has provided a platform for establishing laboratory-supported surveillance for other VPDs of viral etiology, including rubella and yellow fever. A survey in countries in the WHO African Region found that adding other VPDs to the AFP surveillance program did not compromise polio surveillance [5].

The availability of vaccines against diseases caused by *Haemophilus influenzae* type b (Hib), *Neisseria meningitidis* (Nm), and *Streptococcus pneumoniae* (Sp) has created the need to include bacterial disease surveillance in the VPD surveillance framework. Diagnosis of bacterial diseases, however, is more complex than that of viral diseases because of the need for specimen collection before starting antibiotic treatment, an invasive specimen collection procedure, quality laboratory capability at the specimen collection site, and immediate specimen transportation from the collection site to diagnostic laboratories. Surveillance for invasive bacterial disease (IBD) has been conducted in many countries primarily through sentinel hospital networks [6–10], but these systems have not been linked to VPD surveillance.

In 2005, the United States Centers for Disease Control and Prevention (USCDC) and WHO proposed using polio–measles surveillance networks to establish case-based acute encephalitis syndrome (AES) surveillance in India and acute meningitis-encephalitis syndrome (AMES) surveillance in Bangladesh and China. These countries were selected because of strong networks for surveillance and laboratory confirmation of polio and measles; these syndromes were selected because they may be manifestations of several VPDs, including those caused by Japanese encephalitis (JE) virus, Sp, Hib or Nm. Available vaccines that protect against these diseases include multiple formulations of JE vaccine, multivalent pneumococcal conjugate vaccines (PCV), monovalent and combination Hib vaccines, and polysaccharide and conjugate meningococcal vaccines [11–14]. None of the countries had introduced PCV, JE, Hib or meningococcal vaccines into their routine immunization programs, although China provided routine and/or campaign vaccination in some provinces.

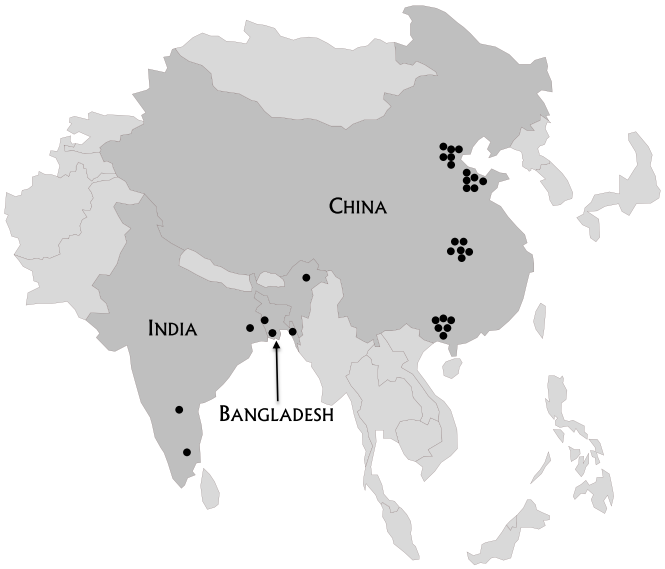

Fig. 1. Location of AMES surveillance sites in Bangladesh and China, and AES surveillance sites in India.

Data on JE and bacterial meningitis incidence in Bangladesh, China and India are limited. In Bangladesh, JE virus appears to be endemic throughout the country [15,16]. In China, approximately 33,900 cases of JE occur annually [17]. JE is endemic throughout much of India with large seasonal outbreaks documented in several states in northern India [18,19]. Although meningitis caused by Sp, Hib and Nm has been greatly reduced in countries where vaccines against these pathogens are routinely used [20], cases continue to occur in Bangladesh, China, and India. In Bangladesh, meningitis caused by Sp and Hib has been monitored through sentinel surveillance networks [10,21,22]. Outbreaks of meningococcal meningitis and septicemia were reported in China from 2003 to 2005 [23]. In Vellore District in the Indian state of Tamil Nadu, the estimated annual Hib meningitis incidence was 7.1 cases per 100,000 children <5 years of age, comparable to rates reported from Europe before Hib vaccine introduction [24].

AMES surveillance was launched by Ministries of Health (MOH) in China in May 2006 and in Bangladesh in October 2007 using the infrastructure of the polio–measles surveillance and laboratory networks. Because of India's priority to identify best practices to improve AES surveillance, meningitis surveillance was not included in India; AES surveillance started in May 2007. Project areas included three sentinel hospitals (one in each of three districts) in Bangladesh, 24 (six in each of four prefectures) in China and four (one in each of four JE-endemic states) in India (Fig. 1). Criteria for selection of project areas included the absence of wild poliovirus circulation and meeting the global indicators for rates of non-polio AFP and adequate stool collection[6] [25]. Details and data

[6] At least one case of non-polio AFP should be detected annually per 100,000 population aged less than 15 years, and all AFP cases should have a full clinical