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# Invasive *Salmonella* infections among children in Bintulu, Sarawak, Malaysian Borneo: a 6-year retrospective review

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## Abstract

**Background:** Invasive *Salmonella* infections result in significant morbidity and mortality in developing countries. In Asia, typhoid and paratyphoid fever are reported to be the major invasive *Salmonella* infections, while invasive non-typhoidal *Salmonella* (iNTS) infections are believed to be uncommon. Data from Sarawak, in Malaysian Borneo, are limited.

**Methods:** A retrospective study identifying all children aged < 15 years with invasive *Salmonella* infections from 2011 to 2016 was conducted in Bintulu Hospital in Sarawak. Population incidences, clinical and bacterial characteristics were examined.

**Results:** Forty-four patients were identified during the 6-year study period: 43 had iNTS infection and 1 had typhoid fever. The average annual iNTS incidence was 32.4 per 100,000 children aged < 5 years. None of the children had malaria or HIV infection, and only 7% were severely malnourished. *Salmonella* Enteritidis and *Salmonella* Java were the commonest NTS serovars identified. Pneumonia was the most common manifestation of iNTS disease, present in 20 (47%) children. Other manifestations included gastroenteritis, fever without a source, septic arthritis and meningitis. *Salmonella* Enteritidis was identified in 76% of those with pneumonia, significantly more frequently than in children with other manifestations. Over 25% of children with iNTS developed severe disease and nearly 10% suffered long term morbidity or mortality. While 78% of *Salmonella* Java isolates were multi-drug resistant, nearly all other isolates were susceptible to most antimicrobials, including ampicillin.

**Conclusions:** Bintulu Division in Sarawak observed a very high incidence of childhood iNTS infections. Enteric fever was uncommon. The epidemiology of invasive *Salmonella* infections in Malaysian Borneo differs considerably from that of neighbouring countries in Asia.

**Keywords:** *Salmonella*, Invasive, Non-typhoidal, Children, Malaysia, Borneo

## Background

Invasive *Salmonella* infections, caused by the various serovars of *Salmonella enterica* subspecies *enterica*, result in significant morbidity and mortality in developing countries [1, 2]. *Salmonella enterica* serovars Typhi and Paratyphi, known as typhoidal *Salmonella*, typically

cause the well-known manifestations of enteric fever (typhoid or paratyphoid fever) [1]. Other *Salmonella enterica* serovars, collectively termed non-typhoidal *Salmonella* (NTS), are important causes of gastro-intestinal infections, but may also cause severe invasive infections including bacteraemia and meningitis, with high fatality rates [3, 4]. These invasive NTS (iNTS) infections have mainly been reported in sub-Saharan Africa, predominantly among children with malnutrition or malaria and in adults living with human immunodeficiency virus (HIV) infection [5]. NTS have now emerged

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