Modelling Based Estimates for Severe Pneumonia and Pneumonia Deaths in Indian States

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Objective
This presentation highlights the use of mathematical model to estimate burden of disease in absence surveillance data. We estimated the burden of severe pneumonia, pneumococcal pneumonia and pneumonia deaths in Indian states using a mathematical model through application of vaccine probe methodology and attributable fraction.

Introduction
The Child Health Epidemiology Reference Group (CHERG) has predicted around 43 million pneumonia cases in India. It is recognized that for huge nation like India, which accounts for 23% of global pneumonia burden, the national estimates may hide regional disparities(1). In this context, we have generated Indian state specific burden of severe pneumonia, pneumococcal pneumonia and pneumonia deaths through use of mathematical model.

Methods
We developed a Microsoft Excel-based model to estimate number of new episodes of severe pneumonia for each Indian state. This model is based on the epidemiological concept of potential impact fraction(1) as follows:

$$Ne/cy = (Pop_{< 1yrs} \times (Inc_{Ind}) \times \{1 + \Sigma_{RF=1-7}\} \times (RR_{RF} - 1))$$

where $Ne/cy$ is the number of new episodes of clinical pneumonia per year in selected Indian state, $Pop_{< 1yrs}$ is the population of children less than 1 years in each state, Inc$_{Ind}$ is the estimated incidence of severe clinical pneumonia at all India level. Prev$_{RF}$ is the prevalence of exposure to n-th risk factor among under-fives in the Indian state of interest, Prev$_{RF}$ is the prevalence of exposure to n-th risk factor among under-fives at all India level and RR$_{RF}$ is the relative risk for developing clinical pneumonia associated with the n-th risk factor. We then estimated the number of pneumococcal pneumonia cases by applying the vaccine probe methodology to an existing Philippines trial. The study reported 19.8% efficacy against radiologic pneumonia (95% CI: 8.8, 40.8) in children age less than 1 year(2).

The 11 serotypes contained in the vaccine were estimated to account 0.56 million and 95 thousand respectively. The contribution of pneumococcal pneumonia was 15.8% to all cause pneumonia cases and 20.8% to all cause pneumonia deaths. The In age specific analysis, we observed that pneumonia related morbidity was highest in 0-1 year age group (51 %) followed by 1-2 age group (22%), 2-3 years (11%), 3-4 years (9%) and 4-5 years (7%).

Conclusions
To summarize, the state-specific estimates are key for identification of states with high burden of pneumonia related morbidity and mortality and to target interventions for pneumonia prevention and control especially pneumococcal conjugate vaccines to achieve maximum impact.

Keywords
Mathematical Modelling; Pneumonia; Vaccine Probe; Pneumococcal Conjugate Vaccine; Pneumococcal Pneumonia

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References

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