BURDEN OF CHILDHOOD MORTALITY CAUSED BY STREPTOCOCCUS PNEUMONIAE IN INDIA

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INTRODUCTION

- 369,000 Indian children died in year 2005 due to pneumonia; these deaths were not equally distributed among Indian states.[1]
- **To inform national policy decisions prioritizing targeted introduction and scale-up of pneumonia prevention and treatment strategies, we estimated state-level mortality due to *Streptococcus pneumoniae* (SP) in children age 1-59 months in India in 2005.**

METHODS

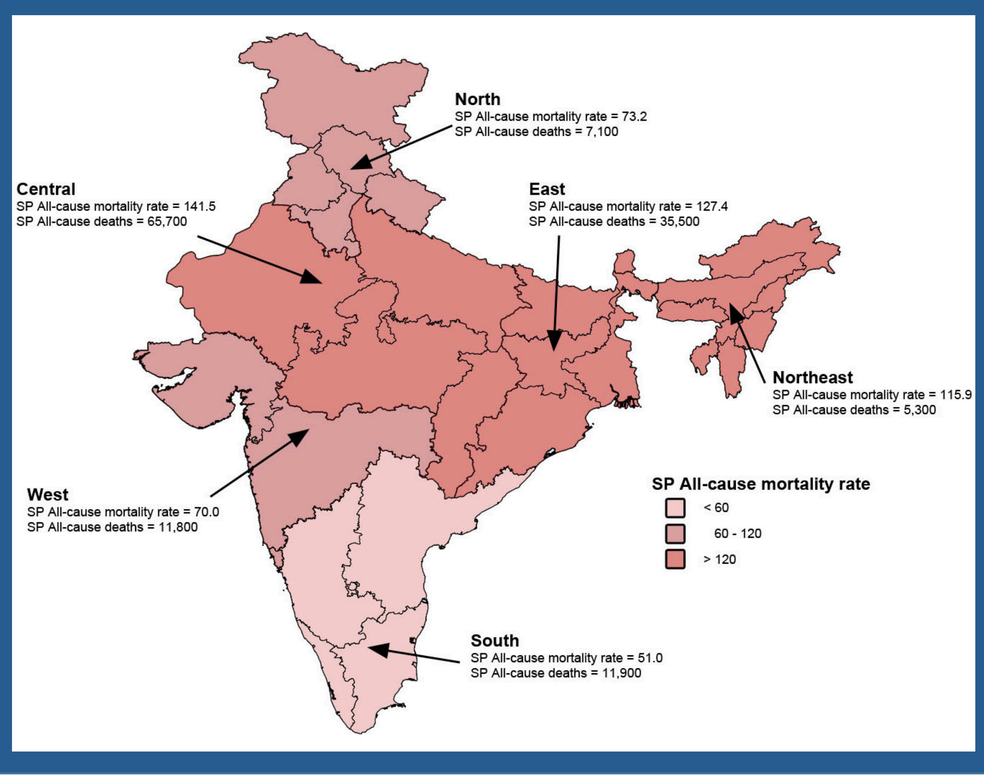
Strategy

- Methods modified from the WHO Hib and Pneumococcal Global Burden of Disease study:[2]
  - pneumococcal meningitis incidence and CFRs identified from a systematic search of the literature and assigned to each Indian state using a hierarchical algorithm based on epidemiologic setting (UN region/sub-region and under-five mortality rate), and adjusted for access to care and HIV prevalence;
  - pneumococcal meningitis deaths were multiplied by an estimate of the ratio of non-pneumonia non-meningitis (e.g. bacteremia without a focus; NPNM) incidence and CFR to estimate pneumococcal NPNM deaths;
  - multiplied % chest x-ray confirmed pneumonia caused by SP from a meta-analysis of four vaccine trials[2] by the number of pneumonia deaths for each Indian state[1] to estimate pneumococcal pneumonia deaths.
- Uncertainty for pneumococcal meningitis and NPNM was estimated from jack-knife analysis; bootstrapping methods incorporating uncertainty in the number of pneumonia deaths and %pneumonia due to SP from the meta-analysis of four clinical trials.
- "North East" (NE) states refers to: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura. "Other" states refers to: Andaman and Nicobar islands, Chandigarh, Daman and Diu, Dadra and Nagar Haveli, Goa, Lakshadweep, Puducherry, Uttarakhand.
- **State-level estimates were aggregated to provide** regional (north, south, east, west, central) and **national estimates for India**.

RESULTS

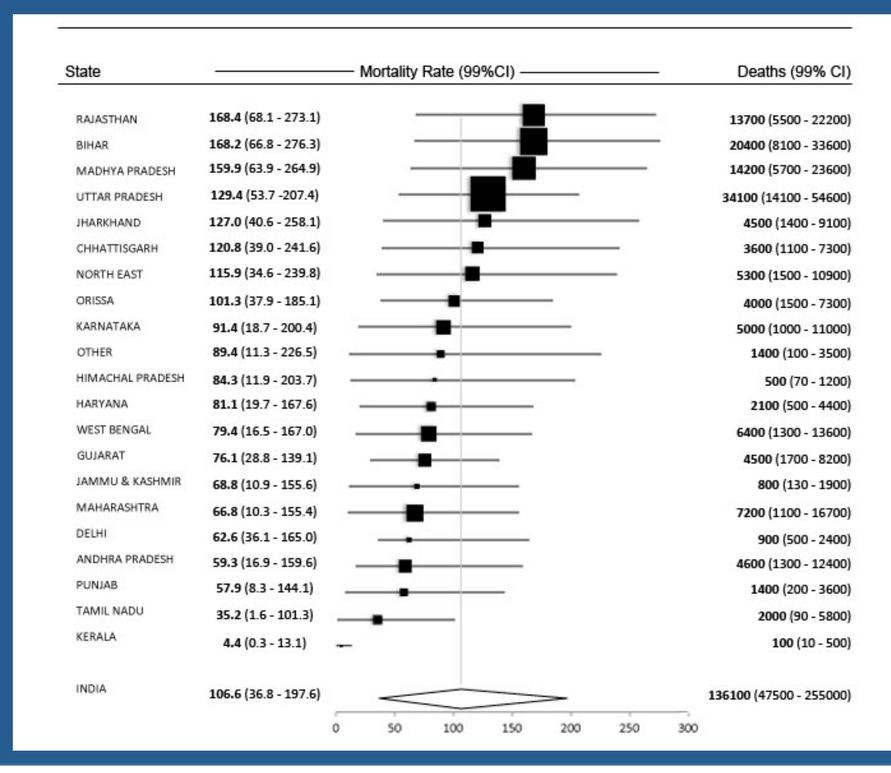
- In 2005, we estimated **pneumococcal disease caused 136,000 deaths** (46,000-253,000) **comprising 10% of deaths in Indian children aged 1-59 months**.
- The **death rate for pneumococci was 106 per 100,000** (36-197), and more than two-thirds of pneumococcal deaths were pneumonia-relate.
- Across regions, **pneumococcal mortality** ranged from 51-141 deaths per 100,000 1-59 months children and was **highest in the Central and Eastern regions** (Figure 1).

Figure 1. Map of pneumococcal mortality rates and number of deaths among Indian children age 1-59 months, by state.



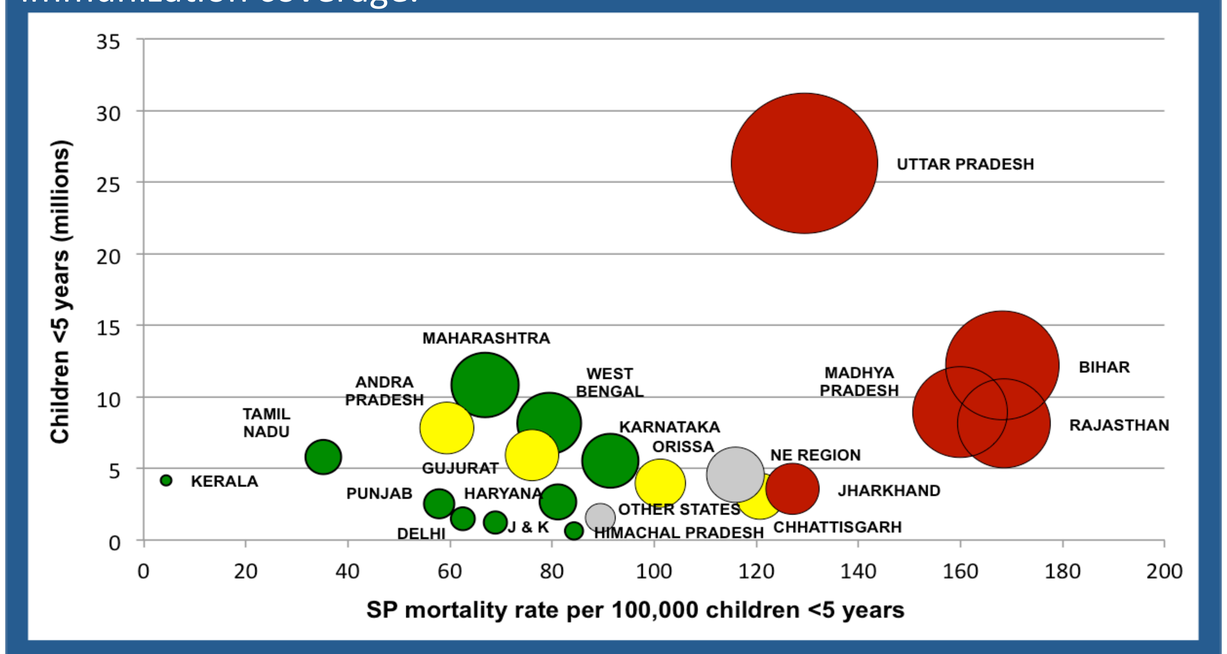
- **>50% of pneumococcal deaths occurred in four states** with reported low rates of antibiotic use[3]: **Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh** (Figure 2).
- The **national rates** of **pneumococcal pneumonia, meningitis, and NPNM** were: **89.2** (30.7 – 164.6), **9.9** (3.9 – 18.3), and **5.4** (0.9 – 12.4), respectively.
- Across states, the distribution of pneumococcal pneumonia is similar to the distribution for all-syndrome pneumococcal mortality in **Figure 2**.
- Most **pneumococcal meningitis** deaths occurred in Uttar Pradesh, Maharashtra, West Bengal and Bihar and together comprise 50% of the **12,800 deaths estimated for India**.

Figure 2. Forest Plot for Pneumococcal mortality rate among Indian children age 1-59 months, by state.



- According to **Figure 3**, the **places where PCV could have the greatest impact are the states with the lowest immunization coverage**.
- Assuming PCV use at current rates of DPT3 coverage levels, **PCV use in high-medium pneumococcal mortality states with >50% immunization coverage** including Chattisgarh, Orissa, Karnataka, Haryana, West Bengal and Gujarat **could have a sizeable impact on the national burden of pneumococcal disease**.
- If **PCV is introduced similar to Hib vaccine**, then the **two lowest pneumococcal mortality states, Kerala and Tamil Nadu would be the first to receive vaccine**.

Figure 3. State-level pneumococcal deaths by pneumococcal mortality rate, number of children <5 years of age, and level of DPT3 immunization coverage.*



*Number of pneumococcal deaths (size of circle), pneumococcal mortality rate per 100,000 children less than five years of age (x-axis), number of children age less than five years (y-axis), and proportion of infants vaccinated with three doses of diphtheria, pertussis, and tetanus toxoid categorized by: <50% (red), 50-69% (yellow) and ≥70% (green).

CONCLUSION

- **Pneumococcal disease burden in Indian children is substantial and not equally distributed** throughout the country.
- Access to life-saving pneumococcal vaccines and scale-up of antibiotic treatment is critical to improve child survival in India and reduce inequities in disease morbidity.
- **Targeting medium pneumococcal mortality states with good immunization coverage can reduce the national burden of disease**; a **large impact would require PCV use in high mortality low coverage states.**

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