

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

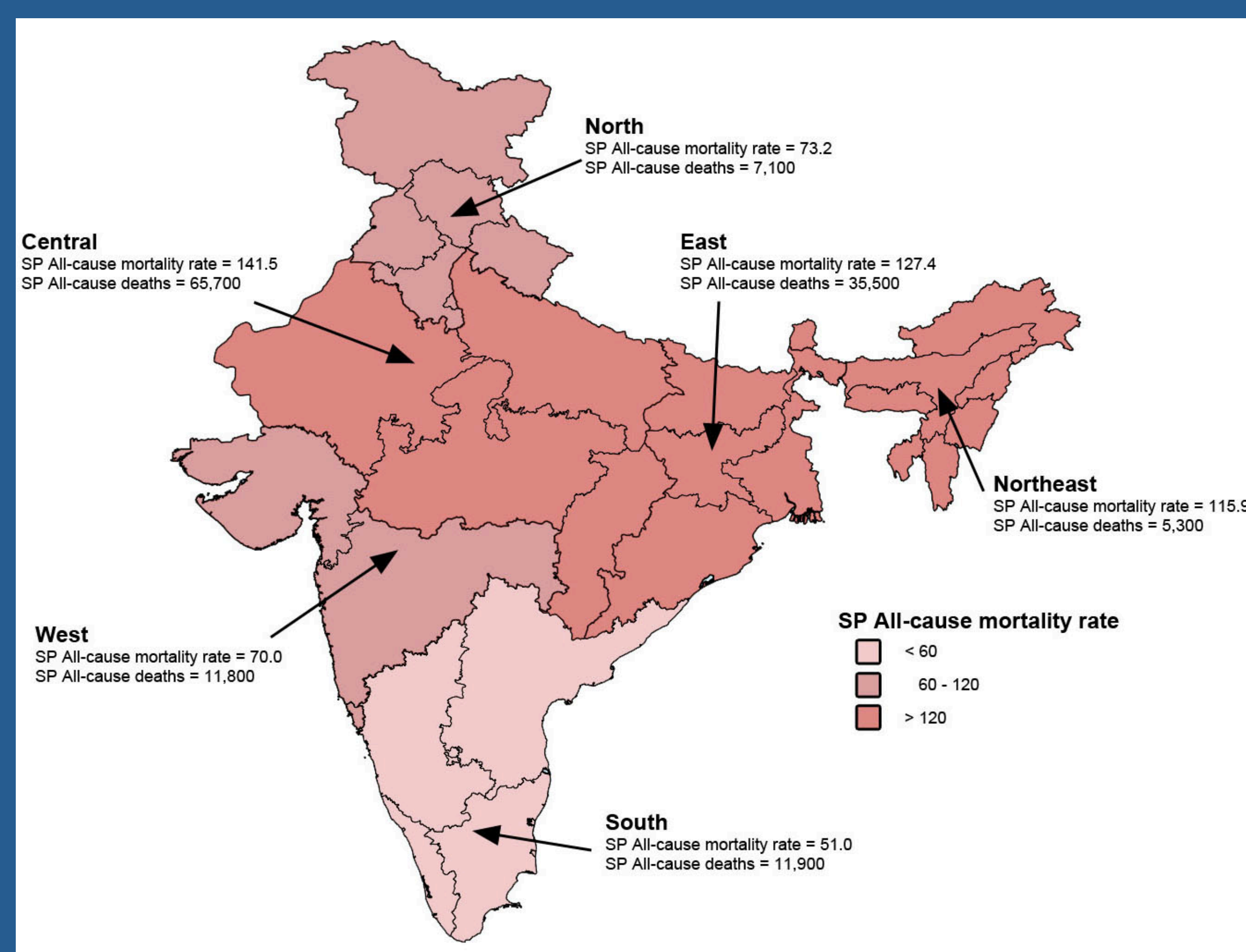
Strategy

- 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 trials² by the number of pneumonia deaths for each Indian state¹ 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

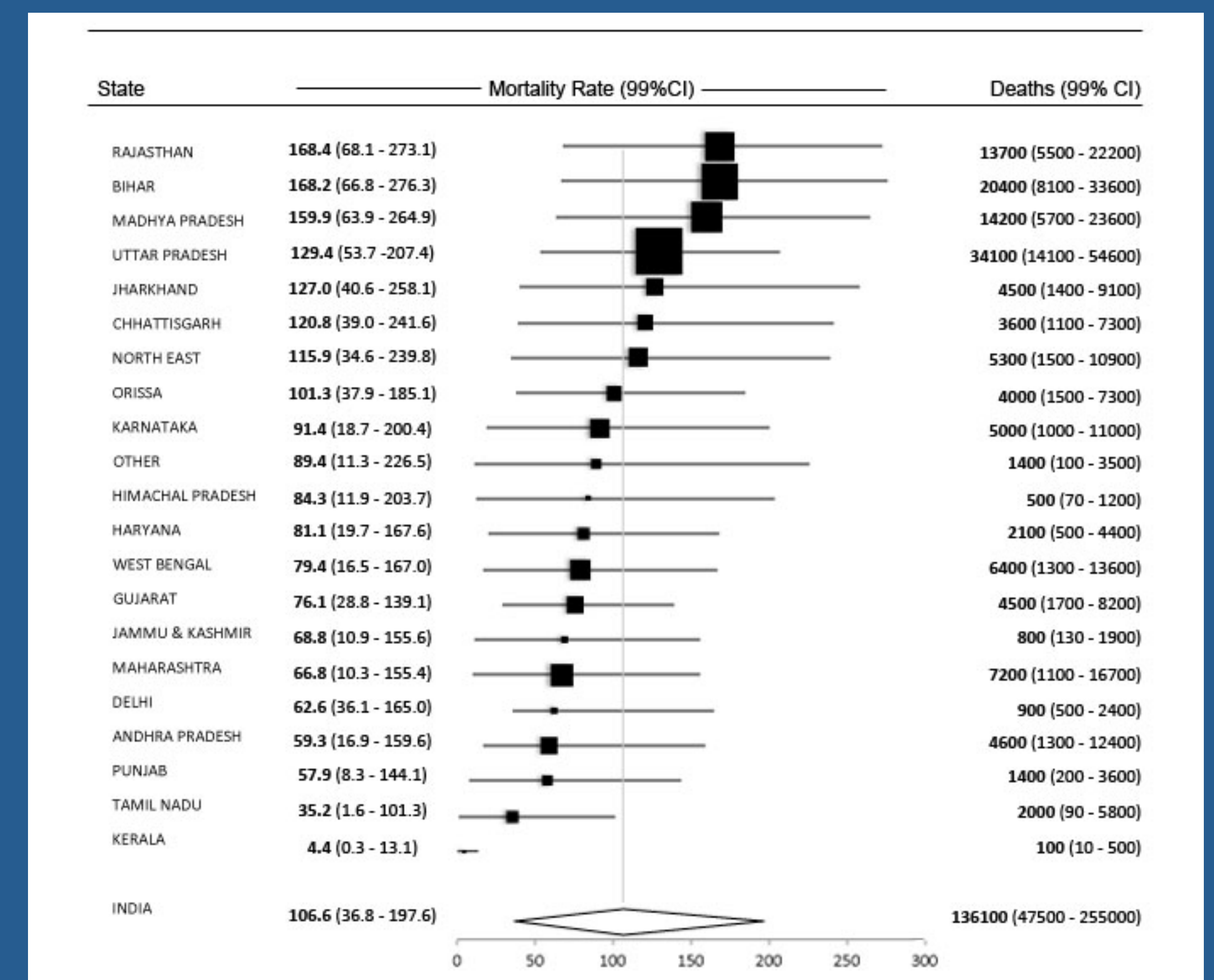
- In 2005, we estimated pneumococcal disease caused 136,000 deaths (46,000-253,000) comprising 10% of deaths in Indian children aged 1-59 months.
- The death rate for pneumococci was 106 per 100,000 (36-197), and more than two-thirds of pneumococcal deaths were pneumonia-related.
- Across regions, pneumococcal 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.



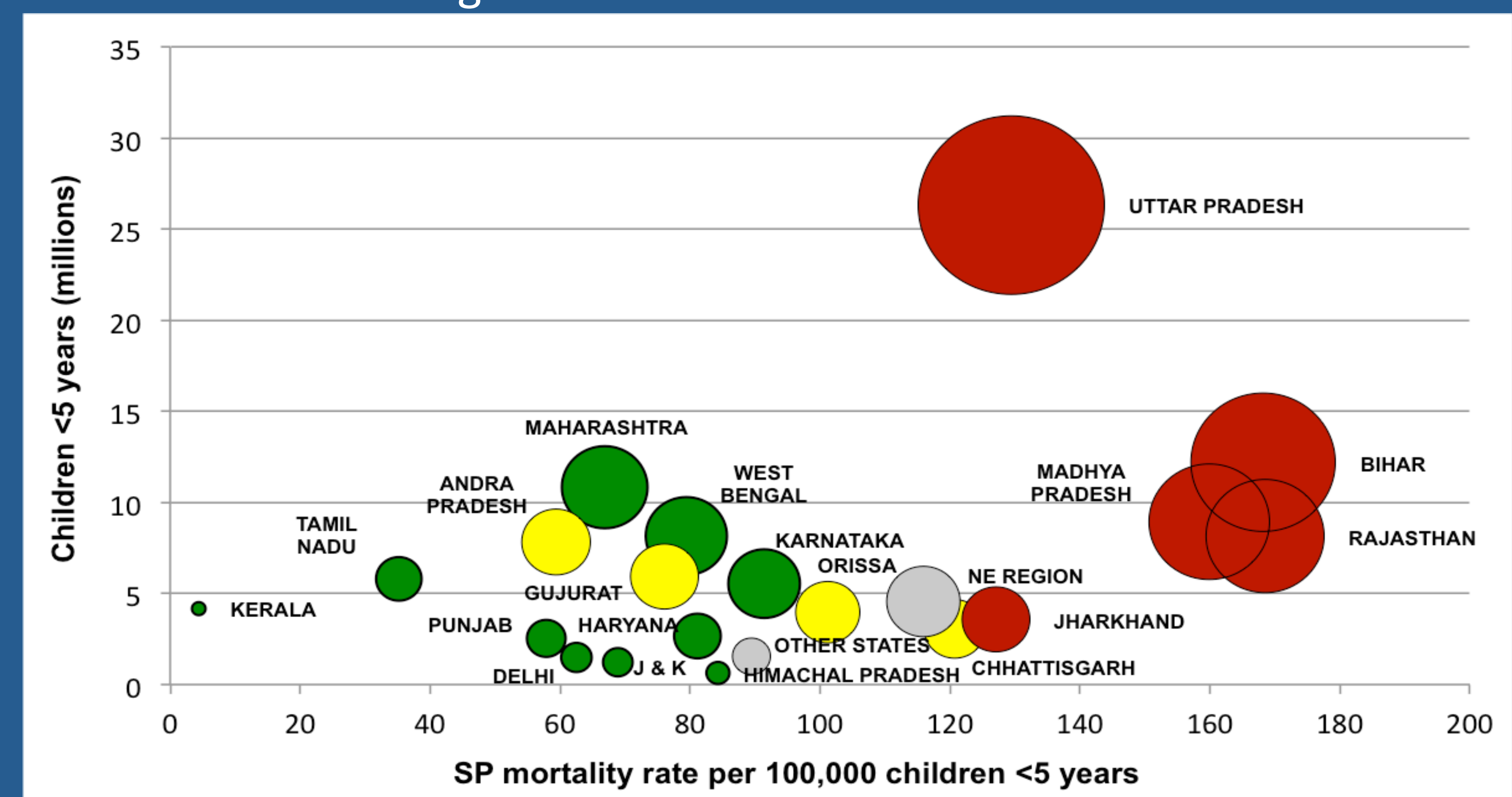
- >50% of pneumococcal deaths occurred in four states with reported low rates of antibiotic use³: Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh (Figure 2).
- The national rates of pneumococcal pneumonia, meningitis, and NPNM were: 89.2 (30.7 – 164.6), 9.9 (3.9 – 18.3), and 5.4 (0.9 – 12.4), respectively.
- 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.

REFERENCES

1. Bassani, D.G., et al., *Causes of neonatal and child mortality in India: a nationally representative mortality survey*. Lancet, 2010. 376(9755): p. 1853-60.
2. O'Brien, K.L., et al., *Burden of disease caused by Streptococcus pneumoniae in children younger than 5 years: global estimates*. Lancet, 2009. 374(9693): p. 893-902.
3. National Family Health Survey (NFHS-3), 2005-06: India: Volume I. 2007, IIPS: Mumbai.

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