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LETTER TO THE EDITOR

Atypical surge of hospitalized and severe cases of pertussis: A single center 19-years study from China

Dear editor,

In recent times, pertussis, commonly referred to as whooping cough, has rapidly spread as a highly contagious respiratory illness, leading to widespread outbreaks across various regions and countries,^{1,2} and China is no exception to this trend.³ According to data released by the National Health Commission of China, national reported cases of whooping cough increased steadily from 821 in March 2023 to 9126 in December, almost a tenfold rise. At the beginning of 2024, reported cases reached up to 15,275 in January, 17,105 in February 2024, and rose further to 27,078 in March. There was a spike in pertussis cases in April, with the number reaching 91,272. Furthermore, 20 deaths have been reported in the first four months of 2024. The pertussis epidemic in China demonstrated a unique and relentless pattern, characterized by an unprecedented scale and rapid spread. However, national surveillance data lack indicators of severity, such as hospitalizations or intensive care unit (ICU) admissions, necessitating the use of alternative data sources to evaluate the burden of pertussis outbreaks. Therefore, we undertook a retrospective study spanning 19 years to examine the epidemiology of pertussis-related hospitalizations and ICU admissions in Beijing Children's Hospital (BCH).

We systematically reviewed the electronic inpatient records of BCH from August 2006 to April 2024. The date of hospitalization, age, admission department and discharge situation of patients with "pertussis" in the diagnosis name were collected. Severe pertussis in this investigation was defined as pertussis resulting in hospitalization in the ICU for at least 24 h, or resulting in death. In total, there were 577 hospital admissions and 96 severe cases, including three deaths, were identified. Nasal continuous positive airway pressure (NCPAP) ventilation was required in 63.5% (61/96) of severe cases. Among these patients, 55.7% (34/61) required invasive mechanical ventilation as the disease severity progressed. Children with severe pertussis had a median stay of 13 days (1–42 days) in ICU.

Fig. 1 depicts the dynamic changes in hospitalized pertussis cases, severe cases, and the national reported pertussis cases from August 2006 to April 2024. Trends in hospitalized

and severe cases align closely with national data, with the exception of BCH's figures, which do not exhibit a sharp increase corresponding to the national reported data at the beginning of 2024. This divergence may stem from the recent surge in pertussis cases, primarily affecting preschool and school-aged children, who typically do not necessitate hospitalization.³ It is well known that the pertussis requiring hospitalization or severe cases occur mainly in infants, defined as those under 1 year of age. In the present cases, infants comprised 83.5% (482/577) of hospitalizations and 94.8% (91/96) of severe cases. In particular, for infants younger than 3 months who have not yet started vaccination, the figures are 48.5% (280/577) and 62.5% (60/96), respectively. Inpatients' ages ranged from 15 days to 15 years and 8 months, with a median age of 3 months and 2 days, and severe cases' ages ranged from 16 days to 2 years and 10 months, with a median age of 2 months and 6 days. It is observed that the number of cases in children aged 1 year and above, as well as their proportion in the hospitalized cases increased since 2018, but not in the way that threatens the infant's dominance (Figs. 1 and 2).

While the increase in hospitalized cases did not match the surge in reported national pertussis cases since the most recent winter, the number of hospitalizations in the first quarter of 2024 (17 cases) marks the highest figure in the past six years, contrasting sharply with the range of 0–12 cases observed in the first quarters of 2019–2022 (see Fig. 2). This supports our earlier hypothesis that infant pertussis may present greater severity due to an epidemic of highly virulent pathogens, despite the absence of a notable increase in the number of infant cases.⁴ Consistent with the seasonal pattern observed in reported pertussis cases nationwide, hospitalizations typically peak in the third quarter of each year. However, an unusual spike is evident in the winter of 2023 (see Fig. 2), deviating from the typical seasonal pattern observed in national reported cases.³

Traditionally, the primary strategy for pertussis prevention in China has involved administering three doses of vaccine, starting at 3 months of age. The primary objective of pertussis vaccination is to mitigate the risk of severe pertussis in infants and young children, given the substantial morbidity and mortality associated with the disease in this demographic.⁵ Nevertheless, our observations indicating an upward trend has been observed in the necessity of hospitalization or admission to intensive care units among pertussis patients over time. This trend is particularly pronounced

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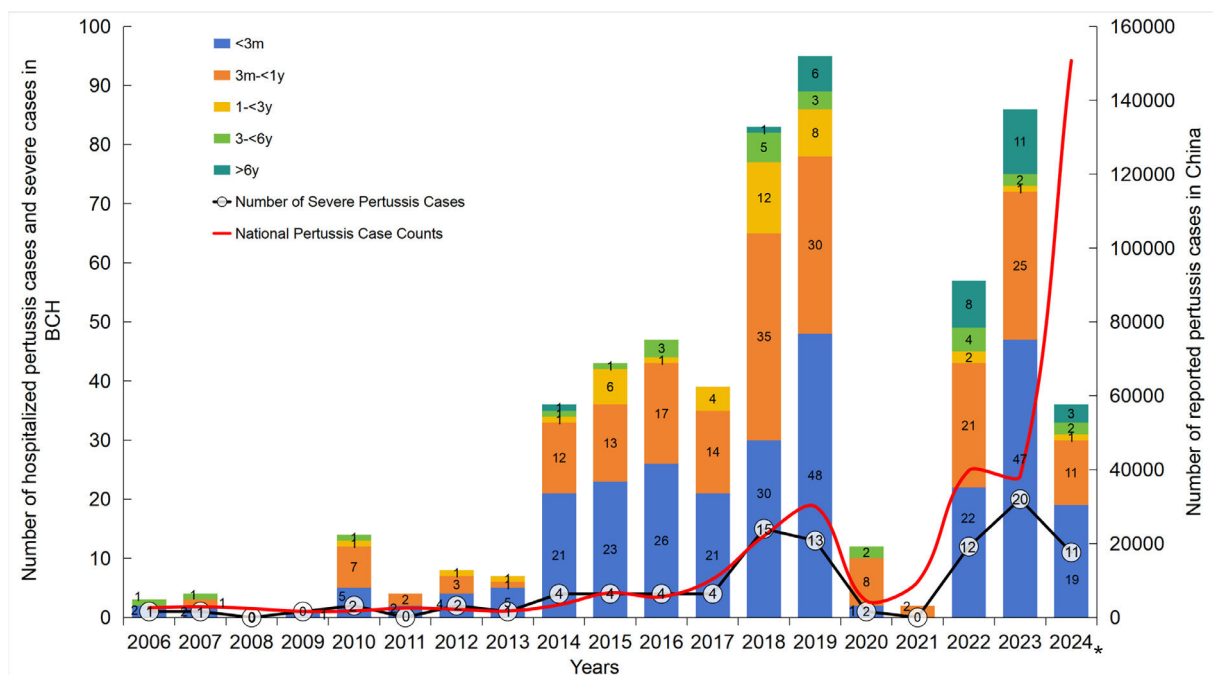


Fig. 1 Age distribution and incidence counts of pertussis hospitalizations and severe cases at BCH, and national pertussis case counts, 2006–2024. Note: *Data for 2024 is based on cases of whooping cough from January through April.

among infants under three months of age, who are not yet eligible for complete protection through active immunization. Notably, numerous countries have embraced pertussis vaccination strategies during pregnancy as a pivotal measure for safeguarding young children.⁶ However, such strategies are not presently integrated into prenatal care in China. According to our findings, nearly half of the hospitalized cases (48.5%) and almost two-thirds of the severe cases (62.5%) occur in infants under 3 months of age. This

subgroup requires greater attention to preventive measures, including pregnancy vaccination. Moreover, the escalation in hospitalization rates among school-aged children signifies a rise in the severity of pertussis infection, likely attributable to the emergence and prevalence of the highly virulent pertussis strain, which is usually resistant to macrolides in China.⁷ Recently, Shi et al. highlighted that the surge in erythromycin resistance-associated pertussis cases in China calls for the adaptation of antibiotic treatment strategies to

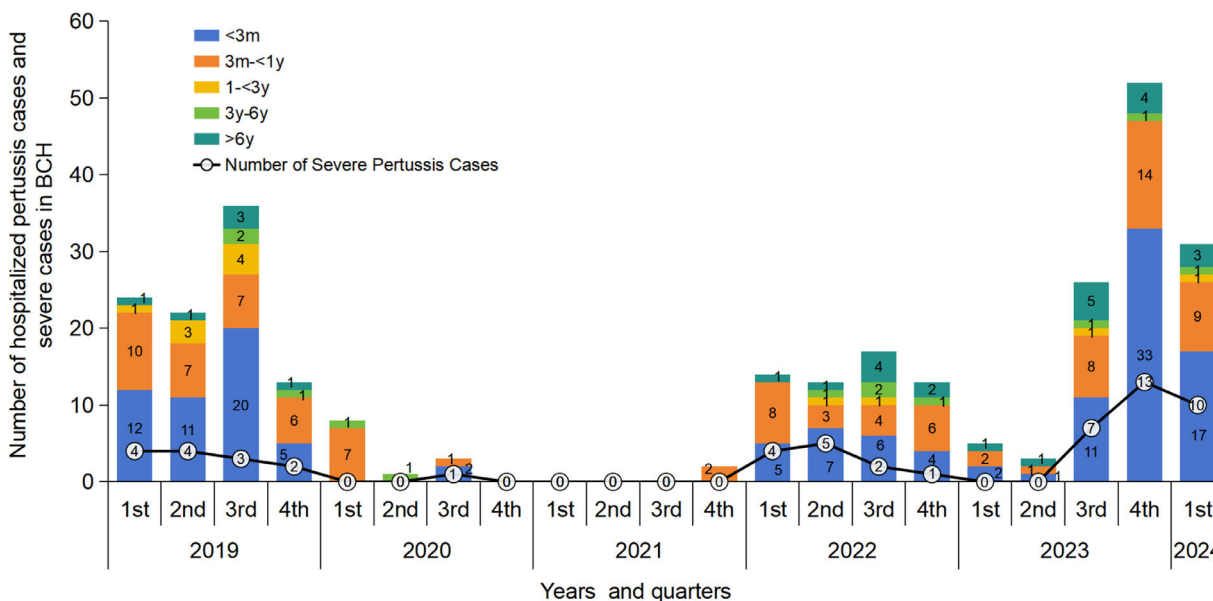


Fig. 2 Changes in age distribution and incidence counts of pertussis hospitalizations and severe cases at BCH, by quarter, 2019–2024.

address the situation more effectively.⁸ The surge in pertussis hospitalization and severe illness rates underscores the imperative to promptly assess and improve novel immunization vaccine strategies, fortify case surveillance, as well as enhance early diagnosis procedures and prophylactic treatment, to mount an effective response to a pertussis pandemic.

Conflicts of interest

All other authors declare no competing interests.

Ethical considerations

This study was approved by the Ethics Committee of Beijing Children's Hospital, Capital Medical University on 29/01/2022.

Disclosures

All authors have reviewed and approved the final version of the manuscript being submitted. They warrant that the article is their original work, has not been previously published, and is not under consideration for publication elsewhere.

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