Pertussis deaths in New Zealand without community transmission—an infant immunity gap?

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Attention was first drawn to development of a post-COVID "immunity debt" in children in late 2021, attributed to reduced community exposure to pathogens transmitted by the respiratory route.[1] Subsequent evidence from multiple European countries has supported this concept for both viruses (especially respiratory syncytial virus (RSV)) and bacteria (especially invasive disease due to Group A Streptococcus), supported by no increase in invasive bacterial diseases not transmitted by the respiratory route, such as *Streptococcus agalactiae*.[2] For RSV, substantial decreases in maternal and infant antibody, related to social distancing to decrease transmission of SARS-CoV-2, support the notion that subclinical RSV infections are common in adults and required to maintain sufficient antibody in women of childbearing age to provide passive protection to their newborns.[3]

Despite a similar epidemiologic scenario to RSV—endemic community circulation and severe disease concentrated among infants less than 3 months[1]—resurgences of pertussis have not been reported. Here we report a cluster of three pertussis deaths in New Zealand infants, despite levels of all-age pertussis notification which are very low by historical standards, but in the context of long-standing, inequitable deficits in maternal immunisation and timeliness of infant vaccination.

Two pertussis deaths at 4 and 5 weeks of age from two districts in New Zealand's North Island occurred during February 2023, against a background of 3 laboratory-confirmed cases in the preceding 12 months nationally. Within one month, a third infant death aged <8 weeks occurred in another North Island district.[4] If projected to all of 2023, this is a mortality rate of 51 per million live births, five-fold higher than the 10.1 per million live births (9 pertussis deaths) over a 15-year period (1999–2013) identified from multiple data sources.[5]

Measuring infant pertussis mortality as deaths per million live births was deemed the most reliable metric for inter-country comparison by the World Health Organization in 2014—the historical New Zealand rate of 10.1 was higher than Australia, Canada, Denmark, and Sweden (3.7–4.2) but comparable to Israel, Portugal and England and Wales (7.4–8.8).[6] A cluster of 14 deaths in 2012 in England and Wales (19.1 per million live births),[6] prompted a precedent-setting emergency maternal pertussis vaccination programme but occurred in the context of large increases in notified pertussis, especially among adolescents.[7]

In New Zealand, pertussis has been a notifiable disease since 1996, with 4–5 yearly epidemic peaks (Fig. 1). After an epidemic beginning in October 2017, all-age notifications decreased to 1206 in 2019, followed by record lows of 171 (2020), 41 (2021) and 18 (2022); in 2023, 33 cases were notified to 17th June.[8] Infant hospitalisations represented 3–6% of total notifications between 2018 and 2020 and none in 2021 and 2022, but 11 (33.3%) to mid-June 2023 (Fig. 1).[8] Non-identification of infant pertussis hospitalisations due to lack of testing is unlikely. Middlemore hospital in South Auckland serves a population with the highest levels of deprivation and paediatric infectious disease burden in New Zealand, disproportionately of Māori or Pacific Island ethnicity. At Middlemore, pertussis is included in all PCR respiratory panels and >90% of paediatric respiratory admissions have been tested since 2012, with an infant death in 2023 the first laboratory-confirmed pertussis hospitalisation since May 2020.

Unfortunately, New Zealand has long-standing poor timeliness for the pertussis vaccine infant primary schedule (3 doses at ages 6, 12 and 20 weeks), especially among Māori and in areas of high deprivation, with timeliness deteriorating further during 2022.[9] Similarly, uptake of maternal pertussis vaccination in pregnancy, fully funded since 2013, although reaching 60% among more socioeconomically advantaged women by 2018, was substantially lower (20–30%) among Māori and Pacific women living in areas of high socioeconomic deprivation.[10] While notifications are known to underestimate pertussis incidence, this cannot account for extremely low levels since 2020 (Fig. 1). We believe that the most plausible explanation for this cluster of deaths is a maternal—infant immunity gap due to 3 factors—absence of community transmission for 3 years and, focussed on some populations, low maternal immunisation and delayed infant immunisation.[10] These factors could lead to complete absence of protective antibodies

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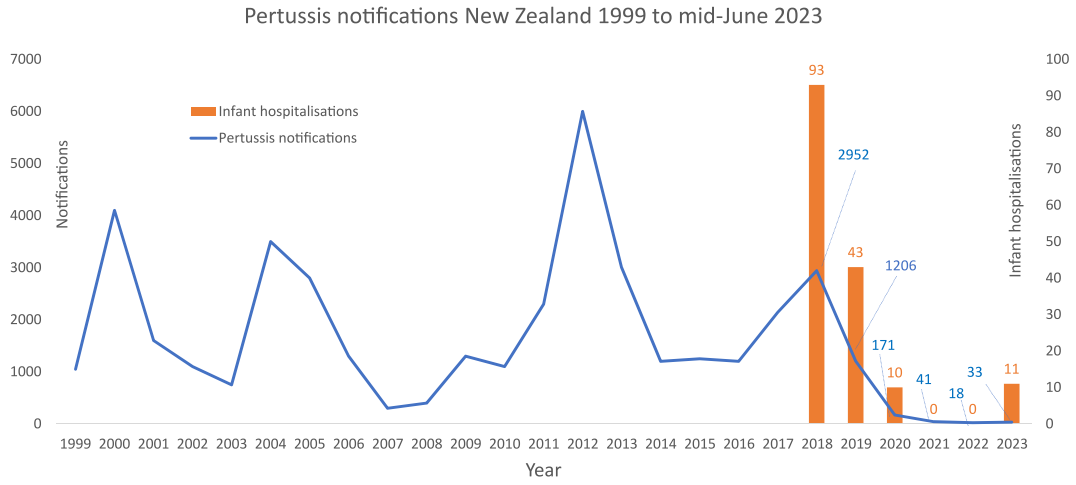

Fig. 1: Pertussis notifications New Zealand 1999 to mid-June 2023.

in an increased proportion of mothers, in turn the main risk factor for fatal pertussis in newborn infants.[1]

While preliminary data, this recent New Zealand experience may point to the potential for immunity gaps against pertussis to emerge in countries with low and/or late maternal and infant vaccination. On 5th April 2023, the report of an independent New Zealand Immunisation Taskforce recommended a range of measures to improve access to and uptake of infant and maternal vaccines, with a focus on service provision to the most underserved groups.[11]

Declaration of interests

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