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## **Pneumococcal disease in New Zealand and prevailing inequalities, the tip of the lower respiratory infection iceberg**

Helen A Petousis-Harris

*Streptococcus pneumoniae* (*S. pneumoniae*) is a Gram-positive diplococcus with over 90 serotypes identified by the polysaccharide capsule that encloses the cell and contributes to virulence and the cause of pneumococcal disease. The organism is widely carried asymptotically in the upper respiratory tract and is a common cause of community-acquired pneumonia (CAP), bacterial meningitis, bacteraemia and otitis media (OM).

Development of capsular polysaccharide vaccines against *S. pneumoniae* began early in the 20th Century with the first vaccines marketed in the 1940s. Poor immunogenicity of the polysaccharide vaccine in children under 2 years of age stimulated the development of conjugate vaccines which, unlike polysaccharide vaccines, induce immunological memory, affect nasopharyngeal carriage and are immunogenic in infants and young children.

Since the introduction of routine pneumococcal conjugate vaccination into infant schedules, significant herd immunity has been demonstrated with reductions in invasive pneumococcal disease (IPD) occurring, in both vaccinated persons and their community contacts. New Zealand (NZ) introduced a 7-valent vaccine (PCV7) against pneumococcal disease in 2008 and in 2011 this was replaced with a 10-valent vaccine (PCV10). There is also a 13-valent vaccine (PCV13) available and funded for persons with high-risk conditions or private purchase.

As observed in other countries who have introduced these vaccines, NZ has experienced a dramatic reduction in IPD caused by the serotypes included in the scheduled vaccine, almost to the point of elimination among the vaccine-eligible age groups.<sup>1</sup> Decreases in pneumococcal pneumonia have been observed internationally<sup>2</sup> and are expected in NZ. Early data has reported some reductions in OM in primary care.<sup>3</sup> Conversely there have been small increases in the rates of IPD caused by non-vaccine serotypes in the over 4 year olds.<sup>1</sup>

In 2012 an important paper on the incidence of serious infectious diseases and inequalities in NZ was published.<sup>4</sup> The study showed an increase in acute hospital admissions for infectious diseases in general between 1989 and 2008 and most significantly for LRI. Hospitalisation for pneumonia and influenza almost doubled during this time period and age standardised hospitalisations for Māori and Pacific increased progressively throughout the 1990s.<sup>4</sup>

A decrease in infectious disease hospitalisations for children under five of all ethnicities occurred from the late 1990s to 2008, although the ratio of Māori and Pacific to European increased.<sup>4</sup> This amounts to a modest improvement overall for the youngest members of the population over the most recent years but a substantial widening of inequalities.

To control vaccine preventable infections, vaccine coverage must be high enough and equitable enough socially and geographically so as to prevent transmission of the infection. The immunisation coverage rates for the infant schedule have been improving over the past few years with over 92% of NZ infants fully immunised by their second birthday.

Along with this overall improvement has been the significant reduction in ethnic and deprivation inequities. In 2009, coverage for Māori children was 73%, Pacific 80%, NZ European 82% and Asian 85%: By the end of 2012, the differences were less apparent with Māori 90%, NZ European at 90%, Pacific 93% and Asian 95%.

The socioeconomic differences have also narrowed with just two percentage points between the highest and lowest quintiles. While larger inequities still exist for on-time vaccinations, there has nevertheless been significant progress made. In terms of geographical variation in vaccine coverage for 2 year olds, there is similarity between District Health Boards (DHBs) (10 percentage points between highest to lowest), but this cannot be said for timely administration of the primary series. For example at 6 months of age there is around 25 percentage points difference between highest and lowest performing DHBs.<sup>5</sup>

The impact of the pneumococcal vaccination programme in NZ is reflected in the incidence of IPD. Reductions in IPD caused by vaccine types have been observed in all ethnic groups and all age groups. This is least profound in Pacific children under 2 years of age. The rate per 100,000 in Māori children under 2 years went from 86.6 in 2009 to 45.2 in 2011. In contrast, Pacific children was not so marked, reducing from 64.0 in 2009 to 56.6 in 2011, despite Pacific children having superior immunisation uptake at age 2 years.<sup>1,5</sup>

The study, in this issue of the *NZMJ*,<sup>6</sup> by Alison Vogel and colleagues investigated the impact of pneumococcal vaccination on hospital admissions for lower respiratory infection in Counties Manukau DHB (CMDHB). The ethnic and socioeconomic disparities for hospital admission are consistent with those observed across a range of childhood infectious diseases in NZ.<sup>7</sup> Unlike the pattern observed for IPD since the introduction of the vaccine, there was a significant decline in admissions for pneumonia among Pacific children under 2 years but not Māori children.

The ethnic disparities are troubling. Clearly LRIs have many causes and it is possible that pneumococcal infection is responsible for a lower proportion of these cases in some groups compared with others. This is unlikely due to any variation in vaccine performance between ethnic groups, as IPD caused by PCV7 serotypes in children under 2 years has effectively ceased nationally and it seems reasonable to assume that these serotypes are no longer a cause of LRI.

Despite improvements it is likely factors such as overcrowding, poor housing and access to primary health care still continue to be barriers to achieving more significant reductions in LRI for Māori and Pacific children in CMDHB.<sup>8</sup> There is robust evidence for the effectiveness of pneumococcal vaccination; however there are other important issues at play, including timeliness of vaccination,<sup>9</sup> which is still a challenge particularly for Māori and Pacific infants.

Further research exploring the role of vaccine exposure could help answer some of these questions. Sadly it appears that the burden of bronchiectasis and pneumonia in

CMDHB and presumably nationally may not be particularly amenable to the use of pneumococcal vaccine and require broader strategies,<sup>10</sup> particularly for Māori and Pacific children. However, improving the low timely uptake of vaccine among these children may help.

**Competing interests:** Nil.

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