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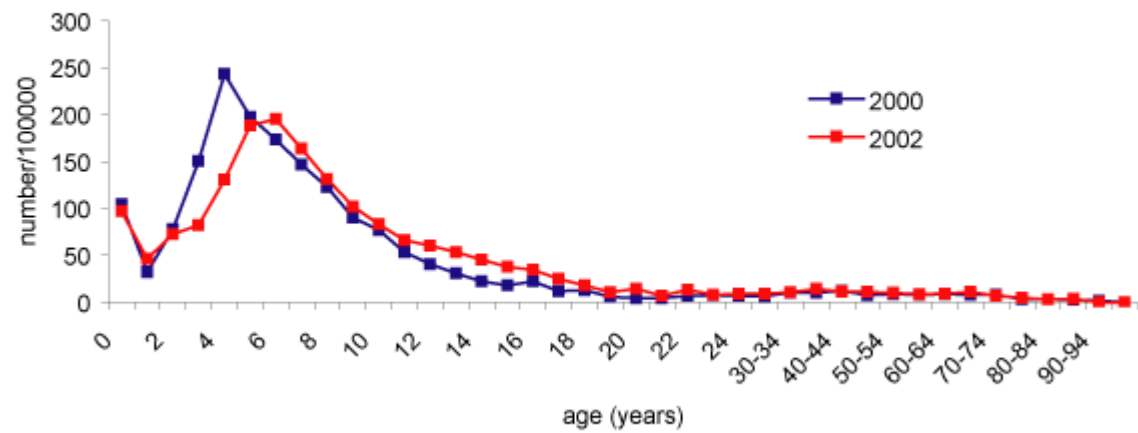
**Pertussis incidence in the Netherlands after introduction of an acellular booster vaccination at 4 years of age**

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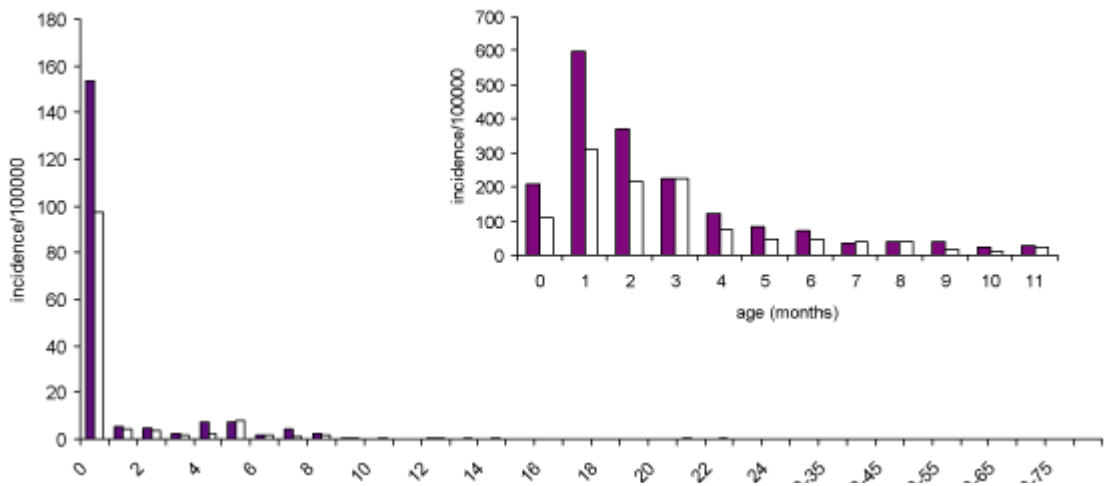
In 1996-1997 different surveillance sources revealed an outbreak of pertussis, mostly in vaccinated children, in the Netherlands. In the following years the incidence of pertussis remained higher than in the period before 1996 and in 1999 another peak was observed [1]. The high incidence of pertussis resulted in the introduction of a booster vaccination after recommendations from the Gezondheidsraad (Dutch Health Council) [2] with an acellular vaccine containing pertussis toxin, pertactin and filamentous haemagglutinin for 4 year olds in the national vaccination programme from October 2001 onwards (details of the Dutch vaccination programme are available, in Dutch, at <http://www.rivm.nl/rvp/>).

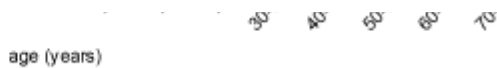
Although the total incidence in 2000 (26.6/100 000), before introduction of the booster vaccination, was slightly higher than in 2002, after its introduction (28.0/100 000) the incidence in the age group (3-4 years) targeted with the acellular booster-vaccination had decreased by 45% compared to 2000 (Figure 1). For the older age groups, a slight increase in incidence was observed in 2002 compared with previous years. Apparently, the total transmission of pertussis has not decreased and hence the probability for young infants to acquire pertussis has not yet diminished. Pertussis can become severe, particularly in young unvaccinated infants, and may lead to hospitalisation (Figure 2). In 2001 and 2002 about 500 infants were admitted to hospital because of pertussis, often with severe symptoms such as collapse, apnoea and cyanosis. Most of these children were infants under 6 months of age, who were too young to be vaccinated or vaccinated completely [3].

**Figure 1.** Incidence of notified pertussis cases according to age (years), 2000 versus 2002.



**Figure 2.** Age specific incidence according to hospital admissions, 2001(dark bars) and 2002 (white bars), age in years and months (children under 1 year, see right corner).





Increases in incidence have also been observed in other countries [4-7]. In the Netherlands, however, the increase has affected all age groups (including young vaccinated children), while in most other countries the rise in incidence has affected mainly adults, adolescents and infants who are incompletely vaccinated or unvaccinated [4,7]. Waning immunity and impaired vaccine effectiveness (as a result of the emergence of non-vaccine-type strains) appear to play an important role in current high incidence in the Netherlands [1,8]. In a mouse model, the Dutch whole cell vaccine was found to be less effective against the non-vaccine-type strains compared to vaccine-type strains [9]. The Gezondheidsraad has therefore advised on measures to be taken to improve pertussis vaccination in the Netherlands [10]. The council recommended the transition, as soon as possible, to the use of an acellular vaccine for immunisation in the first year of life. In agreement with the advice, the minister of health has decided to replace the whole cell vaccine by the acellular vaccine in the national immunisation programme from January 2005 onwards.

Furthermore, additional measures are necessary to protect infants too young to be vaccinated. Studies in other highly vaccinated populations demonstrated that it is mainly adults, often parents, who transmit the infection to these young infants [11]. Separate assessment of infection sources for infants in the Netherlands is useful because pertussis epidemiology may differ by country, dependent not only on the vaccination uptake but also the vaccination scheme, and the nature and quality of the vaccine. To optimise prevention of pertussis, modelling studies are needed to explore future additional vaccination strategies such as starting vaccination at birth, or boosting doses of adolescents or adults.

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