Executive summary

Health Council of the Netherlands. Vaccination of infants against pneumococcal infections (3). The Hague: Health Council of the Netherlands, 2013; publication no. 2013/28.

Combating pneumococcal infections

Infants and young children throughout the Netherlands have been vaccinated against pneumococcal infections since 2006. Pneumococci can cause serious illnesses such as meningitis, septicaemia, and pneumonia. These pathogens are also a major cause of middle-ear infections. Pneumococcal disease is most common in young children, as their immune systems are still immature. The disease can also affect the elderly, as the effectiveness of the immune system declines with age. There are almost one hundred different types (serotypes) of the pneumococcus bacterium (*Streptococcus pneumoniae*), each with a different degree of pathogenicity.

Until 2009, only a single vaccine was available for use in children. This vaccine (PCV7) targeted the seven major types of pneumococci. In that year, however, two new vaccines (PHiD-CV10 and PCV13) entered the market. These had a wider spectrum of activity, targeting ten and thirteen types of pneumocci respectively. The Health Council of the Netherlands adjudged both vaccines to be suitable for use in public programmes. Given the limited availability of relevant data at that point in time, together with the dynamics of pneumococcal infections, the Health Council recommended that the suitability of pneumococcal vaccines for use in the National Immunisation Programme be reviewed two years after the selection of a new vaccine. In line with this recommendation, the Minister of Health, Welfare and Sport requested an evaluation of the

effectiveness of pneumococcal vaccination in the summer of 2013. She also requested the Health Council's advice on the selection of a vaccine, and on the feasibility of using a schedule involving three (rather than four) injections.

Successful use of pneumococcal vaccination in young children

More than six years after the introduction of the pneumococcal vaccination, there has been a drastic reduction in the number of children with invasive pneumococcal disease. In infants and young children, pneumococcal disease caused by any of the seven pneumococcal types targeted by both vaccines used in the Netherlands has virtually disappeared. However, infants and young children are slightly more likely to acquire infections caused by pneumococcal serotypes that are not included in the vaccine. However, the net result (protection without type replacement) has been a sharp decline in invasive pneumococcal disease.

Indirect protection also results in less disease in the elderly

The reduced circulation of the bacterium caused by the introduction of pneumococcal vaccination in infants has also led to a sharp decline in pneumococcal disease in non-vaccinated individuals, especially those aged 65 and above. This indirect protection is partly offset by the greater opportunities now available to those serotypes that are not included in the vaccine. Here too, however, the net effect (group protection without type replacement) is also beneficial.

In the 50-64 age group, the reduction in invasive pneumococcal disease due to pneumococcal types that were included in the vaccine approximately equalled the increase of disease caused by pneumococcal types that were not contained in the vaccine. However, infections caused by the replacement types had a less severe disease course. As a result, there was also a decline in the net mortality rate in this age group.

In summary, the introduction of pneumococcal vaccination in children has also led to a reduction in invasive pneumococcal disease in the elderly and in the population as a whole.

Both vaccines are suitable for use in the NIP

The Committee has (once again) defined the primary goal of vaccination as the prevention of invasive pneumococcal disease and pneumonia in infants and young children. Due to the considerable burden of disease and disease severity involved in pneumococcal disease in the elderly, the Committee has added the indirect protection of that group as a secondary goal of vaccination. It views protection against ear infections as a relevant bonus.

Both of the currently available vaccines (PHiD-CV10 and PCV13) are suited to the primary goal of vaccination. Both are effective in combating invasive pneumococcal disease and pneumonia in infants and young children. Both vaccines have been found to be safe, and to have mild adverse-effect profiles. Compared to PHiD-CV10, PCV13 includes three additional pneumococcal types: serotypes 3, 6A and 19A. PCV13 can be expected to produce slightly greater direct health gains in infants and young children, especially with regard to serotype 19A.

As yet, relatively little data is available concerning the indirect effects of both vaccines. The follow-up to those studies that are available is still rather limited. As a result, the full extent of their effects in other age groups is not yet entirely clear. Based on the data that is available, experience with PCV7 and data on the vaccines' effectiveness against carriers, PCV13 can be expected to provide greater indirect protection than PHiD-CV10.

Efficiency depends on indirect effects and the price of vaccine

Cost-effectiveness analyses show that the efficiency (cost-effectiveness ratio) of pneumococcal vaccination is mainly determined by its beneficial, indirect effects against invasive pneumococcal disease and pneumonia in the elderly. As has been pointed out, however, there is still a degree of uncertainty regarding these effects. The indirect protection provided by PCV13 is expected to be greater than that conferred by PHiD-CV10. In addition, the cost-effectiveness ratio of vaccination is dependent on the vaccine price at the time of tendering. Both vaccines are expected to be efficient in combating pneumococcal disease.

Pneumococcal disease can still be effectively combated with one less injection

From recent studies it appears that three instead of four injections are sufficient for good protection against pneumococcal disease, if vaccination coverage is high – as in the Netherlands – and herd protection has been established. Six years after the introduction of vaccination, there has been a substantial reduction in the levels of the pneumococcal serotypes included in the vaccines. Accordingly, there can now be no objections to switching to a reduced schedule. In a situation like this, a 2+1 schedule is just as effective as a 3+1 schedule in combating invasive pneumococcal disease.

Given equal effectiveness, a three-injection vaccination schedule is more efficient than a four-injection one. This is because it produces virtually identical health effects at a lower cost. The extent of a 2+1 schedule's increased efficiency depends on the vaccine price at the time of tendering.

In immunological terms, a schedule in which infants are vaccinated at 3, 5 and 11 months has more to recommend it than one in which they are vaccinated at 2, 4 and 11 months. As yet, however, there is no evidence to suggest that a 3, 5, 11-month schedule is more clinically effective than a 2, 4, 11-month schedule. In conjunction with the other vaccinations in the National Immunisation Programme, the Committee prefers this vaccination to be administered at the ages 2, 4, and 11 months.

Monitoring continues to be important and needs to be expanded

Pneumococcal infections in the population are characterised by their dynamic nature. Invasive disease needs to be monitored, to provide the data required to evaluate the programme. Such monitoring must focus on serotype-specific effectiveness, type replacement, and indirect effects.

Existing measures for the surveillance of bacterial strains can be used to monitor shifts in the pneumococcal population, as well as the resultant clinical pictures. Clinical surveillance needs to be expanded to yield more information about disease symptoms and about the presence of other disorders (comorbidity). Only in this way will it be possible to obtain a clear view of any adverse, indirect effects in vulnerable groups.

Information on the pathogen involved is often lacking. As a result, it is not clear exactly what effect pneumococcal vaccination is having on pneumonia and ear infections, both in young children and in the rest of the population. To better understand the effects of vaccination on respiratory tract infections, especially pneumonia, the monitoring of such disorders needs to be augmented to include details of the pathogens involved.