

Pneumococcal Vaccination in Developing Countries

C Parker

Introduction

Pneumonia is one of the biggest killers in children under 5 in economically poor countries. This paper examines whether the use of pneumococcal conjugate vaccine is likely to be effective in preventing illness and practical as a long-term solution.

Epidemiology of Pneumococcal Disease

Pneumococcal pneumonia is spread from person to person via respiratory droplets and saliva. In the elderly it is most common during winter months. Pneumococcal disease can lead to disability and death mostly in the very young, the elderly, the poor and those with HIV/AIDS. HIV increases the risk of pneumococcal disease by 20-40 times.⁴ Worldwide, pneumonia causes 1.9 million of the 10 million deaths in children annually. In developing countries it is the leading direct cause of death in children under five and kills more children than AIDs, measles and malaria combined (table 1). In developing countries the incidence of pneumococcal disease is often unclear in neonates, older children and adults due to lack of data. Problems collecting surveillance data and testing laboratory specimens makes it harder to introduce reliable preventative measures. Most cases occur in Sub-Saharan Africa and Asia. Of 6 million children in Kenya, it is estimated that 250,000 will be affected.² In the UK, children receive the pneumococcal vaccination as part of the national immunisation schedule at about 2 years of age. In 2005 only 731 children in England and Wales contracted pneumonia.³

Most acute respiratory infections cause mild illness, however in immunocompromised patients such as those with HIV, these infections can be severe, especially when occurring in conjunction with diarrhoea or malaria¹. Pneumococcal pneumonia and meningitis can occur together. Apart from poor sanitation and water supply, the WHO recognises that pneumococcal disease has the most significant impact on health in poorer countries.²

Treatment and Prevention

Pneumococcal infection is treated with antibiotics. In developed countries like the UK they can only be acquired with prescription whereas in developing countries these antibiotics are often available over the counter. Antibiotics given unnecessarily can contribute to antibiotic resistance. This resistance makes treating the disease more difficult. It is important that health professionals are trained suitably to recognise signs and symptoms of pneumonia and only prescribe antibiotics where appropriate.

Prophylactic cotrimoxazole given to HIV positive children reduces the risk of pneumococcal disease as well as *Pneumocystis jiroveci* pneumonia (PJP), a major cause of death in children with HIV. However antibiotic resistance of these organisms to cotrimoxazole is reported to be increasing.¹ Other methods of prevention and treatment include encouraging exclusive breast-feeding, reducing indoor air pollution and giving micronutrient supplements.¹² Difficulties with treatment including drug resistance make the need for effective vaccination all the more important.

Vaccination

Pneumococcal Conjugate Vaccine (PCV) A study looking at the effect of PCV showed that it decreased the prevalence of drug resistant streptococcus pneumoniae in children and older people.⁵ Some other vaccines including those for measles and haemophilus influenza type b. also reduce mortality from pneumonia. PCV developed for children under 5 was introduced in the USA from the year 2000. It is effective against the 7 most common serotypes of *Streptococcus pneumoniae*. After its introduction, the number of hospital admissions for pneumonia declined by 30%, over 8 years: and a decline of 65% where *Streptococcus pneumoniae* was the primary cause.⁶ It is thought that as the number of vaccinated children increases, transmission to those who are unvaccinated decreases due to 'herd immunity' and in the USA herd immunity is thought to prevent twice as many cases as does vaccination.⁴ Also, in a randomised double blind trial, children under 5 years were given the PCV or the meningococcal conjugate

vaccine as a control. 10 of the 11 cases with pneumococcal pneumonia confirmed by blood culture were in the control group, confirming the value of PCV.⁷

Trials in the Gambia have shown that the PCV vaccine has reduced the number of pneumonia cases by 37%, reduced hospital admissions by 15% and reduced mortality by 16%.¹ In Kenya it is estimated that PCV could prevent 200,000 of the 250,000 deaths each year.²

Need for Vaccines

In a survey conducted by the Kenyan Paediatric Association, health professionals were asked about the significance of

Table 1
The percentages of deaths due to cases of pneumonia in children under 5 in different world regions in 20051

REGION	PERCENTAGE
South Asia	21
Sub-Saharan Africa	21
Middle East and North Africa	15
East Asia and Pacific	15
Latin America and Caribbean	14
Central and Eastern Europe and the Commonwealth of Independent states	13
Developing countries as a whole	20
Industrialised world	2
WORLD	19

pneumococcal pneumonia and meningitis. 96.4% agreed that strategies could be successfully implemented in Kenya to reduce pneumococcal disease and 95.7% thought vaccines against pneumonia were as important if not more important than anti-retroviral drugs for HIV infection.⁸ Roughly 65% thought that a vaccine would be more cost effective than treatment for pneumonia when expensive 3rd generation antibiotics had to be used.⁸

The Economic Impact

Pneumococcal disease increases hours of work lost by parents, hospital admissions and the need for expensive treatments. In Kenya, pneumococcal disease is responsible for 1 in 3 hospital admissions.² This results in substantial pressure on limited resources. Children are often left disabled if they survive a pneumococcal infection putting pressure on family members who may be unable to work due to having to provide on-going care at home.

Cost-Effectiveness of Vaccines

Many vaccinations are already shown to be cost effective and available cheaply in the developing world. In terms of prevention of disease vaccination is the most effective intervention. Providing vaccination for young children should also confer herd immunity, as described above, helping to prevent spread within the community. From a study in 76 developing countries it was concluded that PCV prevented 262,000 deaths per year in children aged 3-29 months and also reduced disabilities. The number was measured as 8.34 million disability-adjusted life years (DALYs). DALYs take into account the number of children left suffering, those who are disabled and those who die. It is a measurement of the overall disease burden.

At £3 per dose the one-off cost for a single campaign to vaccinate all children under 5 would be £517 million. Within the 76 countries the calculated cost of £61.78 per DALY would also be saved. In countries deemed eligible by the Global Alliance for Vaccine and Immunisation (GAVI) this would be cost-effective compared to the countries expenditure per DALY.⁹

The Role of Pharmaceutical Companies

In June 2011 Glaxo-Smith-Kline reduced vaccine costs of PCV to cost price for the world's poorest countries in a bid to help GAVI reduce its estimated £2.2 billion requirement. Other pharmaceutical companies such as Johnson & Johnson and Merck & Co also committed to a reduction in price. The rotavirus vaccine, offered in conjunction with the pneumococcal vaccine, will be reduced by 67%, at £1.50 per dose.¹⁰ Glaxo-Smith-Kline has taken a tiered approach - for example in the USA prices are £31 per dose of vaccine, for private markets in Uganda £4.30 and for the poorest £1.50. When a third of emerging markets for vaccine are in the developing world, drug companies are being encouraged to make reductions and offer a business model globally.

The Future: Change is on the Way:

World leaders were brought together on 13/6/11 to discuss the need for vaccines in developing countries. The UK Government took a lead encouraging other countries to contribute. £2.65 billion was pledged which overshoot the initial target of £2.2 billion, making it a historic event. £366 million will train people to inject the vaccines, recruit and maintain doctors and nurses and this will have a long-term benefit. The reduction in vaccine prices by pharmaceutical companies means that the Millennium Development Goal (MDG) 4 to reduce childhood mortality is a feasible target. GAVI must now ensure vaccines get to the people that need them.

The Effect on Social and Economic Development

Reducing child mortality usually means women will have fewer children as survival in childhood improves. With a smaller population eventually there should be less pressure on food production and a decreasing number affected by poverty. As more children survive beyond 5 years they will be able to contribute more to the family unit, receive education and contribute to their country's development. This could also lead to a more sustainable country, able to provide for itself. Countries such as Kenya would rely less on other countries for economic and other support such as food donations. Child death and mal-nutrition also cause a loss in productivity and it has been estimated that raising life expectancy could improve infrastructure with economic growth increasing income by 10% after 20 years.¹¹ Also a decrease in the need for hospital admissions should remove some pressure on health systems allowing healthcare services to focus more on health promotion, for example, providing preventative programmes against malaria and HIV/AIDs.

Conclusion

- Pneumonia is a preventable disease that kills 1.9 million of the world's children each year.
- Recognition of the disease needs to improve.
- Vaccines are a cost-effective solution to an illness where there is a problem with increasing antibiotic resistance.
- GAVI has been promised the necessary funding and is now taking major steps to ensure that the world's poorest children receive the vaccine. Pharmaceutical companies have aided this process by reducing vaccine prices for poorer countries. This signifies a major change in terms of shaping the pharmaceutical market and for the future of Global Aid.
- The effectiveness of PCV programmes needs to be monitored closely, examining the extent that serotypes are covered by the vaccines; non-vaccinated serotypes and 'replacement' diseases may develop.
- Reaching the Millennium Development Goals by 2015 is a feasible target, which would mean 4 million children's lives would be saved allowing them to be educated and contribute to their country's development.

Catriona Parker, 3rd year medical Student, Glasgow University.

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