

Review

Pneumococcal polysaccharide vaccination in Australia

An examination of barriers and arguments in support of the hospital based approach

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Pneumococcal disease is a major cause of morbidity and mortality, arguably responsible worldwide for more deaths than any other single pathogen. Despite the severe impact of pneumococcal disease and the availability of a safe, efficacious and cost-effective vaccine, vaccination rates have generally remained far below targets. Since 2005 a publicly funded program offering free pneumococcal polysaccharide vaccine for at-risk patients has been implemented in Australia, and early data suggest that this change has had a major positive impact on pneumococcal vaccination rates. However, rates still remain far below the ideal. A literature review identified physician related factors as the major impediment to raising vaccination rates and the use of hospital based vaccination strategies as a potentially useful response.

Introduction

Invasive infection by *Streptococcus pneumoniae* (pneumococcus) is an important cause of morbidity and mortality, particularly in infants, individuals with chronic health conditions and those older than 65 years of age. The most common cause of community-acquired pneumonia,¹ pneumococcus also manifests as a broad spectrum of other disease: upper-respiratory tract infection, otitis media and invasive infections such as bacteraemia and meningitis.² World-wide, pneumococcus is arguably responsible for more deaths than any other single pathogen,³ causing between one and two million deaths per year in children below five years of age and probably similar numbers amongst adults.⁴ In an effort to optimize public health responses to this disease, a literature review was conducted. Physician related factors were identified as a key area of concern in vaccine delivery, and the suggestion of moving towards a hospital-based approach to pneumococcal vaccination was considered.

The Incidence of Pneumococcal Disease

Due to the problematic nature of precisely determining the cause of unspecified pneumonia, the exact incidence of pneumococcal infection is difficult to determine. As the subset of patients with

invasive pneumococcal disease (IPD) can provide an unambiguous diagnosis, IPD incidence rates are frequently used as a barometer of overall pneumococcal disease incidence. A wide variety of studies have supported the conclusion that the annual rates of IPD amongst elderly people (≥ 65 years in age) in the developed world are probably ≥ 50 cases per 100,000 persons.⁵ As 10–20% of cases of pneumococcal pneumonia show a positive blood culture for IPD and 80–90% of adult IPD cases are due to bacteraemic pneumococcal pneumonia,⁵ rates of pneumococcal pneumonia amongst the elderly in the developed world may be expected to be at least two cases per 1,000 population and are quite likely significantly higher.

Pneumococcal rates in the developing world, although somewhat worse, appear to be within a similar order of magnitude.⁵ Rates of IPD amongst HIV-seronegative adults over 65 years of age in a South African study were found to be 64 per 100,000.⁶ However, this picture is likely to worsen in the near future due to the growing impact of HIV/AIDS, as the same study found IPD rates of 197 per 100,000 in HIV-seropositive adults aged 18–40 years.⁶

The primary difference between the developed and the developing world in the case of pneumococcal infection is that of mortality.⁵ Mortality rates in the developing world greatly exceed those in the developed world; the results of a vaccine efficacy study in Papua New Guinea suggested that pneumococcal disease may have previously been responsible for 21% of all deaths in the area.⁵ Although the pattern of infection is broadly similar in both developed and developing countries (being concentrated in infants and the elderly), the pattern of mortality differs. In the developed world, pneumococcal mortality is now almost entirely concentrated amongst the elderly, whereas in the developing world it remains a significant cause of infant death.⁷

Australia is a notable exception to the standard pattern of infection. Despite Australia's position as a wealthy developed nation with access to the full range of medical resources, rates of pneumococcal disease amongst Australian indigenous communities are even worse than those of the developing world.⁸ Rates of IPD infection in all age groups of the indigenous community are up to 75 times higher than those of the non-indigenous Australian population and IPD rates amongst indigenous Australian children are the highest recorded anywhere in the world.³ The unique position of Australia as a country which has both an extremely high incidence of IPD (amongst this subset of the population) and sufficient wealth to respond effectively to the problem provides an overwhelming moral imperative to act.

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A number of vaccines are now available to prevent pneumococcal disease. Although there is still some confusion as to vaccine efficacy against all-cause pneumonia,⁹ solid evidence does exist to support the efficacy of existing vaccines against IPD in adults.¹⁰ Despite the availability of effective vaccines, vaccination rates around the world have generally remained extremely low.^{11,12} However, public funding for the pneumococcal polysaccharide vaccine at State and Federal level in Australia appears to be having a dramatic impact on vaccination rates.^{13,14} In the state of Victoria, within two years of introducing public funding, pneumococcal vaccination rates in at-risk groups rose from 7% to 51%.¹⁴ As similar funding arrangements have now been introduced across the country, a matching improvement would be expected Australia-wide, and early research shows that this appears to be the case.¹³ While this is a positive development, room remains for substantial further improvement.

Barriers to Treatment

Studies of vaccination rates have repeatedly found that the major determining factor of vaccination is physician recommendation.¹⁵⁻¹⁷ Simply put, if medical practitioners offer and advocate vaccination to their patients, then the great majority of patients will accept it, even when the patient holds negative attitudes towards vaccination.¹⁵ The largest cause of missed opportunities is the failure of physicians to offer vaccination.¹⁶

Doubts amongst physicians as to the efficacy of pneumococcal vaccination do not appear to play a significant part in physicians' failure to offer the pneumococcal vaccine,^{17,18} although difficulties in determining the vaccination status of patients and uncertainty as to the safety of revaccination may play a role.¹⁷ The increasing mobility of patients and subsequent decrease in longevity of patient-physician relationships is likely to aggravate such issues. As pneumococcal disease presents a serious risk of mortality in elderly patients and there is no significant danger in repeated vaccination with pneumococcal vaccine,^{19,20} an approach that treats unknown vaccination status as unvaccinated is warranted. Improved physician education in regards to this factor could be worthwhile.

It has clearly and repeatedly been shown that the major barrier to raising pneumococcal vaccination rates is the failure of physicians to offer vaccination.¹⁵⁻¹⁷ Generally speaking, physicians are aware of the benefits of pneumococcal vaccination and at least claim to support the extension of its use.^{18,22} But for a substantial proportion of physicians, such words are not matched by deeds.^{19,21}

A Possible Solution: The Hospital Based Approach

An approach to raising pneumococcal vaccination rates that has been strongly advocated by a number of authors^{22,23} is to make the offering of pneumococcal vaccination a routine part of hospital inpatient care for all at-risk patients. Such programs have been found to be highly effective at raising vaccination rates, particularly when they are implemented in the form of standing orders authorizing nurses or pharmacists to administer vaccinations without an individual physician order for each patient.^{19,24-26}

The benefits of this approach are two-fold. Firstly, it overcomes the main cause of missed vaccination opportunities (physicians' failure to offer vaccination); secondly, it effectively targets vaccination at those patients who are at the highest risk of pneumococcal morbidity and mortality. Recent hospitalization is a highly valuable indicator of

future pneumococcal related hospitalization, as up to two-thirds of patients with pneumococcal bacteremia have been discharged from hospital at least once within the previous five years.²²

Although physician recommendations are the strongest determining factor, patient attitudes do still play a role, with patients' perceived usefulness of vaccination being significantly and independently associated with vaccination status.^{16,27} Any change to emphasize hospital-based vaccination may fail to succeed if there is a substantial difference in patient acceptance of vaccination efforts from sources other than their personal physician.

The importance of vaccination in combating pneumococcal disease amongst the elderly cannot be overstated. Even with the best available antibiotic treatments, mortality rates for pneumonia amongst elderly patients exceed 20%.¹⁴ Due to the aging of the Australian population and the increasing antibiotic resistance amongst many strains of pneumococcus, this situation is likely to worsen considerably in the future.²⁸ This is particularly the case in regards to indigenous Australians, as levels of antibiotic resistance in the strains of pneumococcus common in indigenous communities are already much higher than is usually the case.^{8,29}

Efforts to raise vaccination levels have relevance beyond the specific situation of pneumococcal disease in Australia. Increasing levels of antibiotic resistance in a variety of pathogens and the aging population of the developed world are likely to continue to increase the importance of preventative medicine for a wide variety of diseases, particularly in regard to elderly patients. It is increasingly vital that we discover means of effectively delivering preventative interventions such as vaccinations to elderly patient groups.

In order to substantially impact vaccination rates, we must alter physician behavior. However, the diffuse and independent nature of medical authority in Australia and many other countries renders the achievement of such a goal (altering the behavior of physicians in relation to pneumococcal vaccination) problematic. There is no central authority available through which to conclusively instruct general practitioners to offer vaccination to their patients. The only tools generally available to researchers to alter medical practices are those of education and persuasion, and it has been convincingly shown that the problem is not one of education.

A significant advantage of the hospital based approach to vaccination is the availability of a more centralized authority. Instead of changing the behavior of large numbers of independent general practitioners, improvement could be implemented through the organizational changes flowing from the managerial decisions of a few senior hospital staff. The introduction of standing orders to offer vaccination to all at-risk hospital patients is an achievable goal that, while not a complete solution, could do much to lessen the impact of pneumococcal disease. It is also a goal that could have an immediate impact, whereas any further attempt to solve the apparently intractable problem of physicians' failure to deliver pneumococcal vaccinations appears bound to be a long term project.

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References

1. Andrews RM, Lester RA. Improving pneumococcal vaccination coverage among older people in Victoria. *The Medical Journal of Australia* 2000; 173:45-7.
2. Jefferson T, Demicheli V. Polysaccharide pneumococcal vaccines. *British Medical Journal (International edition)* 2002; 325:292-3.
3. Forrest JM, McIntyre PB, Burgess MA. Pneumococcal disease in Australia. *Communicable Diseases Intelligence* 2000; 24:89-92.
4. Mulholland K. Strategies for the control of pneumococcal diseases. *Vaccine* 1999; 17:79-84.
5. Fedson DS, Scott JAG. The burden of pneumococcal disease among adults in developed and developing countries: what is and is not known. *Vaccine* 1999; 17:11-8.
6. Jones N, Huebner R, Khoosal M, Crewe-Brown H, Klugman K. The impact of HIV on *Streptococcus pneumoniae* bacteraemia in a South African population. *AIDS* 1998; 12:2177-84.
7. Örtqvist Å, Hedlund J, Kalin M. *Streptococcus pneumoniae*: Epidemiology, Risk Factors, and Clinical Features. *Seminars in Respiratory and Critical Care Medicine* 2005; 26:563-74.
8. Krause VL, Reid SJC, Merianos A. Invasive pneumococcal disease in the Northern Territory of Australia, 1994-1998. *The Medical Journal of Australia* 2000; 173:27-31.
9. Skull SA, Andrews RM, Byrnes GB, Kelly NA, Nolan TM, Brown GV, et al. Prevention of community-acquired pneumonia among a cohort of hospitalized elderly: benefit due to influenza and pneumococcal vaccination not demonstrated. *Vaccine* 2007; 25:4631-40.
10. Dear KBG, Andrews RR, Holden J, Tatham DP. Vaccines for preventing pneumococcal infection in adults (Review). *The Cochrane Library* 2006; 4:1-36.
11. Fedson DS. Pneumococcal Vaccination in the United States and 20 Other Developed Countries, 1981-1996. *Clinical Infectious Diseases* 1998; 26:1117-23.
12. Plotkin SA, Orenstein WA. *Vaccines*. Philadelphia, PA: Saunders 2004.
13. Ridida I, MacIntyre CR, Lindley IR, McIntyre PB, Sullivan J, Gilbert GL, Kovoov P, Monolios N, Fox J. Predictors of pneumococcal vaccination uptake in hospitalised patients aged ≥ 65 years shortly following the commencement of a publicly funded pneumococcal vaccination program in Australia. *Human Vaccines* 2007; 3:83-6.
14. Andrews RM, Counahan ML, Hogg GG, McIntyre PB. Effectiveness of a publicly funded pneumococcal vaccination program against invasive pneumococcal disease among the elderly in Victoria, Australia. *Vaccine* 2004; 23:132-8.
15. Zimmerman RK, Santibanez TA, Fine MJ, Janosky JE, Nowalk MP, Bardella JJ, Raymond M, Wilson SA. Barriers and facilitators of pneumococcal vaccination among the elderly. *Vaccine* 2003; 21:1510-7.
16. Bovier PA, Chamot E, Gallacchi MB, Loutan L. Importance of patients' perceptions and general practitioners' recommendations in understanding missed opportunities for immunisations in Swiss adults. *Vaccine* 2001; 19:4760-7.
17. Mieczkowski TA, Wilson SA. Adult pneumococcal vaccination: a review of physician and patient barriers. *Vaccine* 2002; 20:1383-92.
18. Metersky ML, Mennone JZ, Fine JM. Factors Inhibiting Use of the Pneumococcal Polysaccharide Vaccine: A Survey of Connecticut Physicians. *Connecticut Medicine* 1998; 62:649-54.
19. Fedson DS. Clinical practice and public policy for influenza and pneumococcal vaccination of the elderly. *Clinics in Geriatric Medicine* 1992; 8:183-99.
20. Jackson LA, Benson P, Sneller VP, Butler JC, Thompson RS, Chen RT, Lewis LS, Carlone G, DeStefano F, Holder P, Lezhava T, Williams WW. Safety of Revaccination With Pneumococcal Polysaccharide Vaccine. *JAMA* 1999; 281:243-8.
21. Fedson DS. Adult Immunization: Summary of the National Vaccine Advisory Committee Report. *JAMA* 1994; 272:1133-7.
22. Fedson DS. Influenza and Pneumococcal Immunization Strategies for Physicians. *Chest* 1987; 91:436-43.
23. Williams WM, Hickson MA, Kane MA, Kendal AP, Spika JS, Hinman AR. Immunization Policies and Vaccine Coverage Among Adults: The Risk for Missed Opportunities. *Annals of Internal Medicine* 1988; 108:616-25.
24. Fedson DS. Influenza Prevention and Control: Past Practices and Future Prospects. *The American Journal of Medicine* 1987; 82:42-7.
25. Fedson DS, Houck P, Bratzler D. Hospital-based influenza and pneumococcal vaccination: Sutton's Law applied to prevention. *Infect Control Hosp Epidemiol* 2000; 21:692-9.
26. Sokos DR, Skledar SJ, Ervin KA, Nowalk MP, Zimmerman RK, Fox DE, Middleton DB. Designing and implementing a hospital-based vaccine standing orders program. *Am J Health Syst Pharm* 2007; 64:1096-102.
27. Ridida I, Motbey C, Lam L, Lindley IR, McIntyre PB, Macintyre CR. Factors associated with pneumococcal immunization among hospitalised elderly persons: A survey of patient's perception, attitude and knowledge. *Vaccine* 2008; 26:234-40.
28. Turnidge JD, Bell JM, Collignon PJ. Rapidly emerging antimicrobial resistances in *Streptococcus pneumoniae* in Australia. *Medical Journal of Australia* 1999; 170:152-5.
29. Collignon PJ, Turnidge JD. Antibiotic resistance in *Streptococcus pneumoniae*. *The Medical Journal of Australia* 2000; 173:58-63.