Australian Society for Geriatric Medicine
Position Statement No. 7
Immunisation of Older People – Revision
Revised 2004

Compared with younger people, older people have a greater incidence of most infectious diseases, and often respond less well to treatment. Thus prevention of infections is particularly important, and immunisation has been shown to be effective for several infectious diseases. There is, however, evidence of under-utilisation of effective vaccines in all age groups, including older people and those who care for them. With this as a background, the ASGM recommends the following:

1. Influenza Vaccine

Yearly vaccine with the current vaccine is recommended for:

- All people over age 65;
- Aboriginals and Torres Strait Islanders over age 50;
- All residents of residential and long-term care facilities;

The exception to the recommendations is:

- Those with allergies to egg products.

Regular, repeated vaccination may be more effective than first-time vaccination. Newer vaccines and augmentation (eg by micronutrient supplement in undernourished elderly people) need to be considered as more evidence of efficacy becomes available. Neuraminidase inhibitors are effective in both preventing and treating influenza, but should not replace vaccination.

2. Pneumococcal Vaccine

Vaccination with the current 23-valent vaccine is recommended for unvaccinated people over age 65, especially in those who have increased risk of pneumococcal infection, including:

- Chronic heart or lung disease
- Diabetes mellitus
- Asplenia
- Malignancy.

Revaccination should be considered once after five to six years but not before 3 years.

This Position Statement represents the views of the Australian Society for Geriatric Medicine. This Statement was approved by the Federal Council of the ASGM on 9 November 2004. This revision was coordinated by Assoc. Professor Michael Woodward.

3. Tetanus Vaccine

Previously unvaccinated people should have primary course of two doses 1-2 months apart, followed by a third dose 6-12 months later. Where there is any uncertainty about primary vaccination, this should be repeated.

Vaccination with tetanus toxoid should be maintained with 10-yearly boosters.

4. Other Vaccines

There is insufficient evidence to justify routine vaccination of older people with other vaccines. Certain higher-risk older adults warrant consideration for a range of vaccines.

5. Recommendations to Increase Vaccine Utilisation

Various methods can be adopted to improve use of vaccines in appropriate older people.

Higher risk older populations should be particularly targeted, including those with chronic cardiac and respiratory disease, diabetes and those with malignancy. Specific activities to reach these groups include support groups, healthcare facility activities and disease-specific pamphlets.

6. Recommendations for Vaccinating Staff Caring For Older People

It is recommended that staff in regular contact with older hospital patients or with residents of longer-term care facilities, be vaccinated annually against influenza. Healthcare workers should be vaccinated against Hepatitis A and those potentially in contact with blood should also be vaccinated against Hepatitis B.

BACKGROUND PAPER

INFLUENZA VACCINATION

Epidemiology

Influenza shows marked seasonal variations, but at all times there is greater attack rate among older and among institutionalised people. The great pandemics, such as the 1918 outbreak, are caused by antigenic shift, which may occur when avian influenza and human influenza co-infect a host. Some 3,000 to 7,000 excess deaths occur in Australia during a major influenza outbreak. Deaths in severe epidemics can exceed 10,000.[1] A larger

scale study on influenza related mortality[2] in two influenza A epidemics reported that 11 to 13 excess deaths occurred per 100,000 persons, but in those aged 65 and older, the incidence of excess deaths increased to between 68 and 104 per 100,000.

Vaccine Efficacy

In a recent very large community study (N=286,383) of those over age 65, influenza vaccination was associated with a reduction in the risk of hospitalisation for cardiac disease (19%, p<.001), cardiovascular disease (16% one year and 23% the following year, p<.018 and p <.001 respectively) and a reduction in the risk of death from all causes (48% one year, p<.001, and 50% the following year, p<.001).[3] The vaccine is effective in low, intermediate and high-risk elderly community-dwelling people.[4] Influenza particularly increases hospitalisation and deaths in elderly nursing home residents each winter.[5]

There have been numerous case-controlled and cohort observational studies, and one randomised double-blind placebo-controlled trial of vaccine efficacy.[6] A meta-analysis and literature review[7] concluded that cohort studies demonstrated vaccine efficacy in older people of 56% for preventing respiratory illness, 53% for preventing pneumonia, 50% for preventing hospitalisation, and 68% for preventing deaths. Case-controlled studies demonstrated vaccine efficacy of 32-45% for preventing hospitalisation from pneumonia, 31-65% for preventing hospital deaths from pneumonia and influenza, 43-50% for preventing hospital deaths from all respiratory conditions and 27-30% for preventing deaths from all causes. The one randomised placebo-controlled trial showed a 50% or greater reduction in influenza related illness.

While not supported by data, the recommendation to vaccinate Aboriginals and Torres Strait Islanders earlier is justified epidemiologically.

It is probable that for greater proportions of residents vaccinated in residential care facilities, there is less likelihood of an influenza breakout in the home. Thus, attempts should be made to protect residents by vaccinating all – even those whose quality of life may not warrant their individual vaccination.

Cost Effectiveness

Some 10 studies have evaluated the cost effectiveness of influenza vaccination. These have recently been reviewed.[8] Influenza vaccination, particularly among elderly people at higher risk, was generally found to be cost saving.

Adverse Effects of Vaccine

A randomised placebo controlled trial of the 1988/89 trivalent split-antigen vaccine in 336 people over the age of 65 showed no significant difference between influenza vaccine and placebo with respect to the proportion of subjects reporting disability or systemic symptoms.[9] However, local tenderness does occur in around 30% of recipients of the current vaccine.[10] Although there are isolated reports of serious adverse events such as rheumatic conditions, these have not been established as directly caused by the vaccine. The risk of the vaccine causing Guillain-Barre syndrome is very small – probably no more than one excess case per million vaccinated although it is not known if this rate is higher in older people.[11]

Methods to Increase Vaccine Usage

The uptake rate of influenza vaccine by Australians over 65 is 77% and even higher (87%) in residential care.[12] Higher risk people are more likely to be vaccinated than lower risk people[13] suggesting that the main target group should be healthy elderly.

Strategies to increase uptake include advice from the healthcare worker (especially from the doctor), reminder notices through mail or by telephone, and institutional policies to offer the vaccine to all residents/patients or to vaccinate all unless they refuse.[14,15,16,17] Strategies are less effective when there is a higher background immunisation rate. General advertising campaigns (eg the frequent 'killer flu approaches' headlines) seem less effective, especially in non-epidemic years. Establishing vaccination 'stations' in busy clinic areas is another strategy.

Other trialed strategies include vaccinating inpatients on hospital discharge, specialists emphasising and individualising vaccination advice in their communications with primary care physicians, using educational forums to emphasise the benefits of and the barriers to vaccination, setting up displays in communal areas including pharmacy shop-fronts, and rewarding doctors for achieving certain vaccination rates. Van Essen and colleagues[18] have shown that the main factors leading to non-compliance in older people are fear of side-effects of the vaccine and perceived good health, so the low incidence of side-effects and information that the vaccine is protective against influenza even for those in good health need to be emphasised.

Benefits of Repeated Vaccination

Influenza vaccine efficacy is probably greater after repeated annual vaccination, compared with after first administration. In a case controlled study of 315 patients who died of influenza and 777 controls, the odds ratio for certified influenza death was 0.91 for first time vaccinees and 0.25 for those vaccinated in the study year and previously.[19]

Newer Vaccines/Augmentation

Antibody responses in older men have been shown to be enhanced by augmentation with thymosin alpha one[20] and combined live intranasal and inactivated influenza A virus vaccine has been shown to be more effective than the inactivated virus alone[21] The mucosal (intranasal) vaccine may overcome immunoscenescence[22] however at least one trial has been halted because of a greater incidence of Bell's palsy in the

vaccinated group[23]. Undernourished older people may be particularly prone to a poor antibody response to vaccination[24] and this may be overcome by a short period of micronutrient supplementation.[25] However, it may be that greater benefit will be achieved by improving uptake of the current vaccine.[26]

Antiviral Drugs

Amantadine is effective against influenza A and should be considered for prophylactic use in healthcare and residential care facilities during influenza outbreaks.[27] Neuraminidase Inhibitors (oseltamivir and zanamavir) have been proven effective in both treating (reducing symptoms by a mean 0.9 days) and preventing influenza in the elderly and other high-risk groups, including those in residential care [28, 29, 30] However, antiviral drugs should not replace vaccination.[31] Older people may have difficulty using the administration device with zanamavir.[32]

Influenza Vaccination of Healthcare Workers

Healthcare workers are a potential reservoir of influenza in nursing home residents and hospitalised patients, and should be a target group of any vaccination program. In a study of 1,059 residents from 12 long-term aged care facilities in Glasgow, vaccination of healthcare workers significantly decreased total mortality among residents from 17% to 10% (odds ratio 0.56; 95% confidence intervals (0.40 – 0.80). Vaccination of the residents themselves did not significantly effect mortality in this study.[33] Other studies have shown similar benefits.[34,35] Also, vaccinating healthcare workers is likely to be cost effective to their employer, through reducing days off work due to illness.[36] Despite this, baseline vaccination rates of healthcare workers is generally around 5-10%. Strategies to improve vaccination include educational programs, offering free vaccine, maintaining a vaccine status register and directly requesting healthcare workers to be vaccinated. Thomas et al[37] showed that these types of interventions could increase vaccination rates to over 50%, but this is still short of the 90-95% probably required to achieve herd immunity in an institution.

PNEUMOCOCCAL VACCINATION

Epidemiology

Acute pneumonia in the elderly is a common problem, with greater total numbers affected as the population ages. Mortality is high, ranging from 24% to 31%in hospital series. In Victoria (Australia), the annual incidence of pneumococcal pneumonia and bacteraemia rises exponentially after age 50, to nearly 200 per 100,000 by age 80.[38] Pneumonia accounted for 82% of diagnoses of those over age 65 with Streptococcus pneumonia. Nearly all are admitted to hospital, with mean duration of hospital stay rising with age – from 6 days for those under 65 to 13 days for those over age 65. Earlier data (unpublished) from the same group indicated that 83% of those over age 60 with pneumococcal blood or CSF infection had a predisposing illness (chronic respiratory disease 45%, cardiovascular disease 34%, malignancy 23% and diabetes 18%).

Antibiotic Resistance

In a total of 2,396 sequential isolates from hospital and private laboratories in Australia in 1996, Collignon and Bell[39] found 6.7% of S pneumonia were penicillin resistant, with higher resistance rates for erythromycin (10.8%), tetracycline (15.2%) and trimethoprim sulphamethoxazole (41.9%). Risk factors for infection with resistant organisms include age greater than 70, prolonged hospitalisation and attendance at a day care centre.[40] World-wide, penicillin resistance has been found to be as high as 79.7%[41]. Multidrug-resistant S. pneumonia can cause outbreaks of pneumonia and bacteraemia in residential care facilities.[42] Pneumococcal vaccine use may help avoid the problem of antibiotic resistance.

Pneumococcal Vaccine Efficacy

The current vaccine immunises against 23 of the common pneumococci serotypes – these serotypes are estimated to cause 88% of cases of pneumococcal bacteraemia. Recent Victorian data confirms this – in 812 pneumococcal isolates from sterile site infections in those over age 2, 91% belonged to serotypes contained within the 23-valent polysaccharide vaccine.[38]

A Veterans' Administration Co-operative Study[43] found that among elderly vaccine recipients who subsequently had vaccine-type pneumonia or bronchitis, the majority did not make or sustain sufficient serum antibodies against their infecting organism. An earlier study, however, showed an antibody response by elderly individuals similar to that of younger adults.[44] Given that there is potential concern about the antibody responses of older people, clinical efficacy studies are required to determine the value of the vaccine. These have been reviewed[45] and subject more recently to a Cochrane meta-analysis.[46] The efficacy of the vaccine in preventing pneumonia has been estimated in recent studies to be between 70% and 77%, although one study[47] showed lower efficacy in patients over 85 and those with longer time since vaccination.

An indirect cohort analysis[48] demonstrated an overall efficacy for preventing infection caused by serotypes included in the vaccine at 57%. Efficacy among persons with diabetes mellitus was 84%, with coronary vascular disease 73%, with congestive cardiac failure 69%, with chronic pulmonary diseases 65% and with anatomic asplenia 77%. Efficacy for immunocompetent persons older than 65 years was 75%.

In a more recent study among 2,837 older age people, pneumococcal vaccination provided statistically significant protective efficacy of 59% in those with medical risk factors for pneumonia (34% of the group), although vaccination did not protect from

pneumococcal pneumonia in the study group as a whole.[49] Because targeted vaccination of at-risk older people may be difficult and because the at-risk subgroup was a substantial proportion of the total population, the authors recommended vaccinating all older people.

There is little doubt about the efficacy of the vaccine in preventing invasive (ie not just pneumonia) pneumococcal disease, but it is unlikely that there will be more convincing data about the current vaccine's efficacy in preventing pneumonia or mortality in older people. It is notable that after the introduction of free vaccine in Victoria, Australia, overall hospitalisation with pneumococcal pneumonia fell by 39%.[50] A huge recent retrospective cohort study (47,365 people over age 65) showed that receipt of pneumococcal polysaccharide 23 – valent vaccine was associated with a significant reduction in the risk of pneumococcal bacteraemia (hazard ratio 0.56, 95% confidence interval 0.33 to 0.93) but vaccination did not alter the risk of outpatient pneumonia and slightly increased the risk of hospitalisation (hazard ratio 1.14, 95% confidence interval 1.02 – 1.25).[51] A recent Australian analysis in those over age 65 of the cost of vaccination to prevent one hospitalisation from invasive pneumococcal disease showed the pneumococcal vaccine to be of similar cost effectiveness to the influenza vaccine in preventing hospitalisation ($11,494 compared to $10,787 respectively) and more cost effective in preventing death from invasive pneumococcal disease ($49,972 per death prevented each year) than influenza vaccination ($74,801 per death prevented each year).[52]

As invasive pneumococcal disease is associated with high mortality, a vaccine which reduces this is clinically justified. In addition, elderly people have a significant prevalence of coexisting chronic illness, for which the vaccine is most effective. Thus, it is safer simply to vaccinate all older people, the approach taken in Australia, where the National Health & Medical Research Council in Australia has recommended vaccinating all people over age 65.[53]

Advisory committees in the US and Canada, and the World Health Organisation, have variously recommended vaccinating all people over the age of 55 or 65.

Adverse Effects/Safety

Approximately 50% of people given polysaccharide pneumococcal vaccine develop mild side effects such as erythema and pain at the injection site. Fever, myalgia and severe local reactions have been reported in less than 1% of those vaccinated. Severe systemic reaction, such as anaphylaxis, have rarely been reported.

Vaccine Usage and Methods to Increase Usage

Figures from the US[54] show that in 1985 only 10-15% of the target population received pneumococcal vaccination. Another study on US elderly Medicare beneficiaries showed a 5.3% vaccine uptake.[55] The free vaccination campaign in Victoria was estimated in 1998 to have increased vaccination to 42% in those over age 65[56] and more recent USA figures found 33.5% of hospitalised patients over age 65 had received the vaccine prior to hospitalisation.[57]

The strategies to increase vaccine uptake are similar to those for influenza vaccination, but greater emphasis need to be placed on convincing healthcare professionals of the need for and effectiveness of the vaccine, as this knowledge is less widespread than it is for influenza vaccination. In a recent US study, only 81% of specialist physicians strongly recommended pneumococcal vaccinations to their elderly patients[58] Suggesting co-administration of influenza and pneumococcal vaccine, which is safe and does not reduce efficacy of either, is another strategy to increase utilisation, and is practical as those over 65 are recommended to have both. Co-administration may slightly increase the risk of local reactions (from 28% to 44%)[10] but has not been associated with an increased risk of serious reactions.

Revaccination

Antibody levels have been shown to fall after pneumococcal vaccination.[59] In frail chronically ill older nursing home residents, revaccination at least 5 years after primary vaccination was associated with a significant immunological response (greater than 1.4 fold increase in antibodies against 6 serotypes assessed), and was well tolerated.[60] There is no evidence about the additional efficacy of revaccination in preventing pneumococcal disease. At this stage, most public health policy recommends one revaccination after 5-6 years. Local reactions may be increased if revaccination occurs within 3 years.

Tetanus Vaccination

In Australia, since 1980, 80% of tetanus notifications and 90% of tetanus deaths have been in adults over 50 years of age[61, 62] and in the US, 60% of cases occur in persons older than age 60.[63]

Almost all adult cases of tetanus occur in those who never completed a primary childhood immunisation series. A history of immunisation from patients, families or medical charts may be an unreliable indicator of tetanus immunity. Thus, the main thrust of any adult tetanus vaccination policy should be to ensure that everyone receives a primary immunisation series and boosters.

Seroprevalence studies in the US have shown that more than half the adults lack antibody levels that are considered protective against tetanus[64] and support the need to give primary courses and boosters every 10 years, especially to those with tetanus-prone wounds. Older people have a good response to single administration of a single dose of tetanus vaccine.[65] The current (8th) edition of the Australian Immunization Handbook[53] recommends a single booster at age 50.

REFERENCES

1. De Ravin JW, Gerrard PN. The effect of influenza on Australian mortality. Annual Transactions of the Australian Institute of Actuaries 1984; 471-9.
2. Barker WM, Mullooly JP. Impact of epidemic type A influenza in a defined adult population. American Journal of Epidemiology 1980; 112:798-811.
3. Nichol KL. Nordin J, Mullooly J et al. Influenza vaccination and reduction in hospitalisations for cardiac disease and stroke among the elderly. New England Journal of Medicine 2003; 348:1322-32.
4. Nichol KL, Wuorenma J, von Sternberg T. Benefits of influenza vaccination for low, intermediate and high-risk senior citizens. Archives of Internal Medicine 1998; 158:1769-76.
5. Ellis, SE, Coffey CS, Mithel Jr E F et al. Influenza - and respiratory syncytial virus-associated morbidity and mortality in the nursing home population. Journal of the American Geriatrics Society 2003; 51: 761-767.
6. Govaert TM, Thijs CT, Sprenger MJW, et al. The efficacy of influenza vaccination in elderly individuals. Journal of the American Medical Association 1994; 272:1661-5.
7. Gross PA, Hermogenes AW, Sacks HS et al. The efficacy of influenza vaccination in elderly persons: a meta-analysis and review of the literature. Annals of Internal Medicine 1995; 123:518-27.
8. Postma MJ, Baltussen RM, Heijnen M-L A et al. Pharmacoeconomics of influenza vaccination in the elderly. Reviewing the available evidence. Drugs and Aging 2000; 17:217-23.
9. Margolis KL, Nichol KL, Poland GA, Pluhar RE. Frequency of adverse reactions to influenza vaccine in the elderly: a randomised, placebo-controlled trial. Journal of the American Medical Association 1990; 264:1139-41.
10. Honkanen PO, Keistinen T, Kivela SL. Reactions following administration of influenza vaccine along with pneumococcal vaccine to the elderly. Archives of Internal Medicine 1996; 156:205-8.
11. Lasky T, Terracciono GJ, Magder L et al. The Guillain-Barre syndrome and the 1992-1993 and 1993-1994 influenza vaccines. New England Journal of Medicine 1998; 339:1797-802.
12. Australian Institute of Health and Welfare 2004. 2003 Influenza Vaccine Survey. Australian Government Department of Health and Ageing. AIHW cat. no. PHE5I. Canberra.
13. Gillick MR, Ditzion B. Influenza vaccination: are we doing better than we think? Archives of Internal Medicine 1991; 151:1742-4.
14. Setia U, Sereventi I, Lorenz P. Factors affecting the use of influenza vaccine in the institutionalised elderly. Journal of the American Geriatrics Society 1985; 33: 856-8.
15. Nichol KL, Korn JE, Margolis KL. Poland GA et al. Achieving the national health objective for influenza immunisation: success of an institution-wide vaccination program. The American Journal of Medicine 1990; 89:156-60.
16. Verweij M, van den Hoven M. Influenza vaccination rates and informed consent in Dutch nursing homes: survey of nursing home physicians. British Medical Journal 2002; 324:328.
17. Smith DM, Zhou X-H, Weinberger M, Smith F, McDonald RC. Mailed reminders for area-wide influenza immunisation: a randomized controlled trial. Journal of American Geriatrics Society 1999; 47:1-5.
18. Van Essen GA, Kuyvenhoven MM, DeMeiker RU. Why do healthy elderly people fail to comply with influenza vaccination? Age and Ageing 1997; 26:275-9.
19. Ahmed AH, Nicholson KG, Nguyen-Van-Tam JS. Reduction in mortality associated with influenza vaccine during 1989-90 epidemic. Lancet 1995; 346:591-5.
20. Gravenstein S, Duthie EH, Miller BA, Roecker E et al. Augmentation of influenza antibody response in elderly men by thymosin alpha one: a double-blind placebo-controlled clinical study. Journal of the American Geriatrics Society 1989; 37:1-8.
21. Treanor JJ, Mattison R, Dumyati G, Yinnon A, Erb S et al. Protective efficacy of combined live intranasal and inactivated influenza: a virus vaccine in the elderly. Journal of Internal Medicine 1992; 117:625-33.
22. Corrigan EM, Clancy RL. Is there a role for a mucosal influenza vaccine in the elderly? Drugs and Aging 1999; 15:169-81.
23. Mutsch M, Zhou W, Rhodes P et al. Use of the inactivated intranasal influenza vaccine and the risk of Bell's palsy in Switzerland. New England Journal of Medicine 2004; 350:896-903.
24. Potter JM, O'Donnell B, Carman WF, Roberts MA, Stott DJ. Serological response to influenza vaccination and nutritional and functional status of patients in geriatric medical long-term care. Age and Ageing 1999; 28:141-5.
25. Allsup SJ, Shenkin A, Gosney MA et al. Can a short period of micronutrient supplementation in older institutionalised people improve response to influenza vaccine? A randomized, controlled trial. Journal of the American Geriatrics Society 2004; 52:20-4.
26. Fedson DS, Influenza and pneumococcal vaccination of the elderly: newer vaccines and prospects for clinical benefits at the margin. Preventative Medicine 1994; 23:751-5.
27. Couch RB. Prevention and treatment of influenza. New England Journal of Medicine 2000; 343: 1778-87.
28. Hayden FG, Albert DME, Osterhus DUM et al. Efficacy and safety of the neuraminidase inhibitor zanamir in the treatment of influenza virus infections. New England Journal of Medicine 1997; 337:874-80.
29. Peters Jr PH, Gravenstein S, Norwood P et al. Long-term use of oseltamavir for the prophylaxis of influenza in a vaccinated frail population. Journal of American Geriatrics Society 2001; 49:1025-31.
30. Cooper NJ, Sutton AJ, Abrams KR et al. Effectiveness of neuraminidase inhibitors in treatment and prevention of influenza A and B: systematic review and meta-analyses of randomised controlled trials. British Medical Journal 2003; 326:1235-40.
31. Drinka PJ. Influenza vaccination and antiviral therapy. Is there a role for concurrent administration in the institutionalised elderly? Drugs and Ageing 2003; 20:165-74.
32. Diggory P, Fernandez C, Humphrey A, Jones V, Murphy M. Comparison of elderly peoples' technique in using two dry powder inhalers to deliver zanamivir: randomized controlled trial. British Medical Journal 2001; 322:577-9.
33. Potter J, Stott DJ, Roberts MA, Elder AG et al. Influenza vaccinations of health care workers in long-term-care hospitals reduces the mortality of elderly patients. Journal of Infectious Diseases 1997; 175:1-6.

34. Nicholson KG. Should staff in long-stay hospitals for elderly patients be vaccinated against influenza? Lancet 2000; 355:83-4.
35. Carman WF, Elder AG, Wallace LA et al. Effects of influenza vaccination of health care workers on mortality of elderly people in long-term care : a randomized controlled trial. Lancet 2000; 355:93-7.
36. Wilde JA, McMillan JA, Serwint J et al. Effectiveness of influenza vaccine in health care professionals. A randomized trial. Journal of the American Medical Association 1999; 281:908-13.
37. Thomas DR, Winsted B, Koontz C. Improving neglected influenza vaccination among healthcare workers in long term care. Journal of the American Geriatrics Society 1993; 41:928-30.
38. Hogg GG, Strachan JE, Lester RA. Invasive pneumococcal disease in the population of Victoria. Med J Aust 2000; 173: S32-S35.
39. Collignon PJ, Bell JM. Drug-resistant Streptococcus pneumonia: the beginning of the end for many antibiotics? Med J Aust 1996;164:64-7.
40. Caputo GM, Appelbaum PC, Hans HL. Infections due to penicillin-resistant Pneumococci. Archives of Internal Medicine 1993; 153:1301-10.
41. Collignon PJ, Turnidge JD, Antibiotic resistance in Streptococcus pneumonia. Medical Journal of Australia 2000; 1973:S58-S64.
42. Nicorti JP, Butler JC, Crutcher JM et al. An outbreak of multidrug-resistant pneumococcal pneumonia and bacteremia among unvaccinated nursing home residents. New England Journal of Medicine 1998; 338:1861-8.
43. Simberkoff MS, Cross AP. Al-Ibrahim M et al. Efficacy of pneumococcal vaccine in high-risk patients: results of a Veterans Administration Co-operative Study. New England Journal of Medicine 1986; 315:1318-27.
44. Ammann AJ, Schiffman G, Austrian R. The antibody responses to pneumococcal capsular polysaccharides in aged individuals. Proceedings of the Society for Experimental Biology and Medicine 1980; 164:312-6.
45. Woodward M. Pneumococcal vaccine in the elderly. Australian Journal of Hospital Pharmacy 1992; 22:306-9.
46. Dear K, Holden J, Andrews R, Tatham D. Vaccines for preventing pneumococcal infection in adults (Cochrane Review). In: The Cochrane Library, Issue 1, 2004. Chichester, UK; John Wiley & Sons, Ltd.
47. Shapiro ED, Berg AT, Austrian R, et al. The protective efficacy of polyvalent pneumococcal vaccine. New England Journal of Medicine 1991; 325:1453-60.
48. Butler JC, Breiman RF, Campbell JF, Lipman HB, Brown, CV, Facklam RR. Journal of the American Medical Association 1993; 270:1826-31.
49. Koivula I, Sten M, Leinonen M, Makela PH. Clinical efficacy of pneumococcal vaccine in the elderly: a randomised single blind population-based trial. American Journal of Medicine 1997; 103:281-90.
50. Victorian Government Department of Human Services. Influenza and Pneumococcal Pneumonia Immunisation 2001, Hospital and Community Program. Public Health Division, 2001.
51. Jackson LA, Neuzil KM, Yu O et al. Effectiveness of pneumococcal polysaccharide vaccine in older adults. New England Journal of Medicine 2003; 348:1747-55.
52. Kelly H, Attia J, Andrews R, Heller, RF. The number needed to vaccinate (NNV) and population criterions of the NNV: comparison of influenza and pneumococcal vaccine programs for people aged 65 years and over. Vaccine 2004; 22: 2192-8
53. National Health and Medical Research Council. The Australian Immunisation Handbook, 8th Edition 2003. Australian Department of Health and Ageing, Canberra, Sept 2003.
54. Williams WW, Hickson MA, Kane MA et al. Immunisation policies and vaccine coverage among adults: the risk for missed opportunities. Annals of Internal Medicine 1988; 108:616-25.
55. McBean AM, Babish JD, Prihoda R. The utilisation of pneumococcal polysaccharide vaccine among elderly medicine beneficiaries, 1985 through 1988. Archives of Internal Medicine 1991; 151:2009-16.
56. Andrews RM, Lester RA. Improving vaccination coverage among older people in Victoria. Medical Journal of Australia 2000; 173:S45-S47.
57. Bratzler DW, Houck PM, Jiang H et al. Failure to vaccinate medicare inpatients. A missed opportunity. Archives Internal Medicine 2002; 162:2349-56.
58. Nichol KL, Zimmerman R. Generalists and subspecialist physicians' knowledge, attitudes and practice regarding influenza and pneumococcal vaccinations for elderly and other high-risk patients. A nationwide survey. Archives of Internal Medicine 2001; 161:2702-8.
59. Vella PP, McLean AA, Woodhour AF et al. Persistence of pneumococcal antibodies in human subjects following vaccination. Proceedings in Experimental Biology and Medicine 1980; 196:435.
60. Lackner TE, Hamilton RG, Hill JJ, Davey C, Guay DRP et al. Pneumococcal polysaccharide revaccination: immunoglobulin G seroconversion, persistence, and safety in frail, chronically ill older subjects. Journal of the American Geriatrics Society 2003; 51:240-45
61. Department of Human Health and Services, AIDS and Communicable Diseases Branch. Tetanus notifications to the National Notifiable Diseases Surveillance System. Canberra, 1995.
62. Heath TC, Smith W, Capon AG, Hanion M, Mitchell P. Tetanus immunity in an older Australian population. Medical Journal of Australia 1996; 164:593-6.
63. Richardson JP, Knight AL. The prevention of tetanus in the elderly. Archives of Internal Medicine 1991; 151:1712-17.
64. Fernandez R, Valcour V, Flynn B, Masaki K, Blanchette P. Tetanus immunity in long-term care facilities. Journal of the American Geriatrics Society 2003; 51:1116-9.
65. Shohat T, Marva E, Sivan Y et al. Immunologic response to a single dose of tetanus toxoid in older people. Journal of the American Geriatrics Society 2000; 48:949-51.