

Impact of meningococcal C conjugate vaccine use in Australia

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Vaccination response has been impressive, but the hypermutable meningococcus is likely to continue to challenge us

In the past 100 years there have been many dramatic fluctuations in the incidence of meningococcal disease in Australia, as Patel describes in this issue of the *Journal* (page 136).¹ Rising socioeconomic status with reduced household crowding has probably been the major factor in curbing the overall incidence of the disease in recent decades,¹ but the introduction in early 2003 of a routine vaccination against serogroup C for all infants (and a catch-up campaign for those aged under 20 years) has also had an undeniably impressive impact.

Worldwide, surges in the incidence of meningococcal disease due to serogroups A, B, C, W135 and Y have each been associated with the advent of a new strain to which the community largely lacks immunity. Furthermore, new strains are often associated with a higher case-fatality rate and a shift to the right in age incidence, with the disease especially affecting older teenagers. More commonly, these young people do not have the disease but are colonised by the organism and may become “superspreaders” of infection.^{2,3}

The epidemiological signal of rising serogroup C meningococcal disease incidence was detected in the United Kingdom in 1994. A triumvirate of government, industry and academia combined to produce a “win, win, win” situation — an effective and safe vaccine being researched, developed, mass produced and introduced within a mere 5 years.⁴ As a consequence of vaccination, serogroup C disease is now controlled in a number of developed countries. However, the incidence of serogroup C meningococcal disease in teenagers had already peaked in half the regions of the UK and was declining before the vaccine was introduced in 1999. Similarly, in New South Wales, disease incidence was falling before the vaccine was introduced (perhaps due to naturally acquired herd immunity⁵), whereas, in Victoria, vaccination led to a rapid fall in incidence. Western Australia and South Australia had not seen the same surge of serogroup C disease as in the eastern states.^{6,7} However, it should be emphasised that, in the 3 years after the vaccine was introduced, there was a decrease in notification rates in all states and territories except WA, where notification rates remained low.

As in the UK, a catch-up campaign was undertaken in Australia for those younger than 20 years of age. Unlike the UK, where routine vaccination was given as a three-dose course in the first 6 months of life, Australia was able to follow a simpler, more cost-effective approach and offer a single dose at 12 months of age. This was because almost all serogroup C disease was seen in older children, teenagers and young adults, and also because the vaccine is more immunogenic in older infants and children. Australia’s approach has proved successful. A similar outcome has been achieved in the Netherlands, where a single dose is administered routinely at 14 months of age.⁸ In 2005, only 50 laboratory-confirmed serogroup C cases were notified in Australia. This is a greater than 75% reduction from the 213 cases in 2002. There is also evidence that, in the absence of vaccination, disease incidence may fall as naturally acquired immunity rises⁵ but the impact is not

as rapid; herd immunity may also be induced by vaccination but its longevity is uncertain.⁹

Given the extraordinary velocity of the vaccine’s development in the UK, inevitably some issues received attention later than desirable. One was cost-effectiveness — data on this were published well after vaccine introduction.¹⁰ There was interest in both the UK and Australia in the possible use of the cheaper polysaccharide vaccine, as it is effective in the age ranges mostly affected by serogroup C disease and may also be more cost-effective.¹¹ This approach was tried in Spain, but waning immunity after several years led to a follow-up conjugate C vaccine campaign.

Given that this disease can progress with frightening rapidity and has a high case-fatality rate, it receives, arguably, inordinate media attention. The political pressure and impetus to implement a vaccination program that this publicity generates is often lacking for diseases with a lesser public profile. When meningococcal C vaccine was introduced in Australia, there was debate about its merits in relation to, for example, the pneumococcal conjugate vaccine, which is now also part of the routine schedule. Australia was arguably the first country in the world to fund universal immunisation against *Haemophilus influenzae* type b, meningococcus C, and pneumococcus in early childhood. Long-term follow-up will be required to assess the ultimate success of the meningococcal C vaccine program and determine whether booster doses of vaccine might be required or whether serogroup replacement develops.

The problem of serogroup B disease remains. New Zealand has recently completed a large and expensive public health intervention to vaccinate its young people against a particular serogroup B strain that, beginning 15 years ago, caused a major upsurge in incidence. This vaccine would cover only a small proportion of serogroup B cases in Australia,^{6,7} so a different product will be required here, and studies are underway in several Australian centres to assess candidate serogroup B vaccines.

Without a vaccine, it is questionable whether behaviour modification would mitigate risk. Patel claims that “the societal determinants of the current hypersporadic disease pattern are unknown”.¹ This is at odds with Australian and overseas data clearly showing that crowded environments, including university colleges and nightclubs, and risk-taking behaviour (eg, smoking and multiple deep-kissing contacts) are important risk factors¹² and may be modifiable. Despite the recent unravelling of sequence data for the entire genomes of representative strains of meningococcal serogroups A, B and C, the hypermutable meningococcus will likely continue as an “accidental tourist” causing havoc in a small proportion of vulnerable hosts¹ and go on challenging public health control measures throughout the 21st century.

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References

1 Patel MS. Australia's century of meningococcal disease: development and the changing ecology of an accidental pathogen. *Med J Aust* 2007; 186: 136-141.

2 Erickson L, De Wals P. Complications and sequelae of meningococcal disease in Quebec, Canada, 1990-1994. *Clin Infect Dis* 1998; 26: 1159-1164.

3 Peltola H, Kataja JM, Makela PH. Shift in the age-distribution of meningococcal disease as predictor of an epidemic? *Lancet* 1982; 2: 595-597.

4 Miller E, Salisbury D, Ramsay M. Planning, registration and implementation of an immunisation campaign against meningococcal serogroup C disease in the UK: a success story. *Vaccine* 2001; 20 Suppl 1: S58-S67.

5 Kriz P, Kriz B, Svandova E, Musilek M. Antimeningococcal herd immunity in the Czech Republic — influence of an emerging clone, *Neisseria meningitidis* ET-15/37. *Epidemiol Infect* 1999; 123: 193-200.

6 Australian Meningococcal Surveillance Programme. Annual report of the Australian Meningococcal Surveillance Programme, 2002. *Commun Dis Intell* 2003; 27: 196-208.

7 Australian Meningococcal Surveillance Programme. Annual report of the Australian Meningococcal Surveillance Programme, 2005. *Commun Dis Intell* 2006; 30: 211-221.

8 De Greeff SC, de Melker H, Spanjaard L, et al. Protection from routine vaccination at the age of 14 months with meningococcal serogroup C conjugate vaccine in the Netherlands. *Pediatr Infect Dis J* 2006; 25: 79-80.

9 Maiden MC, Stuart JM; UK Meningococcal Carriage Group. Carriage of serogroup C meningococci 1 year after meningococcal C conjugate polysaccharide vaccination. *Lancet* 2002; 359: 1829-1831.

10 Trotter CL, Edmunds WJ. Modelling cost effectiveness of meningococcal serogroup C conjugate vaccination campaign in England and Wales. *BMJ* 2002; 324: 809.

11 Skull SA, Butler JR, Robinson P, Carnie J. Should programmes for community-level meningococcal vaccination be considered in Australia? An economic evaluation. *Int J Epidemiol* 2001; 30: 571-578.

12 Tully J, Viner RM, Coen PG, et al. Risk and protective factors for meningococcal disease in adolescents: matched cohort study. *BMJ* 2006; 332: 445-450. □