

Articles

COMPLIANCE WITH THREE SIMULTANEOUS VACCINATIONS DUE AT THE ONE VISIT AT 12 MONTHS OF AGE IN AUSTRALIA

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Abstract

The introduction of meningococcal C conjugate vaccine (Men C) into the National Immunisation Program Schedule in January 2003 was the first time that 3 simultaneous vaccine injections were recommended for all Australian children. This study aimed to assess the level of simultaneous vaccination at 12 months of age for 4 cohorts of Australian children. The percentage of children with all 3 vaccinations given simultaneously by jurisdiction increased for all states and territories across the 4 study cohorts, however some jurisdictions fared better than others. The percentage of children with all 3 vaccinations given simultaneously varied by the provider type of the Men C vaccine, being lower for general practitioner providers than other providers. Men C vaccine was the vaccine most commonly delayed. The percentage of children who received all 3 vaccinations simultaneously in Australia also varied by indigenous status, with Indigenous children more likely to receive immunisations simultaneously. The study suggests that some children in Australia are at risk of receiving Men C vaccine late, especially children in jurisdictions where general practitioners give the majority of vaccinations. *Commun Dis Intell* 2007;31:198–202.

Keywords: multiple injections, compliance, vaccination coverage, immunisation register, simultaneous vaccination

Introduction

The meningococcal C conjugate vaccine (Men C) was introduced into the National Immunisation Program (formerly the Australian Standard Vaccination Schedule) in January 2003. The vaccine is recommended at 12 months of age, the same age as the administration of the first dose of measles, mumps, and rubella (MMR) and the third dose of the *Haemophilus type B* vaccine (Hib). The introduction of Men C was the first time that 3 simultaneous injections were recommended for all Australian children at any schedule point.

Few studies have examined whether, and to what extent, vaccinations are delayed when more than two are due at the one time. Older studies from the United States of America, utilising attitudinal surveys of providers and analysis of medical record databases, are conflicting. Some report that providers were concerned about administering multiple vaccinations at one visit and were delaying vaccinations, whilst others reported almost complete compliance with multiple, simultaneous vaccinations.^{1–6} A more recent Australian study from north Queensland has shown that 17% of non-Indigenous and 18% of Indigenous children did not receive the 3 injections, due by 12 months of age, at the one visit to an immunisation provider. Men C vaccine, the one most recently recommended, was most likely to be omitted.⁷ These findings have implications for infant 7vPCV vaccination due at 2, 4 and 6 months of age introduced at the beginning of 2005 in Australia.

The aims of the current study were to determine the percentage of 4 consecutive cohorts of children in Australia who received the 3 vaccinations due at 12 months of age and of these, the proportion receiving 3 vaccinations simultaneously at the national level and by state or territory, indigenous status and provider type.

Methods

The National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases receives downloads of Australian Childhood Immunisation Register (ACIR) immunisation data from Medicare Australia (formerly the Health Insurance Commission) each quarter. We chose four 3-month wide birth cohorts, the first born 1 April to 30 June 2002, the second born 1 July to 30 September 2002, the third born 1 October to 31 December 2002, and the fourth born 1 January to 31 March 2003, as our study population. The vaccination records of all children born in these 4 cohorts in Australia and who were registered with Medicare were extracted from ACIR data as at 31 December 2004. This allowed the youngest children in the latest 3-month birth cohort (born 1/1/03 – 31/3/03) to reach 18 months of age at data analysis, giving at least 6 months to receive vac-

inations scheduled at 12 months. The age of each child, the vaccine type and the dates of vaccinations were used to assess if and when children received the relevant 12-month vaccinations and if they received them simultaneously. The indigenous status field was used to assess any differences by indigenous status. This isn't a well completed section of the ACIR notification form in jurisdictions with smaller numbers of Indigenous children but completion has improved significantly in the past few years. The analysis was undertaken using the SAS software system.⁸

Results

There was little change over time in the percentage of children who received all 3 vaccinations by state or territory (regardless of whether administration was simultaneous or not) (Figure 1). A slight decrease from the third cohort to the fourth is most likely due to very late vaccinations not being recorded on the ACIR for children in the fourth cohort by the data assessment date. The Northern Territory (89.3% for the most recent cohort) had the greatest percentage of children with all 3 vaccinations received across all 4 cohorts, with Western Australia (75.6% for the most recent cohort) the lowest percentage. However, the percentage of children with all 3 vaccinations given simultaneously showed a steady increase in all states and territories across the 4 study cohorts (Figure 2). The Australian Capital Territory (86.2% for the most recent cohort), the Northern Territory (80.7%) and Victoria (79.9%) had the greatest percentage of children with all 3 vaccinations received simultaneously across all 4 cohorts. New South Wales (63.2%), Tasmania (63.0%), Western Australia (64.3%) and Queensland (65.2%) had the lowest percentage (Figure 2).

Analysis of the most recent cohort (born 1 January to 31 March 2003)

For more in-depth analysis, we examined the most recent cohort born 1 January 2003 to 31 March 2003. Of the 62,049 children in this cohort, 82.2% (n=51,004) children had a record on the ACIR of having received all 3 vaccinations due at 12 months of age. Of these 51,004, 15,701 (30.8% or 25% of the total cohort), did not receive the 3 vaccinations simultaneously. In this cohort, there were 11,045 children who did not receive all 3 vaccinations due at 12 months of age and were under-immunised. The vaccines these children were missing are shown in the Table. The large majority of children (54%) were missing a Men C vaccine only, with a further 20% missing all 3 vaccines.

The median age of receipt of Men C vaccine in the children who received the 3 vaccines simultaneously was 12.5 months, whilst the median age in the children who did not receive the 3 vaccines at the same time was 14 months.

Figure 1. Trends in the percentage of children with all three vaccinations, by state or territory

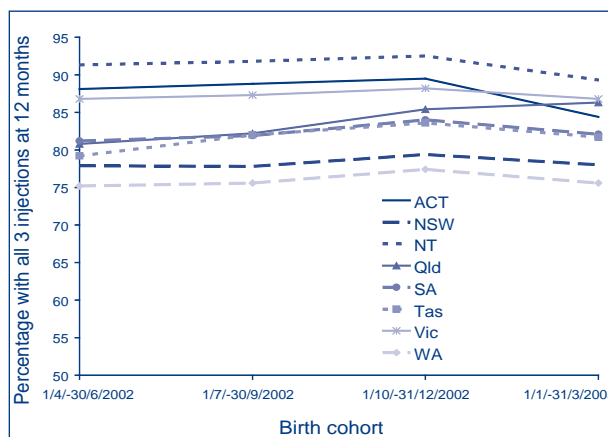
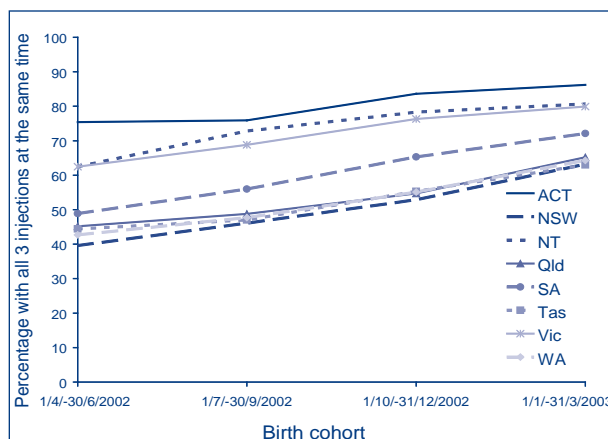


Figure 2. Trends in the percentage of children with all three vaccinations given simultaneously, by state or territory



The number and percentage of children who did not receive all three vaccinations due at 12 months of age, cohort born 1 January to 31 March 2003, by vaccine

Missing vaccines	Number	%
Men C only	5,963	54.0
All three vaccines	2,197	19.9
Men C and MMR	1,943	17.6
MMR only	594	5.4
Hib Only	168	1.5
Men C and Hib	96	0.9
MMR and Hib	84	0.8
Total	11,045	100.0

Men C Meningococcal conjugate vaccine
 MMR Measles-mumps-rubella vaccine
 Hib *Haemophilus type B* vaccine

The percentage of children who received all 3 vaccinations in Australia varied by indigenous status. Indigenous children (86.8%) were more likely to have received all vaccines than non-Indigenous children (82.0%) (Figure 3). Only in those jurisdictions with the lowest proportion of Indigenous children (the Australian Capital Territory, Tasmania and Victoria) did non-Indigenous children have a greater percentage of receiving all 3 vaccines than Indigenous children. A greater proportion of Indigenous (64.4%) versus non-Indigenous children (56.6%) also received vaccines simultaneously (Figure 4). The pattern varied by jurisdiction, with a smaller percentage of Indigenous children in the Northern Territory, South Australia, Tasmania and Victoria receiving vaccinations simultaneously than non-Indigenous children.

Figure 3. The percentage of children with all three vaccinations, cohort born 1 January to 31 March 2003, by state and indigenous status

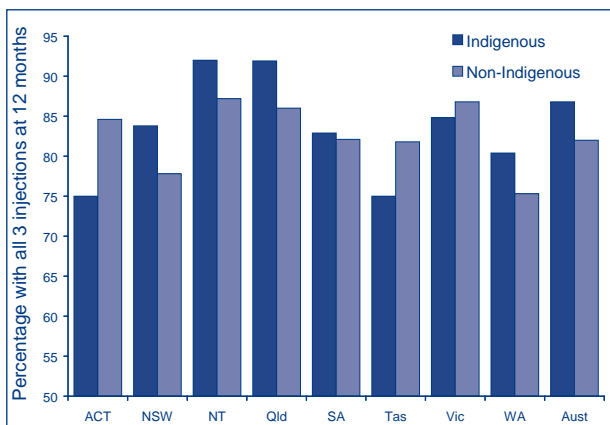


Figure 4. The percentage of children with all three vaccinations given simultaneously, cohort born 1 January to 31 March 2003, by state and indigenous status

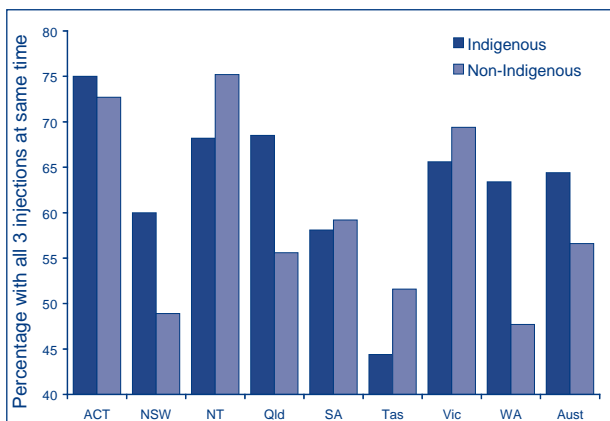
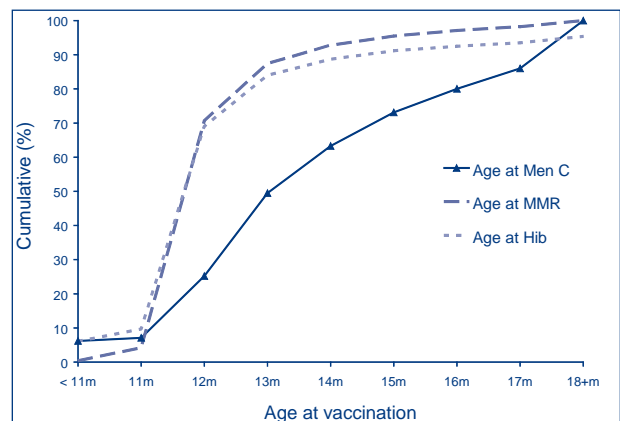


Figure 5 shows that, of the 3 vaccines given to children who did not receive them simultaneously, Men C was more likely to be delayed than MMR or Hib. Around 70% of children received the MMR and Hib vaccine at 12 months of age but only 25% received the Men C vaccine when it was due, with the delay in receipt of Men C vaccine continuing up to 18 months of age.

Figure 5. Age at vaccination for all three vaccines for children who did not receive the vaccinations simultaneously, cohort born 1 January to 31 March 2003



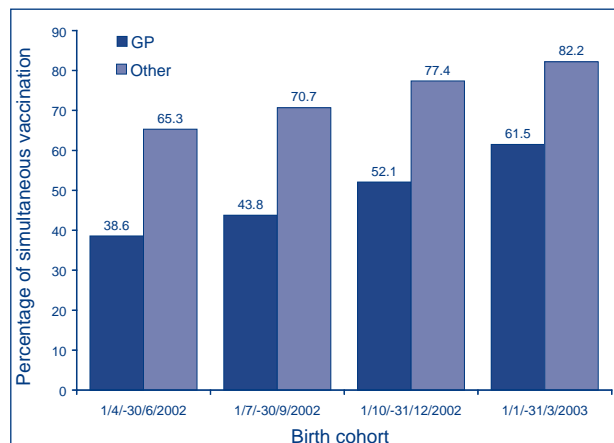
For all 4 study cohorts, the percentage of children with all 3 vaccinations given simultaneously varied by the provider type of the Men C vaccine with children who received their Men C from a general practitioner (GP) less likely to have received all 3 vaccines simultaneously, compared with children who received their Men C vaccine from another type of provider (Figure 6).

Discussion

This is the first study to examine the issue of simultaneous vaccination at 12 months of age in Australian children at the national level. A study undertaken in north Queensland in 2004 found that 83% of children had received the 3 injectable vaccinations simultaneously.⁷ This figure is significantly higher than what we found for Queensland as a whole for the latest cohort studied (65%). However, simultaneous vaccination increased substantially over time for all jurisdictions, suggesting increasing acceptance by parents and providers.

Of more concern is the finding that the lowest levels of simultaneous vaccination occurred in the jurisdictions where general practitioners give the majority of immunisations: New South Wales, Queensland, Tasmania, South Australia and Western Australia. In fact, we found that GPs were less likely than other immunisation providers (by about 20 percentage

Figure 6. The percentage of children with all three vaccinations given simultaneously comparing GP versus Other, all four study cohorts, by provider type



GP' covers the following ACIR provider type categories: 'Division of General Practice', 'Medicare GP', and 'General Practice'

'Other' covers following ACIR provider type categories: 'Council', 'State Health', 'Flying Doctor', 'Community Health Centre', 'Community Nurse', 'Public Hospital', 'Private Hospital', 'Aboriginal Health Service', and 'Aboriginal Health Worker'

points) to give the 3 vaccines simultaneously. This suggests that GPs could be concerned about the logistics of administering multiple vaccination injections to young infants at the one visit and are delaying vaccinations to a later date.^{2,5,6,9} State and council clinics, community health centres and Aboriginal health centres appear to have a greater degree of acceptance in giving 3 vaccines simultaneously. This could be related to differences in attending populations and their expectations, greater adherence to routine procedures or specific measures to allay parent's concerns regarding this.

Men C vaccine was the latest of the 3 vaccines, due by 12 months age, to be added to the National Immunisation Program, so it is no surprise that it was delayed the most, on average by up to 6 weeks, as in previous studies.⁷ In fact, of those children who received all 3 vaccines due at 12 months of age but did not receive them all at the same time, 70% of them had received their MMR and Hib vaccines by up to 13 months of age but only 25% had received their Men C vaccine by this same age. Both the MMR and Hib vaccines are recognised by Australian immunisation providers and parents as highly effective and safe, despite the negative press MMR has received in the United Kingdom over the past 5 years. Men C vaccine is relatively new to Australian parents and its safety profile may not yet be well established. However, Men C is a vaccine for a disease that has attracted a significant amount

of mainstream press over recent years, so it is surprising that parents and/or providers are choosing to delay its administration to young infants. In fact, Men C coverage for the most recent cohort in Western Australia, where there has been some publicity that the vaccine was not worthwhile, was the lowest nationally, by up to 13 percentage points when compared with all other jurisdictions. In this study, the median age of receipt of Men C vaccine in the children who had received the 3 vaccines simultaneously was 12.5 months, whilst the median age in the children who did not receive the 3 vaccines at the same time was 14 months. This was almost identical to that found in the north Queensland study, 12.3 and 14 months, respectively.⁷

In this study, Indigenous children were significantly more likely than non-Indigenous children to have received all 3 vaccinations due at 12 months of age, except in jurisdictions with a low proportion of Indigenous children. They were also more likely to have received all vaccine injections simultaneously, except for in the Northern Territory. This is different from the findings in north Queensland where the same percentage of Indigenous and non-Indigenous children received the 3 vaccines simultaneously.⁷ However, this is not unexpected in light of the fact that community health centres and Aboriginal health centres appear to have a greater degree of acceptance in giving 3 vaccines simultaneously.

The findings of this study will have implications for those jurisdictions that have continued to use vaccines necessitating 3 simultaneous vaccinations at both the encounters due at 2, and 4 months after November 2005: the Northern Territory, Queensland, Victoria, and South Australia. Based on the results from the current study, this potential delay is more likely to occur in the jurisdictions where GPs give the majority of immunisations: Queensland and South Australia. As severe invasive pneumococcal disease notification rates are highest in children aged 1 year or less,¹⁰ it is very important that delays in administering the 7vPCV vaccine to children due at 2, 4 and 6 months are minimised, and that providers and/or parents are informed about the consequences of delay. In particular, possible GP concerns over giving multiple injectable vaccines to young infants need to be addressed.

Limitations of this study are those common to all studies utilising data from the Australian Childhood Immunisation Register, most notably, the under-reporting of immunisation encounters. It is known that the ACIR underestimates coverage for scheduled vaccines by 3–5% because of failure of providers to report to it.¹¹ However, under-reporting is unlikely to affect the main findings of this study.

Another limitation of the study was our inability to determine why some parents or providers appear to delay the administration of Men C vaccine.

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References

1. Lieu TA, Davis RL, Capra AM, Mell LK, Quesenberry CP, Martin KE, et al. Variation in clinician recommendations for multiple injections during adoption of inactivated polio vaccine. *Pediatr* 2001;107:E49.
2. Madlon-Kay DJ, Harper PG. Too many shots? Parent, nurse, and physician attitudes toward multiple simultaneous childhood vaccinations. *Arch Fam Med* 1994;3:610–613.
3. Melman ST, Nguyen TT, Ehrlich E, Schorr M, Anbar RD. Parental compliance with multiple immunization injections. *Arch Pediatr Adolesc Med* 1999;153:1289–1291.
4. Meyerhoff AS, Jacobs RJ. Do too many shots due lead to missed vaccination opportunities? Does it matter? *Prev Med* 2005;41:540–544.
5. Askew GL, Finelli L, Lutz J, DeGraaf J, Siegel B, Spitalny K. Beliefs and practices regarding childhood vaccination among urban pediatric providers in New Jersey. *Pediatr* 1995;96:889–892.
6. Schaffer SJ, Szilagyi PG, Shone LP, Ambrose SJ, Dunn MK, Barth RD, et al. Physician perspectives regarding pneumococcal conjugate vaccine. *Pediatr* 2002;110:E68.
7. Hanna JN, Bullen RC, Andrews DE. The acceptance of three simultaneous vaccine injections recommended at 12 months of age. *Commun Dis Intell* 2004;28:493–496.
8. SAS version 8 [computer program]. Version V8. Cary, NC: SAS Institute Inc.; 1999.
9. Bartlett MJ, Burgess MA, McIntyre PB, Heath TC. Parent and general practitioner preferences for infant immunisation. Reactogenicity or multiple injections? *Aust Fam Physician* 1999;28 Suppl 1:S22–S27.
10. Roche PW, Krause VL, Bartlett M, Coleman D, Cook H, Davis C, et al. Invasive pneumococcal disease in Australia, 2004. *Commun Dis Intell* 2006;30:80–92.
11. Hull BP, Lawrence GL, MacIntyre CR, McIntyre PB. Immunisation coverage in Australia corrected for under-reporting to the Australian Childhood Immunisation Register. *Aust N Z J Public Health* 2003;27:533–538.