Measles in Victoria 1992 to 1996: the importance of laboratory confirmation

Stephen Lambert[1,2]

Abstract

Australia had a major measles epidemic in 1993 and 1994, which appeared to by-pass Victoria. Victorian notification and laboratory testing data for measles, and public hospital discharge codes, from 1992 to 1996, were reviewed. The rate of measles notification in Victoria fell between 1992 and 1996. By contrast the national notification rate increased markedly in 1993 and 1994. The proportion of measles tests performed at the Victorian Infectious Diseases Reference Laboratory (VIDRL) which were positive increased for all age groups in 1993 and 1994. This increase was highest for the 15 to 19 years age group. The hospital discharge codes demonstrated an increase in the number of admissions for measles in 1993 and 1994, largely for adolescents and younger adults. These data suggest Victoria had an age group specific measles outbreak, the magnitude of which was not reflected by the passive notification system. Reasons why younger age groups in Victoria appeared to avoid the epidemic are unclear.

Introduction

The last nationwide measles epidemic occurred during 1993 and 1994, when six cases of encephalitis, three cases of meningitis, and two deaths were reported.[1,2,3] Cases were initially widespread, with highest notification rates in Tasmania, New South Wales, the Australian Capital Territory, Queensland, and the Northern Territory.[4,5,6] There were also confirmed cases of measles related to an outbreak in Western Australia.[7] However, there was no documented increase in the number of cases in Victoria during those years.

The elimination of measles in Australia and its global eradication are possible. Delegates at a meeting cosponsored by the World Health Organization, the Pan American Health Organization, and the Centers for Disease Control and Prevention in July 1996, concluded that measles eradication is technically feasible with current vaccines.[8] Surveillance is a critical

1. Infectious Diseases Unit, Department of Human Services, Victoria
2. Master of Applied Epidemiology Program, National Centre for Epidemiology and Population Health, Australian National University, Australian Capital Territory

ISSN 0725-3141
Volume 22
Number 2
19 February 1998

Contents

Table 1. Measles notifications, 1992 to 1996, for Victoria and Australia, by year

Year	Victorian Notifications		Australian Notifications	
	Reports	Rate per 100,000 population	Reports	Rate per 100,000 population
1992	221	5.0	1,425	8.5
1993	191	4.3	4,536	25.7
1994	185	4.1	4,895	27.4
1995	150	3.3	1,324	7.3
1996	99	2.1	498	2.7
Total	846		12,678	

component of accelerated measles control leading to elimination.

The aims of this review were to compare the measles surveillance data from Victoria during the outbreak years, 1993 and 1994, to the non-outbreak years, 1992, 1995, and 1996; to compare the Victorian data with national data; to consider possible reasons for the differences in Victoria; and to identify ways of improving the usefulness of measles surveillance in the context of measles elimination.

Methods

Notifications

In Victoria medical officers and laboratories are required under the Health (Infectious Diseases) Regulations 1990, to notify the Department of Human Services of any measles cases. During the period under review a case of measles was defined in accordance with National Health and Medical Research Council (NHMRC) recommendations.[9]

All measles notifications with onset dates from 1 January 1992 to 31 December 1996 were collated. Crude and age specific notification rates were calculated using mid-year population estimates from the Australian Bureau of Statistics. The annual number and rate of Victorian notifications were compared with national data from the National Notifiable Diseases Surveillance System (NNDSS).[10]

A laboratory confirmed case was one which met one of the NHMRC laboratory case definition criteria.[10] 'Outbreak years' referred to those years of the nationwide measles outbreak (1993 and 1994). 'Non-outbreak years' referred to the other years of this review (1992, 1995, and 1996).

Laboratory Testing

The Victorian Infectious Diseases Reference Laboratory (VIDRL) notifies most laboratory confirmed cases of measles in Victoria. The results of measles serology performed at VIDRL from 1992 to 1996 were reviewed. A positive laboratory test was one which met one of the laboratory criteria of the NHMRC case definition.

Hospital Data

The Victorian In-patient Minimum Dataset (VIMD) is maintained by the Department of Human Services and contains de-identified information from hospital discharges in Victoria. Data from public hospitals for the years 1992 to 1996 were examined. Private hospital data for these years were incomplete and were not included. Records containing a code for acute measles infection (ICD 9 code 055) were reviewed.

All data were collated and analysed using Epi Info version 6.04b.[11]

Results

Notifications

There were 846 measles notifications made to the Victorian Department of Human Services with onset from

Figure 1. Notifications of measles, Victoria, 1992 to 1996, by month of onset

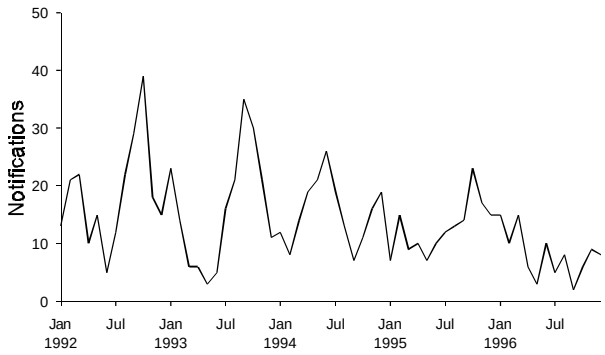
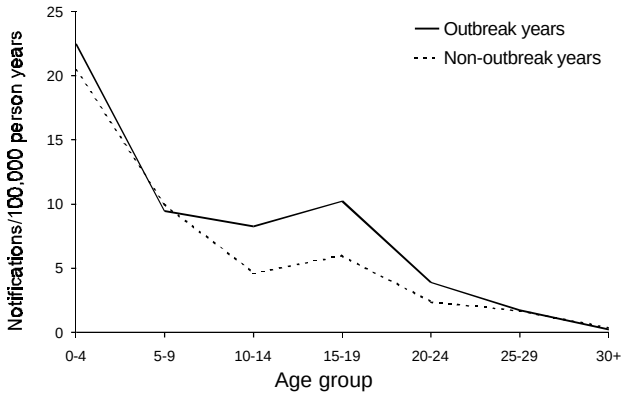


Figure 2. Notification rate of measles, Victoria, 1992 to 1996, by year type and age group



1 January 1992 to 31 December 1996 (Table 1).

In Victoria the crude measles notification rate fell gradually over the five year period (Figure 1). In contrast, national notifications increased substantially in 1993 and 1994 (Table 1).

Notification rates were highest for children below the age of five years (Figure 2). For those aged 15 to 19 years, the rate increased in the outbreak years. Children less than one year of age had the highest rate of notification each year (Figure 3).

Laboratory confirmation was received for 137 of the 846 notifications (16.2%). The VIDRL was the notifying laboratory for 76% of these cases. There were 140 notified cases (17%) under the age of one year. Only five of these (3.6%) were laboratory confirmed.

More notifications were laboratory confirmed in 1993 and 1994 (Figure 4). For the three non-outbreak years, 8 of 44 laboratory confirmed notifications (18%) occurred in the 15 to 19 years age group. In comparison, for the two outbreak years (1993 and 1994), 35 of 93 laboratory confirmed notifications (38%) occurred in the 15 to 19 years age group. These 35 cases were not clustered by time or place. None were identified as being epidemiologically linked to another case.

The notification rate was similar for most age groups in outbreak and non-outbreak years. The greatest difference was among the 15 to 19 years age group, where there was a less than two-fold increase from non-outbreak to outbreak years (Figure 2). The laboratory confirmed incidence rate increased more than six-fold for this age group in the outbreak years (Figure 5).

Laboratory Testing

From 1992 to 1996, 2,725 serological tests for measles were performed by VIDRL. Of these, 300 (11%) were positive. The proportion of positive tests was highest in 1993 and 1994, 18% (94/516) and 17% (75/429) respectively. Most of these were for the 15 to 19 years age group (Figure 6).

Hospital Data

There were 102 discharges with a primary diagnosis relating to measles from Victorian public hospitals from 1992 to 1996. Most were in 1993 and 1994 (Table 2).

Discussion

This review demonstrates the inability of a passive notification system to reflect a change in the epidemiology of measles in Victoria. Based on crude notification data, the incidence of measles cases in Victoria did not increase during the years of the national outbreak. However, the supplementary data indicates that the measles outbreak did reach Victoria, but caused cases largely in adolescents and young adults. In the vaccine era, this age group represents a susceptible cohort which may continue to be at risk of acquiring measles during future outbreaks in Australia.[12,13,14] This susceptibility to infection is likely to have been due to a number of factors. These include those in this age group being too old to have received measles vaccine either in infancy or a second dose through school based programs. Such individuals may also have had little exposure to circulating wild virus.

There was a six-fold increase in the rate of laboratory confirmed notifications among the 15 to 19 years age group for 1993 and 1994. However, the incidence of crude notifications for this age group increased by less than two-fold. Whilst the number of laboratory confirmed cases is small these were not clustered by time or place. They are unlikely to represent unrecognised smaller outbreaks.

The VIDRL testing data suggest the change in laboratory confirmed rates was not a result of a change in testing patterns. Older adolescents and young adults may have been more likely to have had a blood test than those in younger age groups. This would have led to an age specific increase in laboratory confirmed cases. Not only did the absolute number of positive measles tests increase in the 15 to 19 year old age group during outbreak years, but the proportion of positive tests also increased. Each age group during the outbreak years had a higher proportion of positive measles tests. However, for the 15 to 19 year old age group the proportion of positive tests reached very high levels. The discharge data for public hospitals also support the occurrence of an age group specific outbreak involving adolescents and young adults.

There are two possible explanations for the difference between the pattern of measles notifications in Victoria, and other states and territories. Firstly, the outbreak may have been widespread, reached Victoria and not been detected. There is however no

Figure 3. Notification rate of measles in under 5 year olds, Victoria, 1992 to 1996, by year type and age

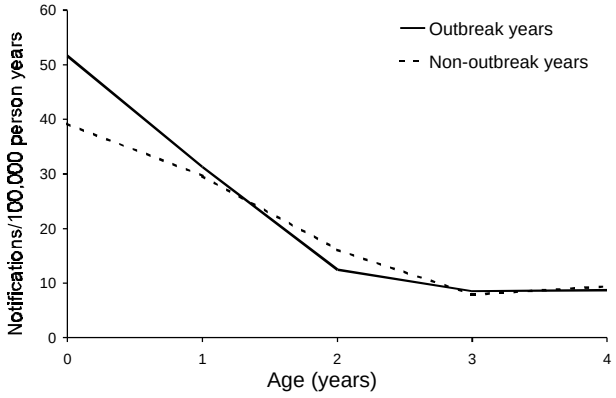


Figure 4. Notifications of measles, Victoria, 1992 to 1996, by year and method of diagnosis

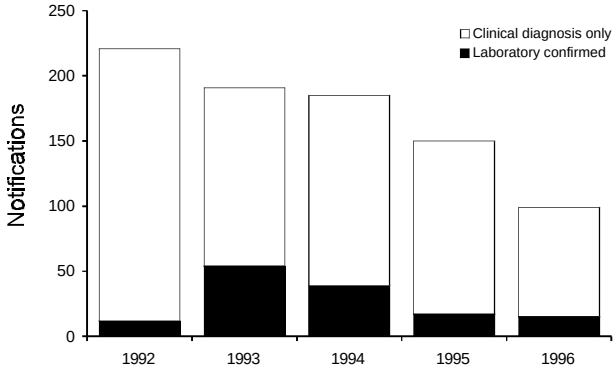


Table 2. Hospital discharges for measles, Victoria, 1992 to 1996, by year and age group

Age group	1992	1993	1994	1995	1996
0 - 4	16	12	11	1	3
5 - 9	2	1	2	2	0
10 - 14	0	3	5	0	0
15 - 19	0	5	7	0	1
20 - 24	2	7	2	1	1
25 - 29	0	6	0	1	2
30+	4	2	1	0	2
Total	24	36	28	5	9

evidence to support this. Problems in each of the passive measles surveillance systems would need to have taken place for an outbreak to have gone undetected. Fundamental errors in each of the passive measles surveillance systems discussed would need to have taken place for an outbreak that crossed into younger age groups to have gone unrepresented. Such errors would need to be state, age group, and disease specific. For example, the rates of Victorian notifications during the current nationwide outbreak of pertussis are amongst the highest in the country, and cross all age groups.

Alternatively, the lower rates of notification, compared to the rest of Australia, may reflect the real situation. Reasons why younger age groups largely avoided the outbreak remain unclear. The 1995 Australian Bureau of Statistics' Childhood Immunisation Survey showed that the reported measles coverage at age two and age six in Victoria was quite high, being 92.5% and 94.9% respectively.[15] These levels, though high, were lower than other states and territories that received large numbers of notifications in the younger age groups during the outbreak. A Victorian serosurvey study performed in 1993 collected blood specimens from 341 children in Year 2, and 641 children in Year 7. Twenty-eight (8.2%) of the Year 2 children were negative for measles antibodies, as were 30 (4.7%) of the Year 7 group.[16] There are no recently published serological data from other states or territories for comparison.

Historically, local councils have been the major provider of all childhood vaccines in Victoria. Many have a systematic recall or reminder program aimed at maximising vaccine coverage. A Victorian study looking at the knowledge and practices relating to maintenance of cold chain showed that councils were significantly better informed about cold chain maintenance, and were significantly more likely to have better cold chain practices in place.[17] Recent surveys of general practitioners highlight problems with knowledge and practices relating to vaccine storage,[18,19] but there is some evidence that these are improving.[20]

The low proportion of cases that are serologically confirmed raises doubts about the quality of Victorian notification data. This is particularly the case for younger age groups. Previous studies have raised concerns about the level of protection afforded to those under the age of one year.[21,22,23] Small serosurvey studies in Australia have suggested that 70-80% of infants may not have protective levels of antibodies at six months of age.[24,25,26] Given the difficulty of clinical diagnosis of measles, the lack of laboratory confirmation for a substantial majority of cases makes it difficult to be certain about the real risk of disease in this age group. Clinical diagnosis of

Figure 5. Laboratory confirmed notifications Victoria, by year type and age group

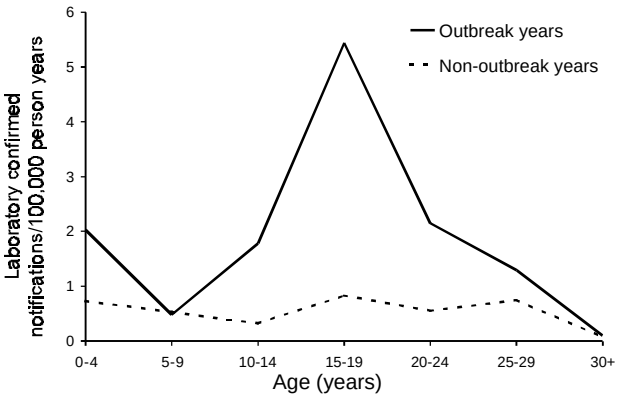
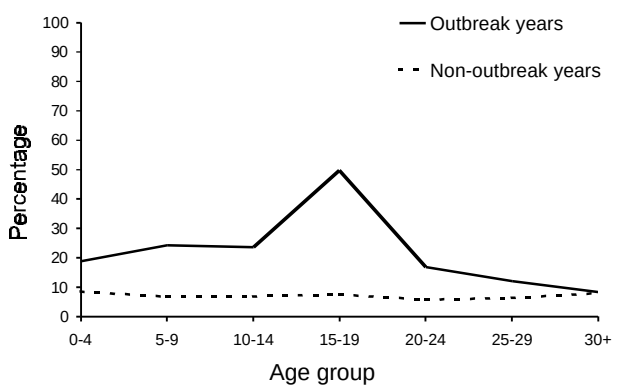


Figure 6. Percentage of positive measles serology results, Victoria, 1992 to 1996, by year type and age group



measles is difficult in populations with high vaccine coverage. In Britain following the National Measles and Rubella Immunisation Campaign 1994, salivary antibody testing of suspected measles cases showed that notification did not provide a reliable measure of disease incidence.[27]

This review has demonstrated that the quality and representativeness of the data collected by the Victorian passive surveillance system is questionable. As Australia approaches measles elimination, surveillance could be improved. A sensitive case definition for public health action, such as that suggested by the NHMRC Measles Working Party, is required to ensure good measles control.[28] Each notification of measles to health authorities should trigger active case finding and encourage laboratory confirmation. A recent proposal for a modified clinical case definition appeared to show an increase in specificity without change in sensitivity. These findings however, may have been due to the application of the new definition to cases detected using the old definition.[29] Notifications should meet a specific case definition before inclusion in notification datasets. In the absence of an outbreak, only cases where laboratory confirmation is available should form part of notification datasets. Changes also need to be made in the way data are collated and reported. The National Notifiable Diseases Surveillance System (NNDSS) needs to include data on laboratory confirmation from all states and territories. The NNDSS annual report could report clinically diagnosed cases and laboratory confirmed cases separately. The Virology and Serology Laboratory Reporting Scheme should consider reporting the proportion of all measles serology tests performed which are positive rather than the number of positive tests.

Other states and territories should consider performing similar retrospective analyses of notification and supplementary data, to enable better characterisation of the nationwide outbreak, particularly with respect to the age group specific rates of laboratory confirmed cases.

If Australia is to interrupt the transmission of measles, the quality of surveillance data will need to be improved. This includes a uniform national approach involving laboratory confirmation of cases. The timeliness of implementing improved methods of surveillance and the introduction of a mass vaccination campaign will determine how quickly Australia achieves the goal of measles elimination.

Acknowledgements

I would like to thank Dr Bill Maskill from the VIDRL for the provision of measles testing data, and acknowledge the VIDRL's continued cooperation and support in measles surveillance and control in Victoria. Particular thanks to Dr Rosemary Lester and Dr John Carnie for their time reading and making comments on draft papers. Thanks also to the Epidemiology Unit of the Victorian Department of Human Services for assistance with gaining access to the VIMD. The Master of Applied Epidemiology Program is funded by the Commonwealth Department of Health and Family Services.

References

1. Curran M. Annual report of the *CDI* Virology and Serology Reporting Scheme, 1993. *Comm Dis Intell* 1994;18:570-596.
2. Curran M. Annual report of the *CDI* Virology and Serology Reporting Scheme, 1994. *Comm Dis Intell* 1995;19:590-615.
3. Editorial addendum following Hanna J, Messer R. Three deaths from the late complications of measles. *Comm Dis Intell* 1994;18:250-252.
4. Longbottom H, Evans D, Myint H, Hargreaves J. Annual report of the National Notifiable Diseases Surveillance System 1993. *Comm Dis Intell* 1995;18:518-548.
5. Hargreaves J, Longbottom H, Myint H, et al. Annual report of the National Notifiable Diseases Surveillance System 1994. *Comm Dis Intell* 1995;19:542-574.
6. Herceg A, Passaris I, Mead C. An outbreak of measles in a highly immunised population: immunisation status and vaccine efficacy. *Aust J Public Health* 1994;18:249-252.
7. Donnelly J, Jeremijenko A, Kelly H. A measles outbreak in Bunbury, Western Australia between February and May 1994. *Comm Dis Intell* 1994;18:476-478.
8. Centers for Disease Control and Prevention. Measles eradication: recommendations from a meeting cosponsored by the World Health Organization, the Pan American Health Organization, and CDC. *MMWR* 1997; 46(No. RR-11):1-22.
9. National Health and Medical Research Council. Surveillance case definitions. Canberra: Australian Government Publishing Service, 1994.
10. Curran M, Harvey B, Crerar S, et al. Australia's notifiable diseases status, 1996: Annual report of the National Notifiable Diseases Surveillance System. *Comm Dis Intell* 1997;21:281-307.
11. Dean A, Dean J, Coulombier D, et al. Epi Info, version 6: a word processing database, and statistics program for public health on IBM-compatible microcomputers. Atlanta, Georgia, USA: Centers for Disease Control and Prevention, 1995.
12. Cheah D, Lane J, Passaris I. Measles vaccine efficacy study in a Canberra high school: A study following a measles outbreak. *J Paediatr Child Health* 1993;29:455-458.
13. Merianos A, Miller N, Patel M. Control of a community outbreak of measles which started in a poorly immunised high school population. *Aust J Public Health* 1993;17:231-236.
14. Jeremijenko A, Kelly H, Patel M. The high morbidity associated with a measles outbreak in a West Australian town. *J Paediatr Child Health* 1996;17:231-236.
15. Australian Bureau of Statistics. Children's immunisation, Australia. (Catalogue No. 4352.0). Canberra: ABS, 1995.
16. Lester R, Hogg G, Murphy M. Prevalence of antibody to measles and diphtheria in Victorian school children. New strategies for old problems. 5th National Immunisation Conference, Sydney, Australia, 1996. Public Health Association of Australia.
17. de Campo M, Lester R. How Victorian councils and general practices maintain the vaccine cold chain. Rights to health. 29th Annual Conference of the Public Health Association of Australia, Melbourne, Australia, 1997. Public Health Association of Australia.
18. Rixon G, March L, Holt D. Immunisation practices of general practitioners in metropolitan Sydney. *Aust J Public Health* 1994;18:258-260.
19. Liddle J, Harris M. How general practitioners store vaccines: a survey in south-western Sydney. *Med J Aust* 1995;162:366-368.
20. Herceg A, Johns M, Longbottom H. Reported general practitioner vaccination procedures, 1994 and 1996. *Med J Aust* 1997;167:299-302.
21. Markowitz L, Albrecht P, Rhodes P, et al. Changing levels of measles antibody titers in women and children in the United States: impact in response to vaccination. *Pediatrics* 1996;97:53-58.
22. Kacica M, Venezia R, Miller J, Hughes P, Lepow M. Measles antibodies in women and infants in the vaccine era. *J Med Virol* 1995;45:227-229.
23. Brugha R, Ramsay M, Forsey T, Brown D. A study of maternally derived measles antibody in infants born to naturally infected and vaccinated women. *Epidemiol Infect* 1996;117:519-524.
24. De Silva L, Karlekar A. Measles susceptibility under one year of age and vaccination strategy. *Med J Aust* 1994;161:725.
25. Hogg G, Politis S, Uren E. Antibody profiles of selected childhood infections. *Aust Microbiol* 1994; 15:A96, P43.

26. Ferson M, Whybin L, Robertson P. Pilot study of measles immunity in infants aged four to six months. *Comm Dis Intell* 1995;19:30-31.

27. PHLS Communicable Diseases Surveillance Centre. What are the causes of suspected cases of measles? *Comm Dis Rep* 1997;7:45.

28. National Health and Medical Research Council. Measles: guidelines for the control of outbreaks in Australia. Canberra: AGPS, 1996.

29. Ferson M, Young L, Robertson P, Whybin L. Difficulties in clinical diagnosis of measles: proposal for modified clinical case definition. *Med J Aust* 1995;163:364-366.