# Short reports

# ROTAVIRUS VACCINATION ONE YEAR ON...

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## Abstract

The rotavirus vaccine was incorporated into the Australian National Immunisation Program from 1 July 2007. To measure early impact of the vaccine on rotavirus disease and the burden of gastroenteritis in young children, we examined 2 surveillance data sources, rotavirus isolates from selected New South Wales laboratories, and New South Wales Emergency Department (ED) visits assigned a gastroenteritis-related diagnosis. Between 2001 and 2008, weekly time series were prepared for 2 age groups representing children young enough to have been offered vaccination prior to the 2008 seasonal epidemic (< 15 months) and older children (15 months to 5 years). In 2008, the seasonal increase in laboratory confirmed rotavirus infection and gastroenteritis related ED visits declined substantially in both age groups compared with earlier years. These data provide preliminary evidence of the effectiveness of the rotavirus vaccination program in New South Wales. Immunising the most susceptible population group, infants, against rotavirus may limit wider circulation of the virus in older children. *Commun Dis Intell* 2009;33(3):337–340.

Keywords: rotavirus, vaccine, immunisation, gastroenteritis, emergency department, surveillance

## Introduction

Rotavirus is a leading cause of gastroenteritis in children, with an estimated mortality as high as 702,000 deaths per year internationally, including 440,000 deaths in children aged under 5 years.[1,2] Eighty-five per cent of deaths occur in low income countries in Africa and Asia.[2]

Fortunately, in Australia, rotavirus was estimated to account for less than 1 death per year during 1990 to 2004.[3] Nevertheless, during 1993 to 1996, rotavirus gastroenteritis resulted in 10,000 hospitalisations per year and accounted for up to 50% of hospitalisations for diarrhoea in Australian children aged under 5 years.[4] Between 1998 and 2006, there were an estimated 22,000 emergency department (ED) presentations annually attributable to rotavirus.[5] In 2006, the estimated cost to the Australian health care system for rotavirus was estimated to be $30 million.[5] In 1997, nearly half of the primary carers and three-quarters of secondary carers of children with confirmed rotavirus suffered from a loss of income or required leave from employment to care for their children.[6]

In Australia, the 0–5 year age group (inclusive) experiences the greatest burden of rotavirus gastroenteritis, with those aged under 2 years representing 72% of all positive laboratory results.[7] Like many gastrointestinal infections, symptoms of rotavirus infection include severe diarrhoea, vomiting and intolerance to large volumes of fluid. The younger the child, the more rapid is the onset of dehydration and electrolyte imbalances.[8]

Rotavirus is seasonal and, in the more temperate regions of Australia, the highest rates occur within the cooler months. In New South Wales this period can range between June to October with the peak occurring in August to September.[5,8,9]

As of 1 July 2007 rotavirus vaccination was incorporated into the National Immunisation Program in Australia.[10] The Program provides free voluntary vaccination to all children and is administered by the Australian Government Department of Health and Ageing and implemented by State and Territory health agencies. In New South Wales, rotavirus vaccination commenced on 1 July 2007, using the oral live attenuated vaccine, Rotarix®, given at 2 and 4 months of age.[11]

Recommendations from the Rotavirus surveillance in Australia report suggest utilising laboratory positive rotavirus results, and general practice and ED presentations, to monitor the effectiveness of the rotavirus vaccine.[12] A previous study in New South Wales in 1996 showed a direct correlation between laboratory surveillance for rotavirus and gastroenteritis in EDs in children aged under 5 years and further confirmed the seasonal pattern.[13]

Based on the above recommendations we examined both laboratory and ED surveillance data to assess the early impact of the vaccine on the burden of rotavirus in young children in New South Wales.

## Methods

For the period 2001 to 2008, we examined weekly time series of counts of laboratory confirmed rotavirus infection from 2 public pathology providers, and visits to New South Wales EDs assigned a primary ED diagnosis of gastroenteritis or gastroenteritis symptoms, which include nausea, vomiting, and/or diarrhoea.

Children 2 months of age were eligible to be vaccinated on 1 July 2007 and would be aged 15 months on 1 August 2008, which would be the approximate mid-point of the seasonal increase. The time series were prepared for 2 age groups: children aged less than 15 months, who would have been offered and have completed the vaccine regime before the 2008 season; and those aged 15 months to 5 years, who were too old to have been included in the program.

Laboratory data were collected from 2 public pathology providers under the South Eastern Sydney Laboratory Surveillance Program. One of these provided services to a children's hospital and the second provided services to 4 adult and 1 children's hospital. Together, the laboratories provided services to both New South Wales paediatric hospitals.

Data for ED presentations were selected from the New South Wales Emergency Department Data Collection[14] based on primary ED diagnoses selected using International Classification of Diseases ICD-9, ICD-10 and SNOMED Clinical Terminology codes for gastroenteritis or gastroenteritis symptoms (codes available from the corresponding author). For the period analysed, this database contains reasonably complete data for 43 hospitals in both metropolitan and regional New South Wales, and these hospitals capture approximately two-thirds of all New South Wales ED presentations.

Catchment populations for New South Wales EDs cannot be determined, therefore disease incidence rates based on the New South Wales population will be under-enumerated due to the incomplete ED coverage. We nevertheless calculated population rates in order to account for changes in the population at risk over time. Rates were only calculated during the rotavirus season, June to October inclusive, and were annualised to be comparable to full year population rates.

## Results

The laboratory and ED time series clearly demonstrate the seasonal nature of rotavirus infection in New South Wales, with incidence peaking during June to October each year. Increases in rotavirus activity clearly coincide with increases in gastroenteritis presentations to EDs in children aged 5 years and under. Prior to 2008, the burden of rotavirus varied from year to year, with the lowest burden in 2004 (Table 1 and Figure). Children under the age of 15 months showed a disproportionately high burden of disease, annually accounting for 30% to 50% of ED presentations in children aged 5 years and under during the rotavirus season.

In 2008, the lowest count in 8 years of rotavirus infections was recorded in the laboratory data, with 117 confirmed infections identified. This compares with a minimum of 178 in 2004. In children aged under 15 months, the count of 36 in 2008 was dramatically lower than in any of the previous 7 years (minimum 83 in 2007). In Children aged 15 months to 5 years, the 2008 count of 81 was the second lowest of the 8 years, with the previous minimum being 76 in 2004 (Table 1). While the weekly counts showed little seasonal activity in the laboratory data in 2008, a distinct but smaller seasonal increase was evident in the weekly ED presentations for gastroenteritis in both age groups (Figure).

In children aged under 15 months, the annualised rate of gastroenteritis ED presentations for the period June to October (75 per 1,000) was lower in 2008 than in any of the previous 7 years (80.6–131.0 per 1,000). A similar pattern was evident in the older age group, with a rate of 26.0 per 1,000 during June to October 2008 compared with 28.9–51.5 per 1,000 in the 7 previous years (Table 2).

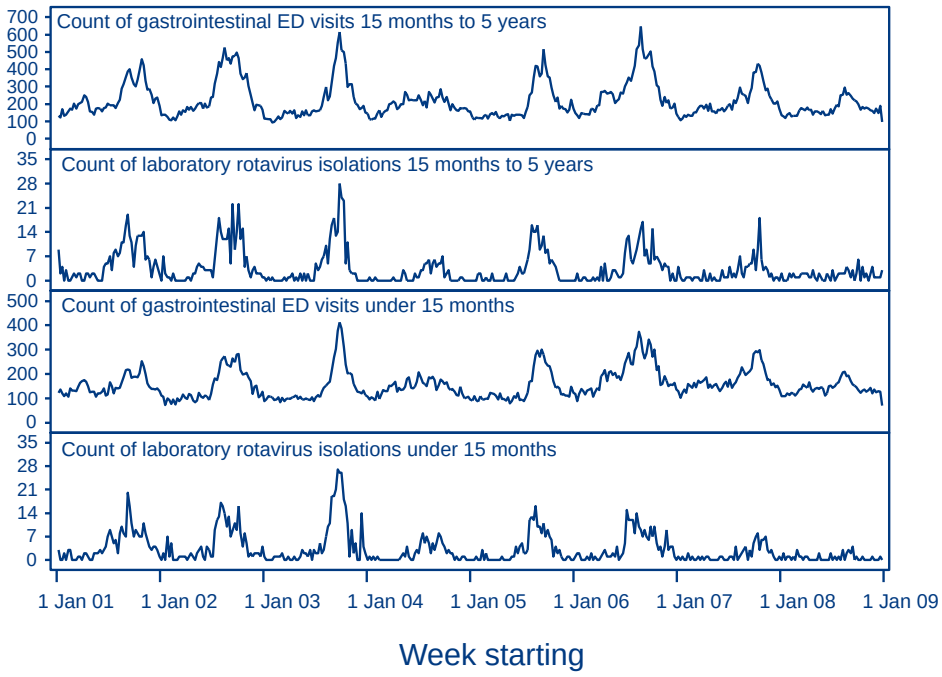
## Discussion and conclusion

We found that introduction of the rotavirus vaccine was associated with the lowest counts of positive

**Table 1: Counts of laboratory rotavirus isolations by year and age from two public pathology laboratories, 2001 to 2008**

| Year | Age under 15 months | Age 15 months to 5 years | Age 0 to 5 years |
|---|---|---|---|
| 2001 | 239 | 276 | 515 |
| 2002 | 238 | 281 | 519 |
| 2003 | 285 | 229 | 514 |
| 2004 | 102 | 76 | 178 |
| 2005 | 165 | 170 | 335 |
| 2006 | 219 | 215 | 434 |
| 2007 | 83 | 122 | 205 |
| 2008 | 36 | 81 | 117 |
| Total | 1,367 | 1,450 | 2,817 |

**Figure: Weekly counts of laboratory-positive rotavirus isolates and ED gastroenteritis presentations, children aged under 15 months and 15 months to 5 years, 2001 to 2008**




Laboratory data are from 2 public pathology laboratories in New South Wales and the emergency department (ED) data are from 43 New South Wales hospitals, and therefore do not include the entire New South Wales population.

**Table 2: Annualised counts and rates per 1,000 population of gastroenteritis presentations to 43 New South Wales emergency departments during and excluding the rotavirus season, June to October, New South Wales, 2001 to 2008**

| Year | Children aged under 15 months | | | | Children aged 15 months to 5 years | | | |
|---|---|---|---|---|---|---|---|---|
| | Presentations June–October | Annualised rate 1,000 June–October | Presentations other months | Annualised rate per 1,000 other months | Presentations June–October | Annualised rate per 1,000 June–October | Presentations other months | Annualised rate per 1,000 other months |
| 2001 | 3,795 | 84.0 | 4,129 | 65.3 | 6,163 | 35.6 | 5,937 | 24.5 |
| 2002 | 4,435 | 101.3 | 3,374 | 55.1 | 8,085 | 47.2 | 5,273 | 22.0 |
| 2003 | 4,267 | 80.6 | 3,409 | 46.0 | 6,557 | 38.1 | 4,695 | 19.5 |
| 2004 | 3,617 | 81.3 | 3,903 | 62.7 | 4,955 | 28.9 | 5,310 | 22.1 |
| 2005 | 4,014 | 90.0 | 3,845 | 61.6 | 5,918 | 34.6 | 5,145 | 21.5 |
| 2006 | 6,084 | 131.0 | 3,856 | 59.3 | 8,824 | 51.5 | 4,955 | 20.6 |
| 2007 | 4,609 | 100.0 | 4,537 | 70.3 | 5,866 | 34.5 | 5,202 | 21.9 |
| 2008 | 3,428 | 75.0 | 3,997 | 62.5 | 4,392 | 26.0 | 4,736 | 20.1 |

Rates underestimate the actual New South Wales population rate because not all New South Wales hospitals are included.

laboratory rotavirus isolates and presentations to EDs for gastroenteritis during the usual rotavirus season in the 8 years to 2008. While laboratory isolates were virtually absent during 2008, there remained evidence of residual seasonal activity in the ED time series. The declines occurred in the age group that would have been offered the vaccine prior to the 2008 season, and older children.

The apparent decrease in both the immunised and non-immunised age groups could be explained by unusually low community circulation of rotavirus in 2008 or by a beneficial effect of vaccination that had a flow-on effect to older children through reduced transmission in the most susceptible age group, infants. This phenomenon has been observed elsewhere,[15,16] but further studies will be required to confirm this apparent herd immunity.

Rotarix® vaccine contains a single, attenuated human rotavirus of serotype G1P[8] and has an efficacy of up to 84.7% against severe rotavirus

gastroenteritis caused by strains that carry the P[8] antigen.[17] In Australia during 2006 to 2007, the most common serotypes for rotavirus were the G1, G3, and G9 strains and each of these possess the P[8] antigen.[7] If rotavirus strains in Australia have not changed since 2006–2007, then Rotarix® should have been effective during the 2008 season. When more recent strain data become available, a clearer picture should emerge on whether a benefit of vaccination should have been expected.

A limitation of this study is that the ED presentation data does not discriminate between rotavirus gastroenteritis and gastroenteritis cause by other infectious and non-infectious agents. Nevertheless, the ED data collection covers a large proportion of the New South Wales population and provides a rapid means of assessing the burden of gastroenteritis in the New South Wales population. Laboratory data were restricted to only 6 hospitals, and this could explain the difference in apparent 2008 seasonal activity between the laboratory and ED time series – geographic variation in vaccine uptake might explain this difference.

As recommended by Ward et al,[12] both laboratory and non-laboratory surveillance of vaccine preventable diseases are valuable in evaluating the effectiveness of the rotavirus immunisation program. It appears likely that the introduction of the rotavirus vaccine in New South Wales has been associated with a marked decline in rotavirus and associated health utilisation activity. This will need to be confirmed by continued surveillance.

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