National Rotavirus Surveillance Program annual report, 2004-05

Carl D Kirkwood,[1] Nada Bogdanovic-Sakran,[2] David Cannan,[3] Ruth F Bishop,[4] Graeme L Barnes[5]

Abstract

The National Rotavirus Reference Centre together with collaborating laboratories Australia-wide has conducted rotavirus surveillance since June 1999. This report describes the serotypes of rotavirus strains responsible for the hospitalisation of children with acute gastroenteritis during the period 1 July 2004 to 30 June 2005. Six hundred and twelve faecal samples from across Australia were examined using monoclonal antibody immunoassays, reverse transcription-polymerase chain reaction and polyacrylamide gel analysis. Serotype G1 was the dominant serotype nationally, representing 48.3 per cent of all strains, followed by serotype G3 (36.7%) and serotype G9 (6.9%). As in previous years, there was substantial geographic variation in the prevalence of rotavirus serotypes. *Commun Dis Intell* 2006;30:133–136.

Keywords: rotavirus, annual report, disease surveillance

Introduction

Group A rotaviruses are the single most important cause of severe gastroenteritis in young children worldwide. An estimated 500,000 children die annually of severe diarrhoea, however, few of these deaths occur in developed countries.[1] Rotavirus induced disease accounts for up to 50 per cent of childhood hospitalisations for diarrhoea, with 10,000 Australian children hospitalised each year,[2] costing an estimated $26 million in direct costs. There is wide acceptance of the need for a vaccine to prevent rotavirus disease in children under 5 years of age throughout the world, as a component of the United Nations Millennium Development Goal 4 ('Reduce childhood mortality'). The first oral rotavirus vaccine was shown to be highly efficacious for the prevention of severe diarrhoea and hospitalisation due to rotavirus infection. A major setback was an apparent association with intussusception, a form of bowel obstruction in infants, which forced a withdrawal of the vaccine 9 months after introduction.[3] Two new rotavirus vaccines (Rotarix®, GlaxoSmithKline; and Rotateq®, Merck) have been developed, and are nearing licensure in many countries. National rotavirus surveillance is an important component in decisions about rotavirus vaccine implementation.

The previous rotavirus surveillance report from the National Rotavirus Surveillance Program, covering the period 1 July 2003 to 30 June 2004, documented the re-emergence of serotype G1 as the major serotype in Australia.[4] Prior to this, serotype G9 had been dominant in 2002/03, representing 74.7 per cent of samples nationally at that time.[5]

The surveillance and characterisation of rotavirus strains causing annual epidemics of severe diarrhoea in young children in Australia continues to be undertaken by the National Rotavirus Reference Centre in Melbourne, together with eight collaborating centres. In this report we describe the results for the period 1 July 2004 to 30 June 2005, and identify the geographic distribution of the predominant rotavirus serotypes.

Methods

Rotavirus positive specimens detected by enzyme immunoassay (EIA) or latex agglutination in collaborating laboratories were collected, stored frozen and forwarded to Melbourne, together with relevant age and sex details of patients. Specimens were then serotyped using an in-house monoclonal antibody (MAb) based serotyping EIA. The EIA employed a

1. Senior Research Fellow, Murdoch Children's Research Institute, Parkville, Victoria
2. Research Assistant, Murdoch Children's Research Institute, Parkville, Victoria
3. Research Assistant, Murdoch Children's Research Institute, Parkville, Victoria
4. Senior Principal Research Fellow, Murdoch Children's Research Institute, Parkville, Victoria
5. Senior Principal Research Fellow, Murdoch Children's Research Institute, Parkville, Victoria

Corresponding author: Dr Carl Kirkwood, Enteric Virus Research Group, Murdoch Childrens Research Institute, Royal Children's Hospital, Flemington Road, Parkville, VIC 3052. Telephone: +61 3 9345 5970. Facsimile: +61 3 9345 6240.
Email: carl.kirkwood@mcri.edu.au

panel of MAbs specific for the major glycoprotein VP7 of the outer capsid of the five major group A human rotavirus serotypes (G1, G2, G3, G4 and G9).[6] Strains which could not be assigned a G serotype were genotyped by reverse transcription/polymerase chain reaction (RT/PCR), using serotype specific oligonucleotide primers.[7] Polyacrylamide gel electrophoresis (PAGE) was used to classify rotavirus strains genetically into electropherotypes, and to examine the extent of sharing of the same electropherotype between collaborating centres.

Results

Number of isolates

A total of 612 specimens were received for analysis from Melbourne and the collaborating centres in Western Australia, the Northern Territory, New South Wales, and South Australia. Five hundred and sixty-eight specimens were confirmed as rotavirus positive using our in-house EIA assay. Specimens containing insufficient specimen for testing, or specimens that were not confirmed to be positive for rotavirus (n=44) were not analysed further.

Age distribution

The overall age distribution of children with acute rotavirus gastroenteritis is depicted in the Figure. In the reporting period, 42.5 per cent of cases were from infants aged 12 months or less, 31 per cent were from patients 13–24 months of age, and 11.2 per cent were from patients 25–36 months of age. Overall, 84.7 per cent of samples were from aged children three years or less, and 90.8 per cent were from aged children five years or less. The male to female ratio was 1 to 1.

Children under 12 months of age were more likely to have a G3 infection (51.6%) than those aged 13–24 months (29.4%). In Alice Springs and Darwin 68.7 per cent of children with a serotype G3 infection were aged 12 months or less. Other serotypes (G1, G2 or G9) were equally common in children under 12 months (38.3%) and in those aged 13–24 months (31.5%).

Serotype distribution

The rotavirus serotypes identified in Australia from 1 July 2004 to 30 June 2005 are shown in the Table. Serotype G1 was the most common, representing 48.2 per cent of all specimens. It was the dominant strain in four of the eight centres (Melbourne, Sydney (POW, Westmead), Adelaide), and was the second most common type in the remaining centres. Serotype G3 was the second most common serotype nationally, and represented 36.6 per cent

Figure. Cases of rotavirus, Australia, 1 July 2004 to 30 June 2005, by age group

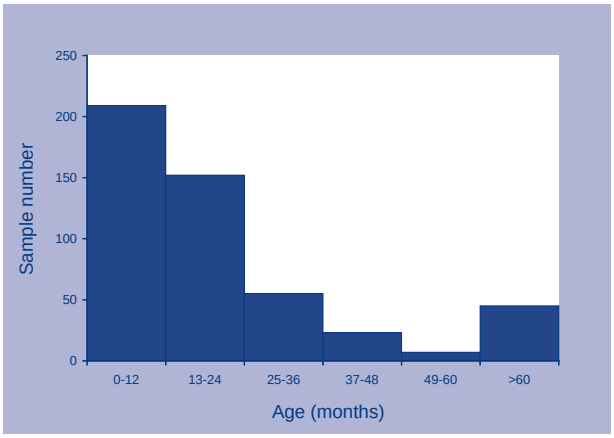

Table. Rotavirus G serotypes, Australia, 1 July 2004 to 30 June 2005

Centre	Total number	G1		G2		G3		G4		G9		Mix		NR	
		%	n	%	n	%	n	%	n	%	n	%	n	%	n
Melbourne	147	77.6	114	0.0		6.8	10	1.4	2	8.8	13	0.7	1	4.8	7
Sydney (POW)	44	56.8	25	2.3	1	0.0		0.0		38.6	17	0.0		2.3	1
Sydney (Westmead)	16	53.3	8	0.0		13.3	2	0.0		0.0		6.7	1	33.3	5
Perth+	98	34.7	34	2.0	2	58.2	57	0.0		5.1	5	0.0		0.0	
PathWest†	142	40.1	57	0.0		40.1	57	1.4	2	2.1	3	0.7	1	15.5	22
Alice Springs	55	1.8	1	0.0		98.2	54	0.0		0.0		0.0		0.0	
Darwin	46	30.4	14	4.3	2	60.9	28	0.0		0.0		4.3	2	0.0	
Adelaide	21	100	21	0.0		0.0		0.0		0.0		0.0		0.0	
Total	568	48.2	274	0.9	5	36.6	208	0.7	4	6.7	38	0.9	5	6.0	34

* An additional 44 specimens were omitted from analysis due to insufficient sample or specimen was not confirmed to be rotavirus positive.

† The two Western Australia centres represent different geographic areas, one urban (Perth) and one remote (PathWest).

of specimens overall. It was identified in six centres and was the dominant type in Western Australia and the Northern Territory. Serotype G9 was the third most common, but represented only 6.7 per cent of all specimens. It was identified in four centres, and was the second most common type in two centres (Melbourne and Sydney POW). Serotype G2 and G4 were each identified in three centres during the study, but each represented less than one per cent of the total strains identified.

Less than one per cent of the rotavirus samples contained multiple serotypes, and in 6.0 per cent of the samples a serotype was not identified. The latter could be samples with virus numbers below the detection limits of our assays, or could have contained inhibitors present in extracted RNA that prevent the function of the enzymes used in RT and/or PCR steps. It is unlikely that these represent unusual serotypes not identified using standard methods, since none of the non-typeable isolates exhibited unusual PAGE patterns. Future studies will include further characterisation of the genes encoding the outer capsid proteins of these strains.

Discussion

National rotavirus surveillance from 1 July 2004 to 30 June 2005 highlighted G1 as the dominant serotype nationally. Thus G1 has been the dominant type for the last two years.[4] It was identified in all centres; was dominant along the Eastern seaboard, in Melbourne and Sydney and Adelaide; and was the second most common serotype from Perth and PathWest. Previously, serotype G1 was dominant from 1999 to 2001.[8,9] The emergence of serotype G9 during 2002–2003, replaced G1 as the dominant serotype in Australia for a short time. Epidemiological studies conducted throughout the world continue to identify serotype G1 as the dominant serotype.[10,11]

G3 was the second most common serotype during this survey, continuing its emergence as a significant cause of acute gastroenteritis in Australia. A slight increase of G3 was seen in this survey, rising from a prevalence of 25.7 per cent during 2003/04 to 36.6 per cent in 2004/05. Of more significance was the finding that serotype G3 was dominant in both Western Australia and the Northern Territory. These serotype G3 strains may move eastward to Sydney and Melbourne, as was earlier seen with serotype G9. The initial major impact of G9 was seen in Western Australia, then the Northern Territory in following seasons, before becoming the dominant type in the eastern states.

The decline in prevalence of serotype G9 has been as dramatic as its emergence. G9 was first identified during Australia-wide surveillance in 1997,[12] and became the dominant strain nationally in 2001/02, comprising 40 per cent of the strains[13] and 74.7 per cent in 2002/03.[5] However, during the current survey, G9 was present in only four centres, and represented only 6.7 per cent of all strains. Thus serotype G9 has waned to become a minor cause of rotaviral disease in Australian children.

During the previous 2003/04 survey,[4] the serotype G3 strains seen in Western Australia infected children aged 13–24 months more frequently than children aged 12 months or less ($P<0.001$). In contrast, serotype G3 identified during the 2004/05 season has been associated with younger infants. Over 50 per cent of the children infected with a G3 strain were aged 12 months or less. However, these occurred mainly in the Northern Territory, where rotavirus infection in general appears to cause disease in a younger age group than in the rest of Australia.

The rotavirus serotyping results from this survey, together with those of previous years, highlight continuing changes in the prevalence and emergence of rotavirus serotypes. Multi-centre surveillance of rotavirus is important to continue to monitor strains in Australia, since state-to-state variation continues to be evident. This information is relevant to strategies about implementation of rotavirus vaccines.

Acknowledgements

The Rotavirus Surveillance Program is supported by grants from the Australian Government Department of Health and Ageing, GlaxoSmithKline and CSL. Dr Kirkwood is supported by an RD Wright Fellowship, NHMRC.

Rotavirus positive specimens were collected from numerous centres throughout Australia. The significant time and effort involved in the collection, storage, packaging, compiling data and forwarding of specimens was much appreciated. Without the contribution of the following people the study would not have been possible.

New South Wales

Prof W Rawlinson, Dr C McIver and members of the Virology Division, Prince of Wales Hospital

Dr A Kesson and members of the Microbiology Department, The Children's Hospital at Westmead

Northern Territory

Dr P Southwell and members of the Microbiology Department, Royal Darwin Hospital, Casuarina

Dr B Truscott and members of the Pathology Department, Western Diagnostic Pathology, Tiwi

Ms F Morey, Mr J McLeod and members of the Microbiology Department, Alice Springs Hospital, Alice Springs

South Australia

Dr A Lawrence and members of the Microbiology and Infectious Diseases Department, Women's and Children's Hospital, North Adelaide

Victoria

Dr R Alexander and members of the Virology Department, Royal Children's Hospital, Parkville

Western Australia

Dr K Lindsay and members of the Virology Department, Princess Margaret Hospital for Children, Subiaco

Dr D Smith, Dr G Harnett and members of Division of Microbiology, PathWest, The Queen Elizabeth Medical Centre, Nedlands

References

1. Parashar UD, Hummelman EG, Bresee JS, Miller MA, Glass RI. Global illness and deaths caused by rotavirus disease in children. *Emerg Infect Dis* 2003;9:565–572.

2. Carlin JB, Chondros P, Masendycz P, Bugg H, Bishop RF, Barnes GL. Rotavirus infection and rates of hospitalisation for acute gastroenteritis in young children in Australia, 1993–1996. *Med J Aust* 1998;169:252–256.

3. Glass RI, Bresee JS, Parashar UD, Jiang B, Gentsch J. The future of rotavirus vaccines: a major setback leads to new opportunities. *Lancet* 2004;363:1547–1550.

4. Kirkwood CD, Bogdanovic-Sakran N, Bishop R, Barnes G. Report of Australian Rotavirus Surveillance Program, 2003/2004. *Commun Dis Intell* 2004;28:481–485.

5. Kirkwood CD, Bogdanovic-Sakran N, Clark R, Bishop RF, Barnes GL. Report of Australian Rotavirus Surveillance Program, 2002/2003. *Commun Dis Intell* 2003;27:492–495.

6. Coulson B, Unicomb L, Pitson G, Bishop R. Simple and specific enzyme immunoassay using monoclonal antibodies for serotyping human rotaviruses. *J Clin Microbiol* 1987;25: 509–515.

7. Gouvea V, Glass RI, Woods P, Taniguchi K, Clark HF, Forrester B, *et al*. Polymerase chain reaction amplification and typing of rotavirus nucleic acid from stool specimens. *J Clin Microbiol* 1990;28:276–282.

8. Masendycz P, Bogdanovic-Sakran N, Palombo E, Bishop R, Barnes G. Annual report of the Rotavirus Surveillance Program, 1999/2000. *Commun Dis Intell* 2000;24:195–198.

9. Masendycz P, Bogdanovic-Sakran N, Kirkwood C, Bishop R, Barnes G. Report of the Rotavirus Surveillance Program, 2000/2001. *Commun Dis Intell* 2001;25:143–146.

10. Gentsch JR, Laird AR, Biefelt B, Griffin DD, Banyau K, Ramachandran M, *et al*. Serotype diversity and reassortment between human and animal rotavirus strains: implications for rotavirus vaccine programs. *J Infect Dis* 2005;192:S146–S159.

11. Santos N, Hoshino Y. Global distribution of rotavirus serotypes/genotypes and its implication for the development and implementation of an effective rotavirus vaccine. *Rev Med Virol* 2005;15:29–56.

12. Palombo EA, Masendycz PJ, Bugg HV, Bogdanovic-Sakran N, Barnes GL, Bishop RF. Emergence of serotype G9 human rotaviruses in Australia. *J Clin Microbiol* 2000;38:1305–1306.

13. Kirkwood C, Bogdanovic-Sakran N, Clark R, Masendycz P, Bishop R, Barnes G. Report of Australian Rotavirus Surveillance Program, 2001/2002. *Commun Dis Intell* 2002;26:537–540.