

Organised mass immunisation

Box: Rotavirus identification and vaccine development and deployment

Rotavirus was the commonest cause of severe diarrhoea in children not only in Australia but worldwide, where it was also responsible for diarrhoeal deaths of children in developing countries. Australian public health research – led by a team of Australian virologists – played a leading role in the identification and discovery of the rotavirus, which led to the development of vaccines against the disease. Vaccine development and its application in turn resulted in major reductions in children’s hospitalisations and deaths from rotavirus, vaccine improvements (with ongoing work to develop improved vaccines in Australia), and different ways of looking at the cost-effectiveness of childhood vaccines, in particular.

Before the discovery of the human rotavirus by a team of Australian virologists headed by Professor Ruth Bishop, most children admitted to hospital with acute gastro-enteritis had no known cause for their illness.¹ The work of Professor Bishop’s team and others in developing vaccines over forty years led to global control of rotavirus infection.

Accelerated development and introduction of rotavirus vaccines into global immunisation programmes was a high priority for many international agencies, including the World Health Organization (WHO) and the Global Alliance for Vaccines and Immunizations.^{2:323} Preventive strategies on a global scale were considered to hold the most promise for reductions in the burden of diarrhoeal diseases.^{3:641}

In Australia, prior to the introduction of the vaccine in 2007, around 10,000 children were hospitalised annually with rotavirus infection. The rotavirus vaccine was given to 80-85% of children in Australia, and hospitalisations decreased substantially.⁴ There were 1,280 hospitalisations due to rotavirus recorded in 2011-12 (the last year for which the Australian Institute of Health and Welfare held data).⁵ Hospitalisations for all cases of acute gastroenteritis were estimated at around 7,000 per year fewer than in the pre-vaccine years.^{5:6} As well as substantial declines in hospitalisations of children aged less than five years, reductions were also seen in those aged 5-19 years, suggesting an increase in herd immunity and reduced transmission of the virus at a population level.⁶

There was however, more that needed to be done in Australia, to address the hospitalisations rates of Indigenous children which remained higher than, and had smaller decreases than those for the non-Indigenous population (in other words, the gap widened as improvements took place across the population).⁶

In 2010, the WHO recommended that rotavirus vaccine be included in all national immunisation programs, noting that countries (including Australia, the Americas and Europe) which had implemented routine childhood immunisation against rotavirus, achieved significant reductions in the burden of severe childhood diarrhoeal disease. Disease rates also appeared to have reduced in unvaccinated children, suggesting that immunisation also conferred the indirect benefits of ‘herd protection’.⁷

Although most developed countries around the world give their children a vaccine, the vaccines are not used in countries with the highest disease burden because of the cost.⁸ Work at the Murdoch Children’s Research Institute on a new rotavirus vaccine which could be administered to babies at birth was planned to be rolled out to 50 million children in developing countries by 2015 (with support from the Global Alliance of Vaccines and Immunizations and the Bill and Melinda Gates Foundation).⁴ In Europe, by February 2014, national universal rotavirus vaccination had been implemented in eight countries in Europe (including Austria, Belgium, Finland, Greece, Norway, and the UK) while other countries (including Germany) were in the process of recommending or implementing universal rotavirus vaccination.⁹ Globally, their introduction into routine childhood immunisation programs in more than 47 countries resulted in rapid declines in hospital admissions and deaths within the relatively short period of three years.⁸

Childhood rotavirus vaccination programs were also used as a case study to progress cost-effectiveness evaluation.¹⁰ Economic evaluation of vaccination programs can be challenging and may not fully estimate benefits for various reasons, including the difficulties of capturing the health and economic

impact of infectious diseases accurately and their interactions. Rotavirus infection, for example, peaks at a similar time as other infectious diseases which can cause hospital overcrowding, which may pose additional risk to more vulnerable children due to the limited availability of hospital isolation facilities. Caregiver burden caused by childhood diseases, which require parents to take time off work, are also important to estimate and cost.¹⁰

In summary, global control of rotavirus infection was well underway and the Australian contribution in this field over more than fifty years, since the identification of rotavirus in 1973, continued to be significant.

References

1. Bishop RF, Davidson GP. Virus-particles in epithelial-cells of duodenal mucosa from children with acute non-bacterial gastroenteritis. *Lancet* 1973; 2(7841): 1281-1283.
2. Glass RI, Parashar UD, Bresee JS, Turcios R, Fischer TK, Widdowson M-A, et al. Rotavirus vaccines: current prospects and future challenges. *Lancet* 2006; 368(9532):323-332.
3. Thapar N, Sanderson IR. Diarrhoea in children: an interface between developing and developed countries. *Lancet* 2004; 363(9409):641-653.
4. ABC News Online. (2013) Professor Ruth Bishop awarded Florey Medal for work on rotavirus vaccine. <<http://www.abc.net.au/news/2013-10-28/scientist-recognised-for-developing-rotavirus-vaccine/5050610>>
5. Australian Institute of Health and Welfare (AIHW). Australia's health 2014. Australia's health series no. 14. AIHW cat. no. AUS 178. Canberra: AIHW, 2014.
6. Dey A, Wang H, Menzies R, Macartney K. Changes in hospitalisations for acute gastroenteritis in Australia after the national rotavirus vaccination program. *Medical Journal of Australia* 2012; 197(8):453-457.
7. Tate JE, Patel MM, Steele AD, Gentsch JR, Payne DC, Cortese MM, et al. Global impact of rotavirus vaccines. *Expert Review of Vaccines* 2010; 9(4):395-407.
8. Glass RI, Parashar U, Patel M, Gentsch J, Jiang B. Rotavirus vaccines: successes and challenges. *Journal of Infection* 2014; 68, Supplement 1(0):S9-S18.
9. Parez N, Giaquinto C, Du Roure C, Martinon-Torres F, Spoulou V, Van Damme P, et al. Rotavirus vaccination in Europe: drivers and barriers. *Lancet Infectious Diseases* 2014; 14(5):416-425.
10. Brügggenjürgen B, Lorrot M, Sheppard FR, Rémy V. Do current cost-effectiveness analyses reflect the full value of childhood vaccination in Europe?: A rotavirus case study. *Human Vaccines and Immunotherapeutics* 2014; 10(8):2290-2294.