Vaccine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Hospitalised rotavirus gastroenteritis in New Zealand: The laboratory database is a valuable tool for assessing the impact of rotavirus vaccination

Matthew J. Kelly [a,*], David Foley [b], Timothy K. Blackmore [b,c]

[a] Department of Medicine, Hutt Hospital, Hutt Valley District Health Board, High St, Lower Hutt 5010, New Zealand
[b] Wellington SCL Microbiology Laboratory, Wellington Hospital, Riddiford St, Wellington 6010, New Zealand
[c] Department of Infection Services, Wellington Hospital, Capital and Coast District Health Board, Riddiford St, Wellington 6010, New Zealand

ARTICLE INFO

Article history:
Received 23 August 2016
Received in revised form 16 June 2017
Accepted 5 July 2017
Available online xxxx

Keywords:
Rotavirus
Vaccination
New Zealand
Hospital admission

ABSTRACT

Aim: To assess the impact of the introduction of rotavirus vaccination in New Zealand at a regional and national level, underlining the utility of a passively collected laboratory dataset.
Method: Retrospective laboratory data for rotavirus testing from Wellington and Hutt Hospitals from 1 January 2010 to 31 December 2016, matched with hospital admissions data of children under 5 years of age with gastroenteritis primary and secondary coded admissions. The second part of the study examined the national dataset of primary coded hospital gastroenteritis admissions from the same period.
Results: Rotavirus testing was performed in 1054 (64.1%) of the 1645 gastroenteritis admissions to Wellington and Hutt Hospitals. Four hundred and nine of these tests (38.8%) were positive. Children who were not given a primary code of gastroenteritis accounted for 5.7% of rotavirus admissions. The estimated annual rotavirus hospitalisation rate in the Hutt and Wellington regions for children under 5 years during the pre-vaccination period was 427.1 per 100,000. In the post-vaccination period (2015–2016), there was a 94.6% reduction in confirmed rotavirus gastroenteritis hospitalisations with only 8 confirmed cases. The total number of gastroenteritis admissions declined by 51.4%. On a national scale, there was a decline of 34.4% in the average annual number of gastroenteritis admissions and the number of coded rotavirus admissions was 87.1% lower than the pre-vaccination average.
Conclusion: The non-restrictive continuous approach to rotavirus testing has provided a detailed description of the epidemiology of rotavirus gastroenteritis hospitalisations in the Wellington and Hutt regions. Rotavirus vaccination introduced on the crest of a peak in rotavirus cases has lead to a marked reduction in the number of admissions with gastroenteritis in New Zealand in the two years following vaccine introduction. The national figures likely underestimate the impact of the vaccine.

1. Introduction

Rotavirus gastroenteritis has a significant burden of morbidity and mortality [1]. Prior to the introduction of the rotavirus vaccine, it was estimated that 90% of children in New Zealand would have developed rotavirus gastroenteritis by three years of age [2]. Approximately one in five children would have received medical care and one in 43 would have been admitted to hospital by five years of age [3]. In 2006, an effective vaccine began to be adopted by national immunization programs worldwide [4]. In July 2014, New Zealand introduced a live attenuated pentavalent reassortment vaccine (RotaTeq) for use in the prevention of rotavirus gastroenteritis [1]. The reassortment viruses, isolated from bovine and human hosts, express a combination of outer capsid proteins and attachment proteins from their parent strains [5]. This orally administered vaccine was included as part of the routine free immunisation schedule at six weeks, three months and five months [1].

By September 2015, 79 countries including New Zealand had incorporated the vaccine into their schedules [4]. Completing the vaccination regimen has been found to be protective against 74% of rotavirus gastroenteritis of any severity, with almost complete protection against severe gastroenteritis [6]. A systematic review of published data from 9 countries reported a decline of between 49% and 89% in laboratory-confirmed rotavirus hospitalizations of children less than five years in the two years after vaccine introduction [7]. A decline was also seen in the incidence of infection in children that were not vaccinated indicating a herd effect [4].

* Corresponding author.
E-mail address: matthew.kelly@huttvalleydhb.org.nz (M.J. Kelly).

http://dx.doi.org/10.1016/j.vaccine.2017.07.018
0264-410X/

The aim of this study was to assess the impact of the introduction of the rotavirus vaccine in New Zealand at a regional and national level. We report on the utility of a regional continuous passively collected dataset in providing a detailed epidemiological evaluation of the impact of the introduction at a regional level. We examined the data from two neighbouring district health boards, Wellington and Hutt Hospital laboratory services. Wellington and Hutt Hospitals provide the only acute inpatient hospital services for the local population consisting of over 28,000 children under 5 years accounting for 9.2% of that population in New Zealand [8]. The only other emergency services available for children in the region are general practice clinics. Data from the period spanning pre- and post-vaccine introduction was utilised to describe the epidemiology of gastroenteritis admissions and rotavirus in the hospital setting, including hospital-acquired infections. Secondly, we evaluated the impact on the overall national admission rate for gastroenteritis and rotavirus coded hospital admissions of children under 5 years in New Zealand.

2. Methods

The first part of the study employed retrospective laboratory data for rotavirus testing from Wellington and Hutt Hospitals from 1st January 2010 to 31st December 2016, matched with hospital admissions data of children under 5 years of age. It is our standard practice that all stool specimens from children under 5 years of age are tested for rotavirus, even when not specifically requested. This is the only viral test that is reflexively performed. Testing for other viruses such as adenovirus or norovirus must be specifically requested. Rotavirus tests were performed using the Coris BioConcept RotaStrip test (Wellington Hospital) or Meridian Latex agglutination test (Hutt Hospital). Duplicate tests were defined as a repeat test performed on the same date and were excluded.

Children with a primary or secondary diagnostic code for acute gastroenteritis (ICD-10-AM) covering known infectious or unknown causes of gastroenteritis (A000–A090) were selected from the hospital admissions database. This includes the specific code for rotaviral enteritis (A080). An admission was classified as admission onto a paediatric ward. Children discharged from the Emergency Departments or Child Assessment Units were not included. Second admissions were excluded if occurring within 7 days. Data was matched in Microsoft Excel using the unique National Health Index (NHI). The rotavirus test was considered to be relevant to the child's admission if the test was performed from 3 days prior to admission until 3 days after discharge. To account for potential miscoding, children with a positive rotavirus test without a gastroenteritis admission code were identified. If an admission occurred without a gastroenteritis code, the clinical notes were reviewed to determine if the admission could be attributed to rotavirus. These cases were included in the analysis.

2.1. Burden of disease

To estimate the total number of rotavirus admissions, children with gastroenteritis who did not have a rotavirus test performed were assumed to have the same positivity rate as those who did undergo testing, standardising for age (six-monthly intervals), coding category (primary vs. secondary) and season (summer-autumn vs. winter-spring). Population estimates were calculated using data from Statistics New Zealand from Census 2013 [8]. Rotavirus vaccine became freely available from the start of July 2014. This corresponded with the peak season for rotavirus. The year of vaccine introduction was included as part of the pre-vaccination period due to the relatively small number of children eligible for vaccination during this time.

2.2. Hospital acquired infections

Potential hospital-acquired infections (HAI) with rotavirus were defined as a positive rotavirus test 3 or more days after the date of admission or within 7 days of discharge. The clinical notes of potential cases were reviewed to determine if this was consistent with a probable HAI. Probable HAI cases were excluded from analyses of gastroenteritis hospitalisations.

2.3. National data

The second part of the study examined the national data set of all coded paediatric hospital admissions from January 2010 to December 2016. This data set captures all public and private hospital discharge codes. The number of admissions of children under 5 years of age with a primary diagnostic code of acute gastroenteritis (A000-A090) and rotaviral enteritis (A080) were extracted. Only acute admissions were included in the analysis. The data was examined in yearly cohorts.

2.4. Analysis

Statistical analyses were performed using Stata/IC 11.1 statistical software. Categorical variables were compared using chi-squared tests. Unconditional logistic regression was performed to assess the impact of factors on testing and positive results. Results of statistical tests are presented as odds ratios with 95% confidence intervals.

2.5. Ethics

This study was a surveillance activity using routinely collected clinical and laboratory data. The Hospital Research Governance Group determined that this did not require formal ethical review. The study was registered with the local Child Health Research Committee.

3. Results

During the study period, 3836 rotavirus tests were performed (excluding 64 duplicates) of which 498 (13.0%) were positive. The number of children admitted with a diagnostic code for gastroenteritis during this period was 1645 which included 334 (20.3%) admissions with gastroenteritis as a secondary diagnostic code. A further 11 admissions with a positive rotavirus test which did not have a diagnostic code for gastroenteritis were identified from the laboratory data and were included in the data set. Twenty-five admissions, including 3 un-coded cases, were identified as hospital-acquired rotavirus infection and were excluded from the analysis.

Rotavirus testing was performed in 1054 (64.1%) of the 1645 gastroenteritis admissions (Table 1). Four hundred and nine of these tests (38.8%) were positive. The rotavirus specific code (A080) was used in 362 (88.5%) of these confirmed rotavirus gastroenteritis admissions. Twenty-six children (7.2%) were incorrectly coded with the A080 code when they had either a negative rotavirus test or had not been tested.

3.1. Factors associated with being tested

Children were more likely to be tested if they were admitted to Wellington hospital compared to Hutt Hospital (68.5% vs. 56.1%, OR 1.67, 95%CI 1.36–2.05). Testing was more likely to occur during the winter-spring seasons when rotavirus is more prevalent compared to the summer-autumn season (66.6% vs. 59.9%, OR 1.33,

Please cite this article in press as: Kelly MJ et al. Hospitalised rotavirus gastroenteritis in New Zealand: The laboratory database is a valuable tool for assessing the impact of rotavirus vaccination. Vaccine (2017), http://dx.doi.org/10.1016/j.vaccine.2017.07.018