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Impact of five years of rotavirus vaccination in Finland – And the associated cost savings in secondary healthcare

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ABSTRACT

Introduction: This study aimed to estimate the impact of the national rotavirus (RV) vaccination programme, starting 2009, on the total hospital-treated acute gastroenteritis (AGE) and severe RV disease burden in Finland during the first five years of the programme. This study also evaluated the costs saved in secondary healthcare by the RV vaccination programme.
Methods: The RV related outcome definitions were based on ICD10 diagnostic codes recorded in the Care Register for Health Care. Incidences of hospitalised and hospital outpatient cases of AGE (A00-A09, R11) and RVGE (A08.0) were compared prior (1999–2005) and after (2010–2014) the start of the programme among children less than five years of age.
Results: The reduction in disease burden in 2014, when all children under five years of age have been eligible for RV vaccination, was 92.9% (95%CI: 91.0%–94.5%) in hospitalised RVGE and 68.5% (66.6%–70.3%) in the total hospitalised AGE among children less than five years of age. For the corresponding hospital outpatient cases, there was a reduction of 91.4% (82.4%–96.6%) in the RVGE incidence, but an increase of 6.3% (2.7%–9.9%) in the AGE incidence. The RV vaccination programme prevented 2206 secondary healthcare AGE cases costing €4.5 million annually. As the RV immunisation costs were €2.3 million, the total net savings just in secondary healthcare costs were €2.2 million, i.e. €33 per vaccinated child.
Discussion: The RV vaccination programme clearly controlled the severe, hospital-treated forms of RVGE. The total disease burden is a more valuable end point than mere specifically diagnosed cases as laboratory confirmation practises usually change after vaccine introduction. The RV vaccination programme annually pays for itself at least two times over.

1. Introduction

Rotavirus (RV) is a common cause of severe gastroenteritis among children: worldwide, almost all children have had an episode of RV gastroenteritis (RVGE) by the age of five; 1 out of 5 children have visited an outpatient clinic, 1 out of 65 has been hospitalised and approximately 1 out of 293 died [1,2]. Due to the globally high disease burden, the World Health Organization has recommended RV vaccine to be included in national immunisation programmes [3].

The effectiveness of both of the RV vaccines on the market, RotaTeq (Merck) and Rotarix (GlaxoSmithKline), has been adequately shown before marketing [4–7] and also in field use in various settings [8–14]. Despite this, less than a third of the European countries have implemented universal RV immunisation programmes [15].

Although the vaccine has not been widely implemented, costs caused by RV have been estimated in several European countries, for example in Germany, Italy, and Sweden [16]. According to this multicentre study, the mean direct medical cost per an RVGE episode requiring an emergency department visit ranged from €80 to €476, and an episode requiring inpatient hospitalisation ranged from €1217 to €1515 [16]. Furthermore, several European countries such as France, the UK, the Netherlands, and Ireland, have carried out cost-effectiveness analyses in order to consider universal RV immunisation [17–21]. The results in these studies have been inconsistent.

In the cost-effectiveness studies prior to the immunisation programme implementation, several assumptions on issues such as vaccine price, impact of the programme, achievable immunisation coverage or possible indirect protection have to be made. For

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example in the Netherlands, one reason for the inconsistent results in four different cost-effectiveness analyses has been the lack of consensus on the impact [20]. The total impact, including both direct and indirect protection, can be confirmed only after the immunisation programme implementation [22].

In Finland, the national RV vaccination programme started in 2009. RotaTeq has since been offered free of charge to all children born in July 2009 or later. Based on the National Vaccination Register [23], RV vaccination coverage was estimated at 91%–93% (www.thl.fi/ vaccine coverage). Consequently, there were roughly 300 000 vaccinated children by the end of year 2014. In this study, we compare the population-based incidences of hospitalised and hospital outpatient cases of acute infectious gastroenteritis (AGE) and RVGE before the RV vaccines were available to the respective incidences in 2014, when all children under five years of age had been offered the vaccine. Through this comparison we estimate the overall impact of the national RV vaccination programme in secondary healthcare.

2. Methods

We performed a register-based ecological study comparing the RV disease burden before and after the introduction of RV vaccination in Finland. Removing a transitional period from 2006 to 2009, when RV vaccination was not yet covered by the programme but available by the parents' own expense and approximately a third of a birth cohort was vaccinated, we defined the years 1999–2005 as pre-vaccine period and the years 2010–2014 as (post-introduction) vaccination period.

The study population comprised all children younger than five years of age living during the pre-vaccine and/or vaccination period in Finland. We obtained the size of the study population stratified by calendar year and age from the Finnish Population Information System. Timely fluctuations of the population count were ignored and the exact number of children susceptible to RV at any specific time point was not assessed.

We estimated the incidence of AGE based on diagnostic information recorded in the Care Register for Health Care (Hilmo) [24]. Hilmo contains nationwide data on inpatient and outpatient healthcare provided in Finnish hospitals (i.e. secondary healthcare). We extracted the unique personal identifier and the age of the patient, the date and the type of the visit, as well as the reason for the visit, i.e. the International Classification of Diseases, 10th revision (ICD10) diagnostic codes. We selected all inpatient and outpatient visits of children within the study population with records of A00-A09 (intestinal infectious diseases), R11 (nausea and vomiting) and K52 (other non-infective gastroenteritis and colitis) as primary diagnosis (Fig. 1). Iterative visits of a child were linked by using the unique personal identifier and were assumed to be caused by the same disease episode if 21 days or less had elapsed from the previous visit or discharge till the next visit or admission.

We categorized all episodes based on the registered diagnostic codes (Fig. 1A). All episodes with at least one visit due to A00-A09 or R11 formed the general outcome AGE. We counted all AGE episodes as cases. Further subclassifying these AGE episodes, all episodes with at least one visit due to A08.0 were defined as RVGE and all episodes with at least one visit due to A08.4 (acute gastroenteritis, without known aetiology, which on clinical grounds is assumed to be of viral origin) or A08 but none due to A08.0 as unspecified viral gastroenteritis (UVGE). Another AGE subclass was other unspecified gastroenteritis (UAGE) formed by all episodes with all visits only due to R11, A09, and the most unspecific codes in A00-A09. All remaining AGE episodes that

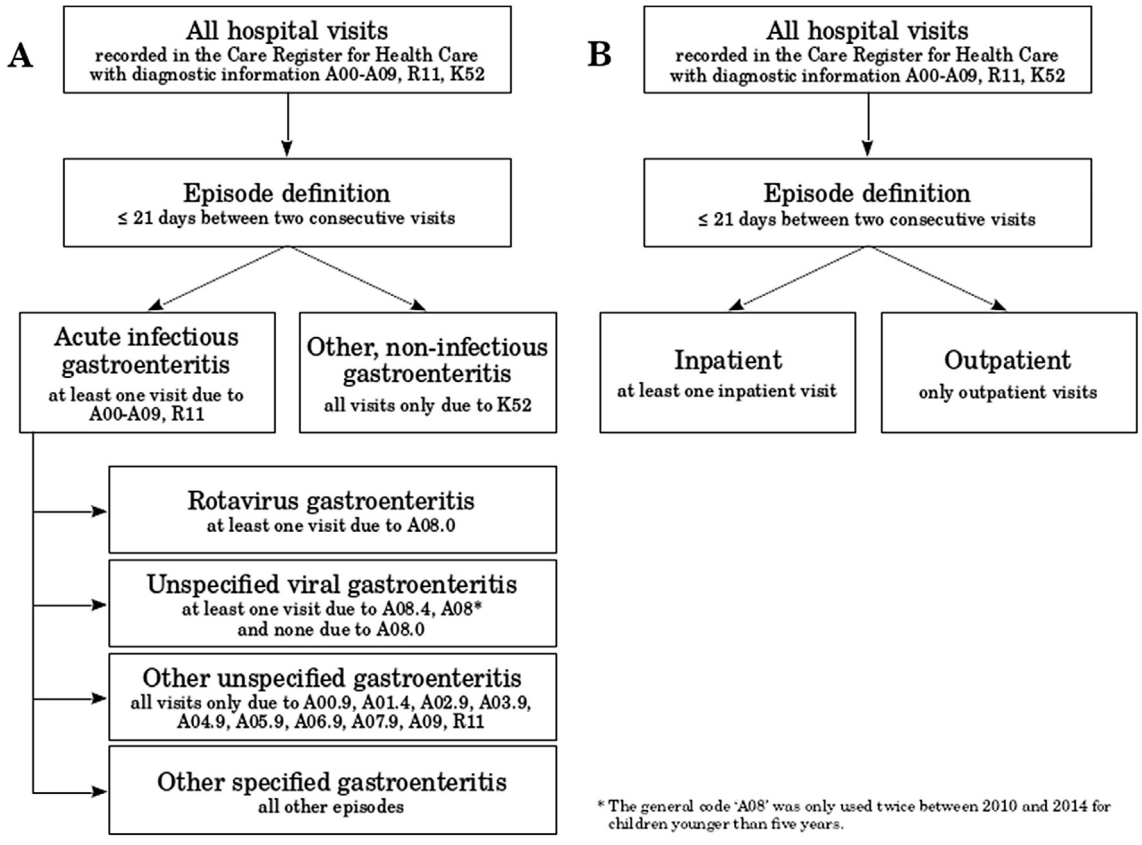

Fig. 1. Episode classification based on the hospital visits defining it. A: Classification by diagnostic information. B: Classification by type of hospital visit.