

## Acute rotavirus diarrhea in pediatric patients

Jadwiga Bednarek<sup>1</sup>

<sup>1</sup> Doctoral studies, Faculty of Medicine and Health Sciences, Jan Kochanowski University in Kielce

Address of correspondence:

e-mail: [jagoda.bednarek@wp.pl](mailto:jagoda.bednarek@wp.pl);

<http://orcid.org/0000-0003-4482-707X>

**Keywords: diarrhea, rotavirus, nosocomial infection**

### Abstract

Rotavirus is the most common cause of gastroenteritis. He is responsible for non-hospital and hospital gastrointestinal infections. It is a major epidemiological threat especially in the pediatric population. Acute diarrhea and dehydration cause 2 million hospitalizations and cause deaths of around 440,000 children annually. Rotavirus is also one of the most common aetiological factors of nosocomial infections in pediatric wards. The incidence of hospital RV infections ranges from 2.5 to 7.9 per 1000 days of hospitalization. It extends the stay from 1.7 to 7 days depending on the country [1,2,3,4]. Between 13 and 80% of children with RV infection require infusion therapy [1,2,5]. One of the most effective ways to reduce the incidence of RV infection is to immunize the body. There is evidence of the effectiveness of vaccination programs in both industrialized and developing countries [6].

### Streszczenie

Rotawirus jest najczęstszą przyczyną zapalenia żołądka i jelit. Odpowiada za pozaszpitalne i szpitalne zakażenia przewodu pokarmowego. Stanowi duże zagrożenie pod względem epidemiologicznym zwłaszcza w populacji pediatrycznej. Ostra biegunka i odwodnienie jest przyczyną 2 milionów hospitalizacji i przyczyną śmierci około 440 000

dzieci rocznie. Rotawirus jest również jednym z najczęściej występujących czynników etiologicznych zakażeń szpitalnych w oddziałach pediatrycznych. Częstość występowania szpitalnych infekcji RV waha się od 2,5 do 7,9 na 1000 dni hospitalizacji. Wydłuża to pobyt od 1,7 do 7 dni w zależności od kraju [1, 2, 3, 4]. Od 13 do 80% dzieci z infekcją RV wymagają płynowej terapii infuzyjnej [1,2,5]. Jednym ze skuteczniejszych sposobów zmniejszenia zachorowań na infekcję RV jest immunizacja organizmu. Istnieją dowody skuteczności programów szczepień zarówno w krajach uprzemysłowionych, jak i w krajach rozwijających się [6].

## **Introduction**

Gastrointestinal infection (GI) manifested by acute diarrhea is one of the most common causes of hospitalization. Many children suffer from it especially in the first three years of life. Approximately 50% of GIs are caused by Rotavirus (RV) [7]. RV is the cause of significant morbidity and mortality among children in both developed and developing countries. According to the Centers for Disease Control and Prevention report (CDC), Rotaviruses cause close to 111 million cases of gastrointestinal infections treated at home and 25 million outpatient visits. Acute diarrhea and dehydration cause 2 million hospitalizations and 352 thousand to 592 thousand deaths of children under 5 in developing countries and 230,000 in the European Union [8]. Rotavirus is one of the most common aetiological factors of nosocomial gastrointestinal infections. These infections are a significant problem among hospitalized infants during the winter months. RV infection is associated with an important health care problem, especially in the case of nosocomial infections, where it has been observed that the stay in the hospital has been prolonged. Both hospital and non-hospital infections caused by RV are a significant economic problem for public health [9].

## **Epidemiology**

Rotavirus is a major epidemiological threat. The results of many studies indicate a large problem of RV infections in the pediatric population [7,8,10]. A large number of virus molecules excreted in the acute phase of the disease and a low infectious dose (less than 100 virus particles) and a long period of persistence in the environment and resistance to disinfectants make it spread quickly and easily in the environment [11,12]. Rotavirus is the most common cause of acute gastroenteritis in children under 5 years of age. The virus can cause severe diarrhea and dehydration, especially in children from 6 to 24 months of age. In developing countries, acute gastroenteritis caused by RV infection is the cause of the death of approximately 440,000 children annually [13,14].

In the US, 58 000 to 70,000 children are hospitalized annually due to RV infection [15]. In Europe, this virus accounts for about 25 to 52% of all acute diarrhea. Approximately 2-5 in 100 children under the age of 5 diagnose severe diarrhea RV. The most susceptible to rotavirus infections are children from 6 months to 2 years old [8,10,16]. In Poland, rotavirus infections affect about 30% of children hospitalized due to acute diarrhea [17,18].

Rotavirus is also one of the most frequent aetiological factors of nosocomial infections. The incidence of nosocomial gastrointestinal infections with RV etiology varies. This is due to the small number of tests and the lack of uniformity in the definition of infection. Rotavirus infection can be defined as a hospital, when symptoms appear after 48 hours of admission to the hospital and within 72 hours after discharge from the hospital [19]. In Poland and in European countries, hospital rotavirus infections constitute about 21-24% of all RV infections [2,20,]. In retrospective studies, a lower incidence rate of RV for nosocomial infections was obtained. In France, this frequency was 2.5 / 1000 days of hospitalization [1]. In Poland, 2.05 / 1000 days of hospitalization [2]. A prospective study in Italy showed that the overall incidence of RV in hospital-based infections was 7.9 / 1000 days of hospitalization [3]. RV nosocomial infection is associated with prolonged hospitalization.

In Poland, a rotavirus hospital infection extended the hospital stay by an average of 7 days (average treatment time in the hospital - 4.6 days) [2]. Prospective studies have shown less prolonged hospitalization time. In France, hospital RV infection increased the time of hospitalization by 2.2 days [4], and in Italy by 1.7 days of hospitalization [3].

Hospitalization of children with RVGI is a major economic burden for the national healthcare system. It was calculated that the average cost of RV treatment in Poland is 741 euros. Extrapolating this data to the total number of hospitalizations, we can estimate that the cost of treatment of acute intestinal aesclesias with rotavirus aetiology reaches 13.2 million per year [21]. In Italy, the costs caused by NRV can be estimated at 8 million euros per year [3].

### **Risk factors**

The risk of rotavirus hospital infection increases with age and length of hospital stay [4]. The occurrence of epidemic disease caused by RV and RSV (respiratory syncytial virus) in winter leads to thickening in pediatric wards. It is one of the risk factors for RV of nosocomial infections in hospitalized small children. The risk of an RV hospital infection increases with the length of hospital stay. In children hospitalized over 5 days it is almost 3 times higher than in children whose stay in the hospital was shorter (RR=2,8) [3,5,22,]. Boys are twice as likely to be exposed to a hospital RV infection as girls. Children hospitalized at 9 months of age are 4 times more likely to be exposed to a hospital-acquired RV infection [3].

Because the virus is stable in the environment, transmission can occur as a result of consumption of contaminated water and food and through contact with contaminated surfaces and objects. An important vector of RV transmission and cross-infection in healthcare facilities are the hands of people who care for the sick. The virus is ubiquitous in the environment in which the person is ill. It has the ability to survive on surfaces, hands where it lasts for a long time. and is resistant to disinfectants. It is therefore difficult to control in pediatric departments, where RV is repeatedly introduced by hospitalized persons and their families.

A symptom of concern is an asymptomatic rotavirus infection. In about 3% of children hospitalized without symptoms of gastroenteritis, the examination of faeces for the presence of RV is positive [3]. Both patients and healthcare professionals with asymptomatic RV can also spread RV. This may be the reason for underestimating the risk of prophylaxis of rotavirus hospital infections and their occurrence [19,23].

### **Diagnostics, clinical picture and treatment**

Rapid diagnosis is important for predicting clinical implications and treatment. The virus is mainly transmitted through the phaleo-oral route or through direct contact, sometimes it is also a droplet path. Acute rotavirus-induced intestinal inflammation has an incubation period of 1 to 3 days, followed by an abrupt onset of watery diarrhea, with possible dehydration, vomiting and fever lasting from 4 to 7 days. Clinical picture of infection is very diverse, in some patients, the disease is mild (asymptomatic gold is also unspecific course), can also lead to dehydration (80%) metabolic disorders, organ failure requiring hospitalization and parenteral hydration [24]. In industrialized countries, RV infection is rarely the cause of death of children [25]. However, there are cases of very severe course of infection, with necrotic or haemorrhagic character of colitis that can lead to the death of a child [26]. Also described are: pancreatitis, encephalitis, cerebellar infection, kidney infection or kidney stones of the urinary tract leading to renal failure [27,28]. RV infections are also seen in children who have had intussusception [29].

The most severe is the first rotavirus infection and presents a more unfavorable result mainly in developing countries [30]. The most common symptoms of gastrointestinal

infection with rotavirus aetiology are: diarrhea (occurs in 66%), vomiting (68%) and fever (64%) leading to dehydration of the body [2]. The severity of dehydration is an important symptom of the severity of the disease. It has a prognostic character and determines the therapeutic process. Most of the affected children require hydration by oral or intravenous route. The number of children with RV infection requiring fluid infusion therapy varies in different countries, e.g. in Poland, 80% of children [2], in the Netherlands 46% [5] and in France 13% [1].

Even the mild course of RV infection should be monitored, not only because of the problem of dehydration and electrolyte imbalance, but also because of the possibility of complications of complications. Some patients (around 12%) require rehospitalization in the first four days after discharge from the hospital [5].

### **Prevention**

Prevention of virus transmission requires the use of isolation or cohortation of sick children. Both medical personnel and caregivers of hospitalized children must strictly follow the principles of isolation including hand hygiene. The selection of disinfectants must take into account the effectiveness of the fight against rotavirus. An important element is also shortening the time of hospitalization and reducing the number of beds in the hospital. These activities will limit the number of rotavirus hospital infections.

One of the most effective ways to reduce the incidence of RV infection is to immunize the body. In 2007, the World Health Organization recommended the inclusion of rotavirus vaccinations in national vaccination programs in countries [11]. In European countries where widespread vaccination against rotavirus has been implemented, studies have shown a reduction of 65% to 84% of rotavirus hospitalizations in children eligible for vaccination after the introduction of a vaccine [31]. There is evidence of the effectiveness of vaccination programs in both industrialized and developing countries [6]. The data suggest that in some states of North America, the number vaccinated against RV is up to 70% [32]. The number of children vaccinated against RV in European countries is from 35% to 85% [33].

### **Summary**

Rotavirus infections are still a very important and growing epidemiological problem in our country. Rotavirus is a well-known hospital pathogen under pediatric conditions. The necessity of effective and multi-faceted prophylaxis is constantly valid. Reducing the number of rotavirus hospital infections can be an important factor to improve patient safety, as well as to avoid additional health costs.

Currently in Poland vaccinations against rotavirus are in the recommended vaccination group, which means that they are not financed from public funds. A large number of hospitalizations due to RV indicates that the economic and social impact of the disease deserves attention. There is a need to extend research on hospital rotavirus infections to determine the scale of the problem in Poland.

## Literature

---

- 1 Marinosci A, Doit C, Koehl B et al. Gastro-ente´rites nosocomiales a` rotavirus: e´tude re´trospective dans un service de pe´diatrie ge´ne´rale. Nosocomial rotavirus gastroenteritis. Archives de Pe´diatrie 2016;23:1118-1123
- 2 Nitsch-Osuch A, Kuchar E, Kosmala A, Życinska K, Wardyn K. Clinical research Nosocomial rotavirus gastroenterocolitis in a large tertiary paediatric hospital in Warsaw, 2006-2010. Arch Med Sci 2013; 9, 3: 493-498
- 3 Festini F, Cocchi P, Mambretti D et al. Nosocomial Rotavirus Gastroenteritis in pediatric patients: a multi-center prospective cohort study. BMC Infectious Diseases 2010, 10: 235. <http://www.biomedcentral.com/1471-2334/10/235> (27.07.2018)
- 4 Marc E, Biscardi S, Soulier M. Nosocomial rotavirus infections in a pediatric unit: surveillance during four successive winters. Médecine et maladies infectieuses 2007; 37: 61–66. <http://france.elsevier.com/direct/MEDMAL/> - (25.07.2018)
- 5 Verhagen P, Moore D, Manges A, Quach C. Nosocomial rotavirus gastroenteritis in a Canadian paediatric hospital: incidence, disease burden and patients affected. Journal of Hospital Infection. 2011; 79: 59-63. [www.elsevierhealth.com/journals/jhin](http://www.elsevierhealth.com/journals/jhin) - (29.07.2018).
- 6 Vesikari T, Matson DO, Dennehy P et al. Safety and efficacy of a pentavalent human-bovine (WC3) reassortant rotavirus vaccine. N Engl J Med 2006, 354:23-33.
- 7 Guarino A, Winter H, Sandhu B, Quak SH, Lanata C. Acute gastroenteritis disease: report of the FISPGHAN Working Group. J Pediatr Gastroenterol Nutr 2012;55(5):621–626.
- 8 Clark H, Marcello A, Lawley D, Reilly M, DiNubile MJ. Unexpectedly high burden of rotavirus gastroenteritis in very young infants. BMC Pediatr 2010;10:40–44.
- 9 Łoś-Rycharska E, Czerwionka-Szaflarska M. Biegunki rotawirusowe – dlaczego warto im zapobiegać. Przegląd Gastroenterologiczny 2011;6:60–68.
- 10 Van Damme P, Giaquinto C, Huet F, Gothefors L, Maxwell M, Van der WM. Multicenter prospective study of the burden of rotavirus acute gastroenteritis in Europe, 2004–2005: the REVEAL study. J Infect Dis 2007;195(Suppl. 1):4–16.
- 11 World Health Organization Rotavirus vaccines. WHO position paper - January 2013. Weekly Epidemiol Rec Health Sect Secr Leag Nations 2013; 88(5):49-64.
- 12 Payne DC, Wikswo M, Parashar UD. Manual for the surveillance of vaccine-preventable diseases. Chapter 13: Rotavirus. Cent Dis Control Prev Atlanta GA 2011; 1-11.
- 13 Parashar UD, Burton A, Lanata C, Boschi-Pinto C, Shibuya K, Steele D, Birmingham M, Glass RI: Global mortality associated with rotavirus disease among children in 2004. J Infect Dis 2009, 200(Suppl 1):S9-S15.
- 14 Parashar UD, Gibson CJ, Bresse JS, Glass RI: Rotavirus and severe childhood diarrhea. Emerg Infect Dis 2006, 12(2):304-6.
- 15 Charles MD, Holman RC, Curns AT, Parashar UD, Glass RI, Bresee JS: Hospitalizations associated with rotavirus gastroenteritis in the United States, 1993-2002. Pediatr Infect Dis J 2006, 25(6):489-93.
- 16 Giaquinto C, van Damme P, REVEAL Study Group. Age distribution of paediatric rotavirus gastroenteritis cases in Europe: the REVEAL study. Scand J Infect Dis 2010;42: 142–147.
- 17 Patrzalek M, Patrzalek M.P. Zachorowania dzieci na biegunkę o etiologii Rotawirusowej z terenu Kielc i powiatu kieleckiego leczone w Wojewódzkim Specjalistycznym Szpitalu Dziecięcym w Kielcach w latach 2002-2006. Przegl Epidemiol. 2008; 62: 557-563.
- 18 Smok B, Zieniewicz-Cieślik K, Smukalska E, Pawłowska M. Acute diarrhoea induced by rotavirus in children hospitalized in provincial hospital for infectious diseases in Bydgoszcz in 2014 year. Przegl Epidemiol. 2016;70(3): 462-470.
- 19 Gleizes O, Desselberger U, Tatochenko V. et al. Nosocomial rotavirus infection in European countries: a review of the epidemiology, severity and economic burden of hospital-acquired rotavirus disease. Pediatr Infect Dis J 2006; 25:S12-21

- 
- 20 Verstraeten T, van den Bosch W. Burden of rotavirus disease in the new European Union (poster). Presented at 23rd ESPID Congress, Valencia, Spain 2005.
  - 21 Tichopád A, Müllerová J, Jackowska T. Cost Burden of Severe Community-Acquired Rotavirus Gastroenteritis Requiring Hospitalization in the Czech Republic, Slovakia, Poland, and Hungary: A Retrospective Patient Chart Review. *VALUE IN HEALTH REGIONAL ISSUES* 2016; 10C: 53 – 60. [www.elsevier.com/locate/vhri](http://www.elsevier.com/locate/vhri) - (27.07.2018)
  - 22 Stefcovicova M, Simurka P, Jurackova L, et al. Nosocomial rotavirus gastroenterocolitis in pediatric department. *Centr Eur J Publ Health* 2008; 16: 12-6.
  - 23 Posfay KM, Zerr DM, Pittet D. Infection control in pediatrics. *Lancet Infect Dis* 2008; 8: 19-31.
  - 24 Phillips G, Lopman B, Rodrigues L, Tam CC. Asymptomatic rotavirus infections in England: prevalence, characteristics, and risk factors. *Am J Epidemiol* 2010;171:1023–1030.
  - 25 Rheingans RD, Heylen J, Giaquinto C: Economics of rotavirus gastroenteritis and vaccination in Europe: what makes sense? *Pediatr Infect Dis J* 2006, 25(1 Suppl):S48-55.
  - 26 Bagci S, Eis-Hübinger A, Yassin A, Simon A, Bartmann P, Franz AR, et al. Clinical characteristics of viral intestinal infection in preterm and term neonates. *Eur J Clin Microbiol Infect Dis* 2010;29:1079–1084.
  - 27 Kumagai H, Matsumoto S, Ebashi M, Ohson T. Acute pancreatitis associated with rotavirus infection. *Indian Pediatr* 2009;46:1099–1101.
  - 28 Shiiharaa T, Watanabea M, Honmaa A, Kato M, Morita Y, Ichiyama T, et al. Rotavirus associated acute encephalitis/ encephalopathy and concurrent cerebellitis: report of two cases. *Brain Dev* 2007;29:670–673.
  - 29 Blanch A, Perel S, Acworth J. Paediatric intussusception: epidemiology and outcome. *Emerg Med Austral* 2007;19: 45–50.
  - 30 Bernstein DI. Rotavirus overview. *Pediatr Infect Dis J* 2009; 28:S50-3; PMID:19252423; <http://dx.doi.org/10.1097/INF.0b013e3181967bee>
  - 31 Karafillakis E, Hassounah S, Atchison C. Effectiveness and impact of rotavirus vaccines in Europe, 2006–2014. *Vaccine*. 2015; 33: 2097–2107. [www.elsevier.com/locate/vaccine](http://www.elsevier.com/locate/vaccine) - (39.07.2018).
  - 32 Parashar U. Uptake and impact of Rotavirus vaccines in U.S. children. 14th International Congress on Infectious Diseases; March 9-12, 2010; Miami
  - 33 Vesikari T, Sutherland D, Jackson AE: Report of the ‘European Expert Meeting on Rotavirus Vaccination’, Tampere, Finland, 19-20 May 2009. *Vaccine* 2009, 27:7222-7.