



EVALUATION OF THE EFFECTIVENESS OF ROTAVIRUS VACCINE FOLLOWING THE IMPLEMENTATION OF THE NATIONAL ROTAVIRUS VACCINATION PROGRAM IN BULGARIA

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ABSTRACT

INTRODUCTION: Rotaviruses are a leading cause of infectious diarrhea in infants and children up to 5 years of age. Their widespread distribution, high morbidity, and mortality define them as a disease of significant public health and social importance.

AIM: To study the effectiveness of the rotavirus vaccine after the introduction of the National Program for Vaccination against Rotaviruses in the Republic of Bulgaria for the period 2014–2023.

MATERIALS AND METHODS: Data from the national registration of communicable diseases in Bulgaria, published in the official reports of the National Center of Infectious and Parasitic Diseases (NCIPD) for the period 2014–2023, and data from the official websites of WHO and ECDC were analyzed. Documentary, epidemiological, descriptive, and mathematical-statistical methods were used for processing the obtained results.

RESULTS: During the period 2014–2023, rotaviruses ranked second (11%) after enterocolitis (81%) in the structure of intestinal infectious diseases in the Republic of Bulgaria, reaching the highest morbidity rate in 2017 – 40.52%. With the introduction of the National Program for Control and Treatment of Rotavirus Gastroenteritis 2017–2021 in the country, free recommended rotavirus vaccines have been provided to all newborns. In the period 2017–2023, a significant increase in immunization coverage of newborns has been observed, reaching from 17.9% in 2017 to 43% in 2023. A high correlation is reported between the number of immunized children and the number of cases ($r = -0.74$), as during the same period the morbidity rate of RGE decreased significantly to 9.72% in 2023.

CONCLUSION: With the increase in immunization coverage with rotavirus vaccines in children during 2017–2023, a significant reduction in morbidity from RGE was observed, which clearly demonstrates the effectiveness of the rotavirus vaccine.

Keywords: rotavirus infections, rotavirus vaccines, Bulgaria, immunization coverage

INTRODUCTION

Rotaviruses are a leading cause of infectious diarrhea in infants and children under 5 years of age worldwide, including in Bulgaria (1). The widespread distribution of rotavirus gastroenteritis, high morbidity, severe clinical course, and mortality define them as a disease of pronounced health and social significance (2). Low- and middle-income countries (LMIC) and high-income countries (HIC) show approximately equal prevalence of rotavirus

infections, but mortality is higher in poorer countries due to unfavorable socio-economic and living conditions, malnutrition in children, and limited access to timely rehydration therapy (3). In HICs, the high incidence of rotavirus infections leads to serious economic losses related to increased public health expenditures, parental work absenteeism, and pressure on healthcare systems (4). Due to the major clinical and epidemiological significance of rotavirus infections, under the recommendation of WHO, national and regional surveillance systems have been established in most regions of the world (5). Today, immunoprophylaxis plays a leading role in the management of the epidemic process of rotavirus gastroenteritis. The introduction of rotavirus vaccines into national immunization

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programs since 2009 has led to a significant reduction in morbidity, hospitalization rates, and healthcare costs in many countries worldwide (6, 7).

In the United States, before the introduction of the Rotavirus Vaccination Program in 2006, approximately 80% of children aged 5 years had experienced rotavirus gastroenteritis, leading to 55,000–70,000 hospitalizations of infants and children annually and a total annual cost of about 1 billion USD. In 2007, after the introduction of RotaTeq (RV5) in the United States, a 16% reduction in hospitalization rates for acute gastroenteritis was observed, particularly among children aged 3–11 months, compared with the period 2000–2006 (8). A CDC study conducted in the USA after 7 years of applying the pentavalent rotavirus vaccine demonstrated 100% effectiveness, proving its long-term preventive and protective effects against hospitalizations and emergency department visits associated with rotavirus gastroenteritis (9).

In Venezuela, before the introduction of the vaccine in 2006, 23% of diarrheal diseases and 33% of hospitalizations were caused by rotavirus infections. After vaccination introduction, an 82% decrease in rotavirus hospitalizations was reported (10).

In the European Union, Belgium was the first country to introduce the rotavirus vaccine into its national immunization program in 2006 with coverage exceeding 90%. Five years after its introduction, a 70% reduction (95% CI 66–74) in hospitalizations associated with rotaviruses was reported, and 84% (95% CI 79–89) after 10

years (11, 12). In Finland, after the introduction of the rotavirus vaccine in 2009, morbidity from rotavirus infections among children under 5 years of age declined to 30/100,000 in 2022 compared with 460/100,000 before vaccine introduction (13).

THE AIM of the present study is to track the effectiveness of the rotavirus vaccine after the introduction of the National Vaccination Program against Rotaviruses in the Republic of Bulgaria for the period 2014–2023, with an emphasis on epidemiological results and immunization coverage in childhood.

MATERIALS AND METHODS

Based on documentary and epidemiological methods, data from the national registration of communicable diseases in Bulgaria, published in the official reports of the NCIPD for the period 2014–2023, as well as data from the official websites of ECDC and WHO, were analyzed. The obtained results were processed using graphical analysis, calculation of relative share, and correlation analysis – Pearson's r coefficient.

RESULTS AND DISCUSSION:

In Bulgaria, during the observed period 2014–2023, rotavirus gastroenteritis ranked second in the etiological structure of intestinal infectious diseases, with a relative share of 11%, after enterocolitis, which accounted for 81% of the total intestinal morbidity in the country (14) (**Figure 1**). Since mid-2011, rotavirus gastroenteritis has been included as a separate nosological unit in the List of Communicable Diseases subject to mandatory registration and reporting (15).

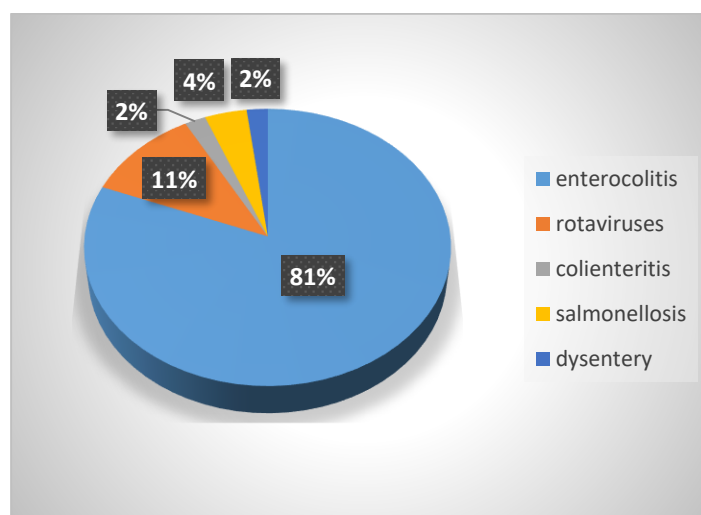


Figure 1. Etiological structure of intestinal infectious diseases in Bulgaria for the period 2014–2023

According to NCIPD data, between 2011 and 2017 a sharp increase in morbidity from RGE was observed, with the number of registered cases increasing from 4.7‰ (346 cases) in 2011

to 40.52‰ (2,878 cases) in 2017 (**Table 1**). The most affected group were children aged 1–4 years, with a morbidity of 1123.60‰ (212 cases) in 2017.

Table 1. Incidence of rotavirus gastroenteritis in Bulgaria for the period 2011–2016

Year									
Number of cases									

As a result of the increasing morbidity from rotavirus infections, with Decision № 8 of January 6, 2017 of the Council of Ministers, Bulgaria adopted the National Program for Control and Treatment of Rotavirus Gastroenteritis 2017–2021, committing the state to provide funds through the Ministry of Health budget for immunization against rotavirus gastroenteritis, while maintaining the recommended nature of the vaccine and parents' right to choose whether to vaccinate their children. The program's goal was to ensure high immunization coverage among the vulnerable group – children from 6 weeks of age (16).

With the introduction of the National Program 2017–2021, from 2018 a sharp decline in morbidity from RGE was observed, reaching its lowest value of 4.31‰ (298 cases) in 2021. The low trend of RGE morbidity in 2020–2021 is also likely related to the COVID-19 pandemic, during which strict anti-epidemic and preventive measures were implemented, including restrictions on movement and gatherings in public places, mask-wearing, and recommended hand disinfection (**Figure 2**). After the COVID-19 pandemic, the spread of RGE showed a slight increase in 2022 – 12.3‰, followed by a decline in 2023 – 9.72‰ (627 cases).

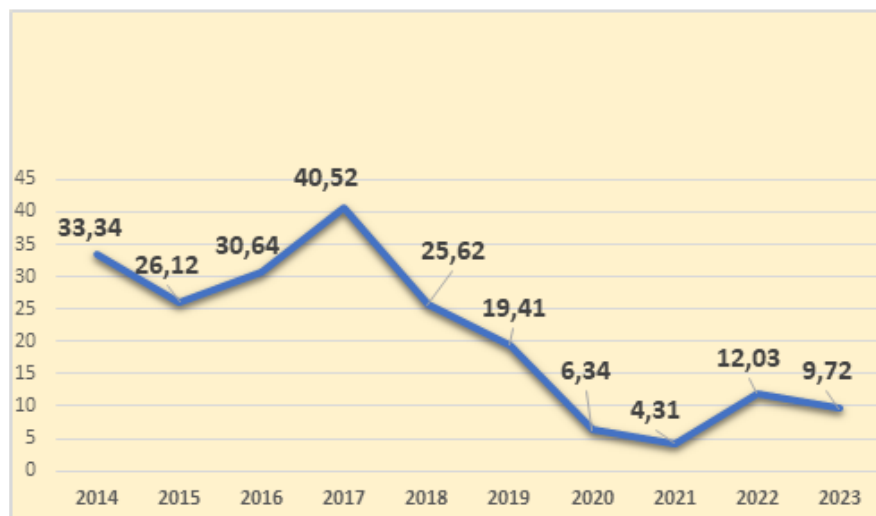


Figure 2. Incidence of rotavirus gastroenteritis in Bulgaria for the period 2014–2023

Since 2010, two rotavirus vaccines, Rotarix (RV1) and RotaTeq (RV5), have been registered and approved for use in Bulgaria, and in the same year the Ministry of Health included them in the list of recommended immunizations, which, according to Ordinance № 15 of 2005 on immunizations in the Republic of Bulgaria (promulgated, State Gazette, issue 45 of 2005), were administered at parents' expense for children over 6 weeks of age.

Until 2017, vaccine coverage with rotavirus vaccines in the country was very low: in 2015 and 2016, respectively 1,306 and 1,440 children were immunized. The low interest in vaccination was most likely due to the high cost paid by parents, low awareness of vaccine availability in the country, and to some extent insufficient activity from pediatricians and GPs to recommend it, due to lack of experience and data on the benefits of the rotavirus vaccine. In

2017, with the adoption of the National Program for Control and Treatment of Rotavirus Gastroenteritis 2017–2021 and the provision of free vaccines by the Ministry of Health, the number of immunized children increased more

than 7.9 times (11,418 immunized) in the same year. In the following years, immunization coverage in infancy showed a steady upward trend, reaching 21,988 immunized children in 2021 (**Figure 3**).

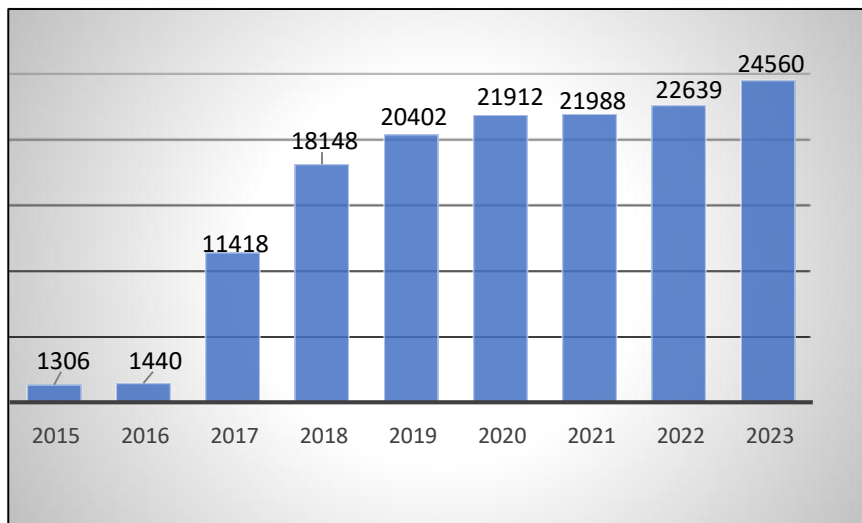


Figure 3. Number of children immunized with rotavirus vaccine in Bulgaria for the period 2015–2023

Recognizing the positive trends in parents' willingness to vaccinate their children and to ensure continuity in the vaccination of newborns against rotavirus infections, the Ministry of Health continued the activities of the National Program for Prevention of RGE in Bulgaria for the next period 2022–2025, in line with WHO and EU policies and recommendations (17).

Compared with the number of newborn children in Bulgaria during the observed period, significant progress in immunization coverage is evident. Before the introduction of the

National Immunization Program for RGE, in 2015 only 2% (1,306 vaccinated) of 65,950 newborns were immunized. The increase in the number of immunized newborns started in 2017 with 17.9% vaccine coverage (11,418 immunized of 63,955 newborns), and this trend continued until 2023, when the proportion of immunized children reached 43% (24,560 immunized of 57,197 newborns), fulfilling one of the objectives of the National Program 2017–2021 for achieving high immunization coverage of newborns from 6 weeks of age within the 5-year implementation period (**Figure 4**).

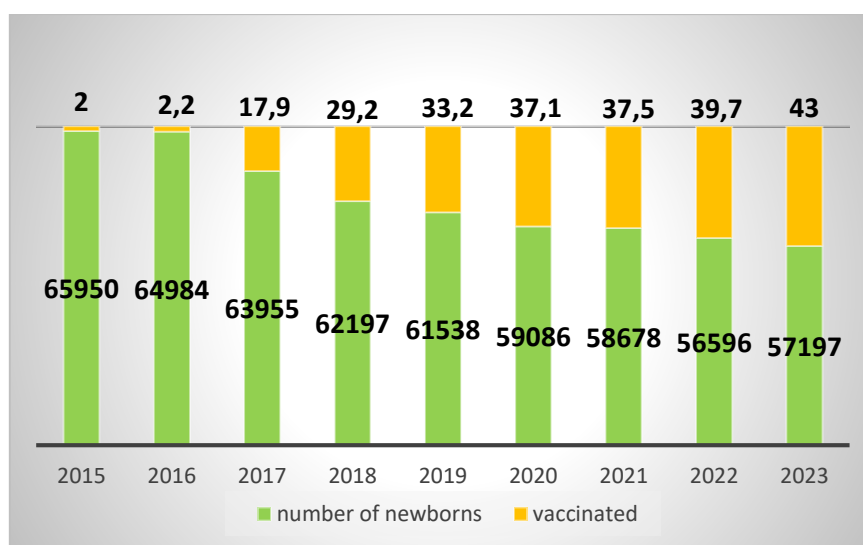


Figure 4. Vaccine coverage among children in Bulgaria for the period 2015–2023 relative to the number of live births

With the increase in the number of vaccinated children, a significant decline in the frequency of rotavirus gastroenteritis was also observed. A high correlation was reported between the number of immunized children and the number

of cases ($r = -0.74$; $p < 0.05$), as in 2023, at 43% immunization coverage, morbidity declined to 9.72‰ (2023) (**Figure 5**).

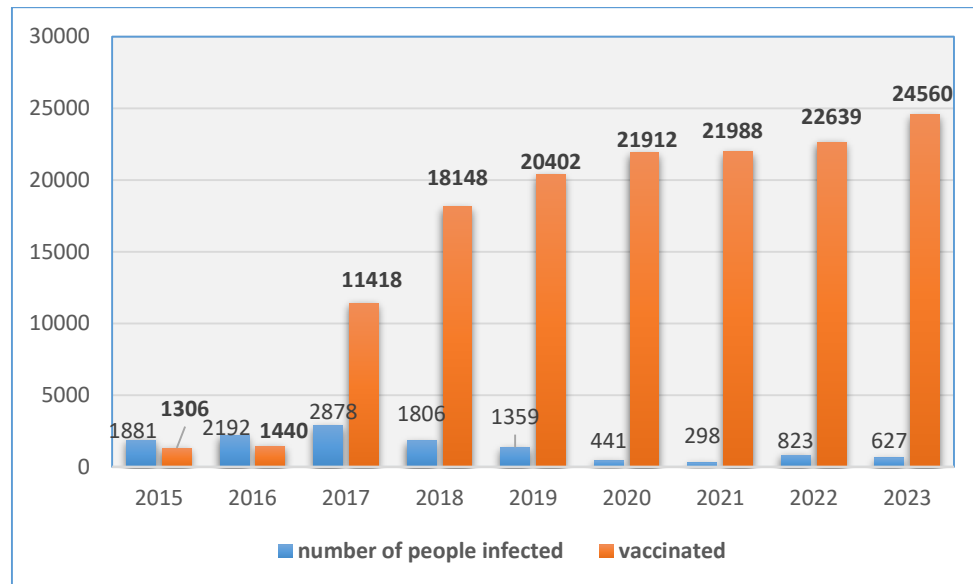


Figure 5. Number of cases and number of vaccinated children for the period 2015–2023

CONCLUSION

With the introduction of the rotavirus vaccine as part of the National Program for Control and Treatment of Rotavirus Gastroenteritis in the Republic of Bulgaria, a significant decline in morbidity from rotavirus infections in children during 2014–2023 has been observed, which clearly proves the effectiveness of rotavirus vaccines. The increasing number of vaccinated newborns contributes to the development of herd immunity, subsequently limiting virus circulation in the community, reducing the risk of severe disease in infants, decreasing hospitalizations, and improving family quality of life, while also reducing stress and financial burden for parents.

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