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MEASLES OUTBREAK IN A ROMA COMMUNITY IN THE EASTERN REGION OF SLOVAKIA, MAY TO OCTOBER 2018

IZBRUH OŠPIC V ROMSKI SKUPNOSTI NA VZHODNEM SLOVAŠKEM MED MAJEM IN OKTOBROM 2018

Henrieta HUDEČKOVÁ[1], Janka STAŠKOVÁ[2], Ján MIKAS[3], Adriana MEČOCHOVÁ[3], Edita STAROŇOVÁ[3], Alexandra POLČIČOVÁ[3], Tibor BAŠKA[1], Martin NOVÁK[1*], Nora MALINOVSKÁ[1], Jana ZIBOLENOVÁ[1], Viera ŠVIHROVÁ[1], Elena NOVÁKOVÁ[1], Mária ŠTEFKOVIČOVÁ[4,5]

[1]Comenius University in Bratislava, Jessenius Faculty of Medicine in Martin, Department of Public Health, Malá Hora 11149/4B, 03601 Martin, Slovak Republic
[2]Regional Public Health Authority in Michalovce, Slovak Republic
[3]National Public Health Authority SR in Bratislava, Slovak Republic
[4]Alexander Dubček University in Trenčín, Slovak Republic
[5]Regional Public Health Authority in Trenčín,, Slovak Republic

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ABSTRACT

Background: Despite the effective National Immunization Programme of Slovakia, some population groups are incompletely vaccinated or unvaccinated. We aimed to describe the measles outbreak spread in Eastern Slovakia between May and October 2018, affecting the Roma communities in relation to the existing immunity gaps.

Methods: We defined a group of persons living in socially closed communities with low vaccination coverage.

Results: Of 439 measles cases (median age: 10 years), 264 (60.1%) were vaccinated, 137 (31.2%) received two doses and 127 (28.9%) one dose of measles vaccines, 155 (35.3%) were unvaccinated and 20 (4.6%) had an unknown vaccination status. Samples from 102 patients (with two-dose vaccination status) were additionally tested for antibodies against rubella and mumps. Of 102 cases, 68 (66.7%) cases had a positive IgM and 23 (22.5 %) IgG antibodies against measles. For rubella, only 20 (19.6%) cases had seropositive IgG levels, for mumps higher positivity was detected in 60 persons (58.8%). We could detect only a small percentage with positive serology results of rubella IgG antibodies across all age groups. We have assumed that rubella antibodies had to be produced following the vaccination. Their absence in the cases with two doses of MMR suggests that these vaccines could not have been administrated despite the fact that this data was included in the medical records. Sequential analysis of two samples showed measles genotype B3.

Conclusion: This outbreak can outline the existence of a vulnerable group of the Roma. Low vaccinate coverage represents a serious public health threat.

Keywords:
measles, Roma, outbreak, vaccination coverage

IZVLEČEK

Ozadje: *Kljub učinkovitemu nacionalnemu programu imunizacije na Slovaškem so nekatere skupine prebivalcev nepopolno cepljene ali necepljene. Želeli smo opisati izbruh ošpic na vzhodnem Slovaškem med majem in oktobrom 2018, ki je prizadel romske skupnosti v povezavi z obstoječimi vrzelmi v imunosti.*

Metode: *Opredelili smo skupino ljudi, ki živijo v socialno zaprtih skupnostih z nizko precepljenostjo.*

Rezultati: *Med 439 primeri ošpic (mediana starost: 10 let) je bilo 264 ljudi cepljenih (60,1 %), 137 (31,2 %) jih je prejelo dva odmerka in 127 (28,9 %) en odmerek cepiva proti ošpicam, 155 (35,3 %) jih je bilo necepljenih, pri 20 (4,6 %) pa status cepljenja ni bil znan. Vzorce 102 bolnikov (s statusom cepljenja z dvema odmerkoma) smo dodatno testirali za protitelesa proti rdečkam in mumpsu. Od 102 primerov jih je 68 (66,7 %) imelo pozitiven rezultat za protitelesa IgM in 23 (22,5 %) za protitelesa IgG proti ošpicam. Kar zadeva rdečke, smo samo pri 20 (19,6 %) primerih ugotovili seropozitivne ravni IgG, medtem ko smo za mumps odkrili večjo pozitivnost pri 60 posameznikih (58,8 %). V vseh starostnih skupinah smo odkrili samo majhen odstotek posameznikov s pozitivnimi serološkimi rezultati za protitelesa IgG proti rdečkam. Predpostavili smo, da po cepljenju zagotovo nastanejo protitelesa proti rdečkam. Njihova odsotnost v primerih z dvema odmerkoma cepiva MMR nakazuje, da to cepivo ni moglo biti uporabljeno, čeprav so bili ti podatki vključeni v zdravstveno kartoteko. Sekvenčna analiza dveh vzorcev je pokazala genotip ošpic B3.*

Sklep: *Ta izbruh lahko kaže na obstoj ranljive skupine Romov. Nizka precepljenost pomeni resno grožnjo za javno zdravje.*

Ključne besede:
ošpice, Romi, izbruh, precepljenost

***Corresponding author:** Tel. + 421 91 188 62 56; E-mail: novak60@uniba.sk; martin4novak@gmail.com

1 INTRODUCTION

For more than three decades of high reported coverage (≥98% at the national level) with two doses of schedule (Measles-containing-vaccine first-dose (MCV1) and Measles-containing-vaccine second-dose (MCV2)) in the routine immunization programme, Slovakia has eliminated measles and rubella according to established criteria of the Regional Verification Commission for Measles and Rubella Elimination in Europe (1). Measles outbreaks continue to occur in Europe, however, and several countries have reported outbreaks affecting the general population due to inadequate vaccination coverage and the persistent circulation of the measles virus (2).

One of many factors contributing to a decline in immunization rates is a growing community of Roma population (3). About 500,000 (9.2% of the total population) Roma live in Slovakia, mainly in three of eight Regions of Slovakia (the Košice, Prešov and Banská Bystrica). The communities are mostly sedentary groups living in poor, isolated living sites (4). The measles outbreak between May 4 and October 16 2018 was detected in the Košice Region in the Michalovce and Sobrance Districts.

The aim of the study is to better understand the role of vaccination gaps in Roma communities in Slovakia with regard to the epidemic spread of measles. The results can contribute to more effectively implementing preventive measures in the future.

2 MATERIALS AND METHODS

2.1 Study Design

The study is designed as a case study analysing the epidemic outbreak of measles in the defined community.

2.2 Case Description and Outbreak Investigation

The data from the patients diagnosed with measles during the outbreak was collected from the mandatory case notifications that were transmitted to the Epidemiological Information System of the Slovak Republic (EPIS SR). The patients were ambulatory or inpatients admitted to the Michalovce Hospital's Department of Infectious Diseases and the Children's Faculty Hospital in Košice between May to October 2018. The necessary data was obtained by interviewing the patients' relatives, their paediatricians and the GPs as well as by reviewing the inpatients' medical records.

Measles cases were classified according to the classification of measles cases as defined by the Commission Implementing Decision (EU) 2018/945 (5).

The suspected clinical cases were defined as having a fever with a body temperature ≥380C, maculopapular rash, and at least one of the following symptoms: conjunctivitis, coryza, cough, or Koplik's spots (6).

The case-based reports provided data for disease onset, date of birth, sex, confirmation of diagnosis (i.e. laboratory confirmed, epidemiologically linked, or clinically compatible case), vaccination status, hospitalization and complications.

An outbreak of measles was defined as the occurrence of a chain of transmission of three or more cases linked in time and place and was declared by the Regional Public Health Authority (RPHA) in Michalovce and the National Public Health Authority of the Slovak Republic (NPHA of SR).

2.3 Vaccination Coverage and Incidence Data

The data about vaccination status (MCV1, MCV2) was collected from the annual administrative monitoring in Slovakia. A retrospective review of vaccination coverage of measles was carried out for the years 1999 to 2018. The vaccination status of 24-month-old children was analysed according to date of birth from 1999 to 2016 (MCV1). The epidemiological data about measles transmission was obtained from the EPIS SR and the data about vaccination from the annual regular controls in Slovakia.

2.4 Laboratory Data

The ELISA tests were used to measure immunoglobulin M and G (IgM, IgG) antibodies. Tests were performed at the Alpha medical, s.r.o. (microbiological laboratory) and the National Reference Laboratory for Measles, Mumps and Rubella (NRL MMR) of the NPHA SR in Bratislava.

Measles were tested semi-quantitatively for IgM and IgG antibodies with Enzygnost Anti-Measles-Virus IgM/IgG (Siemens) sets, and cut-off values for a positive IgM/IgG>0.100 were calculated as the index of optical densities (OD) of the cut-off/OD of the sample, Rubella was tested with Enzygnost Anti-Rubella-Virus IgG (Siemens) semi-quantitatively (OD cut off/OD sample), with cut-off values for a positive IgG>0.100. Mumps IgG was tested quantitatively with RIDASCREEN Mumps Virus IgG (R-Biopharm AG) with cut-off values for a positive IgG>244 U/ml.

Clinical specimens of four laboratory-confirmed cases were submitted to the WHO European Regional Reference Laboratory for Measles and Rubella at the Robert Koch Institute in Berlin, Germany to determine the genotype of the measles virus (MV) circulating during the outbreak as well as to identify its likely origin. The serum was sent for confirmatory testing and the throat swabs were submitted for virus detection, sequencing and genotyping of the MV RNA according to standard instructions.

2.5 Outbreak Control Measures

Specific control measures for the target populations affected by the outbreak were implemented by the RPHA in Michalovce in accordance with the national guidelines, including conducting outbreak and contact investigation for cases, implementing isolation measures, catch-up and post-exposure vaccination and prophylaxis with immunoglobulin for people at high risk of developing severe disease, as well as providing information about the epidemiological situation. Proactive communication was carried out with parents, healthcare workers, microbiologists, hospitals, healthcare institutions, state administrations, the NPHA SR, the Ministry of Health of the Slovak Republic (MoH SR) and the Crisis Staff of the Michalovce District Office (7). Eligibility for prophylactic MMR vaccination and human normal immunoglobulin (HNIG) was assessed for all contacts and the healthcare workers. Those who had not been vaccinated appropriately for their age (i.e. the first dose of MMR vaccine at 15 months, the second dose at 10 years) were eligible for prophylactic MMR vaccination, in which case they were administered the vaccine within 72 hours of the contact with an infectious measles case. HNIG was considered for immunocompromised contacts, unvaccinated pregnant women, and selected infants under six months of age if they had been in contact with an infectious case in the previous six days (7, 8).

The letters with recommended control measures were sent out immediately: GPs were requested to check the immunization status of all contacts (children, adolescents and adults) and to immunize all those unvaccinated with one dose of MMR vaccine. The medical specialists in hospitals and outpatient settings were requested to be alert to the early detection, timely reporting, isolation, diagnosis, and treatment of measles cases. It was also recommended to hospitalize the patients with measles living in crowded households to ensure better conditions for treatment and care and to minimize the spread of the disease in communities with poor living conditions. The close Roma contacts with measles cases were isolated for 21 days at home.

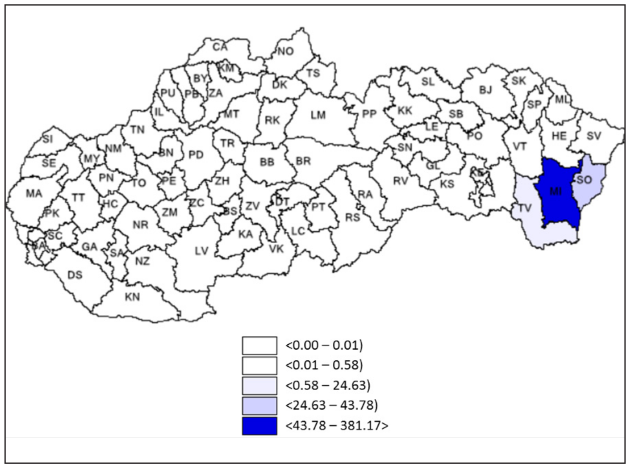
2.6 Methods of Data Analysis

The study uses descriptive data to characterize epidemic outbreak of measles, which is then used as a basis for the qualitative analysis of the implemented epidemic measures.

3 RESULTS

3.1 Outbreak Description

From May to October 2018 a measles outbreak was confirmed in Eastern Slovakia, specifically the region of Košice. First cases were imported from the UK (three imported and 1 imported-related cases). Measles spread to the Roma settlements in the Michalovce (416 cases from May 4 to September 20) and Sobrance (19 cases from May 25 to October 16) districts and affected the Roma population. During the outbreak period, four healthcare workers (HCWs) also developed measles in the Michalovce Hospital. A total of 439 measles cases were reported to the EPIS SR (Figure 1).



Source: EPIS SR, © Public Health Authority of the Slovak Republic

Figure 1. Map of the reported measles cases by districts, Slovakia, May 4–October 16, 2018 (n=439).

Figure 2 shows the measles incidence rate and level of vaccination coverage from 1997 to 2018 in Slovakia. The long-term high-performing immunization programme at national and sub-national (regional) levels showed a significant drop from 99.6% to 95.2% and from 99.5% to 95.4%. The vaccination coverage (MCV1) in the monitored districts ranged from 99.7% to 97.3% and from 100.0% to 96.3%.

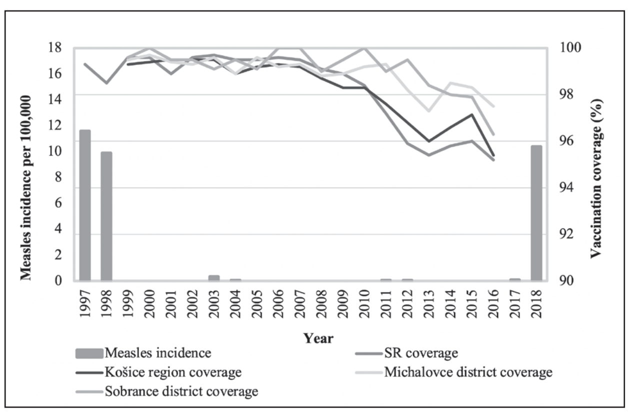


Figure 2. Measles incidence rate and measles vaccination coverage according to the cohorts 1999-2016, the Michalovce and Sobrance districts in the Košice region, Slovakia, 1997-2018.

Figure 3 shows the number of the reported measles cases by date of symptoms onset. The outbreak reached its peak by July 2018 (week 28/2018), with 80 (18.2%) reported cases.

A total of 439 cases were reported with the dates of rash onset from May 4 to October 16, 2018 (weeks 19/2018 to 43/2018).

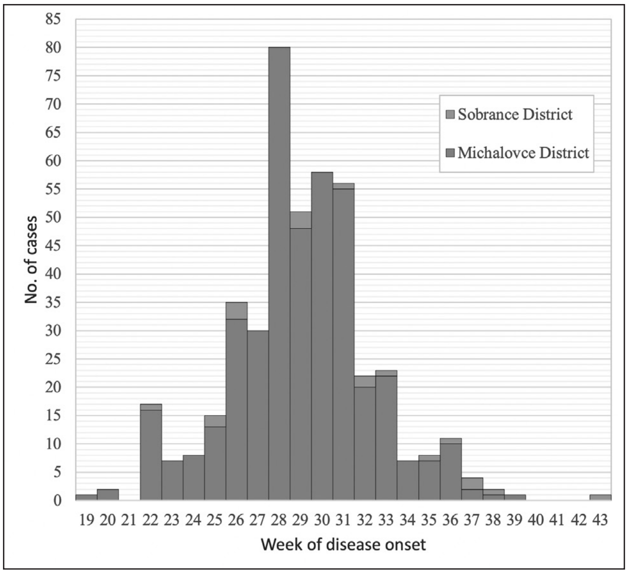


Figure 3. The epidemic curve of the total measles cases, May–October 2018, for the Michalovce and Sobrance districts, Slovakia (n=439).

The median age for the total of 439 measles cases was 10 years (range: 0 month–51 years), while in 278 measles cases (63.3%) it was ≤14 years.

Measles was diagnosed after two or more days (from two to 12) following rash onset. 274 cases were laboratory confirmed and 165 were classified as probable cases. The reported complications included 39 cases of pneumonia. Out of total 439 cases, 288 patients were admitted to hospital with median hospitalization of 6.5 days (range: 1–10 days). The most common age group affected by measles were children <1 year of age and then adolescents in 15-19 years of age (157 cases; 35.8%). Out of 288 hospitalized cases, a ten-day stay in hospital was recorded in 67 patients, of whom 64 were children and adolescents aged 0-19 years.

Table 1 shows the characteristics of all cohorts (439 cases) and the characteristics of the 102 measles cases cohort with positive two doses vaccination status by gender, age and type of applied vaccine (monovalent, bivalent and trivalent vaccines). More than 90% of the cohort patients were vaccinated with two doses of trivalent MMR (measles, mumps, and rubella) vaccine.

Within the Roma cohort, 175 out of 435 cases were unvaccinated or had unknown vaccination status for measles. Four sick healthcare workers were vaccinated with two doses of bivalent measles-mumps vaccine. Out of 264 vaccinated cases, 137 (31.2%) received two doses and 127 (28.9%) only one dose of measles vaccine in their vaccination records. 155 measles cases (35.3%) were unvaccinated and 20 (4.6%) of unknown vaccination status. We additionally tested antibodies against rubella and mumps in a set of 137 patients with two doses of vaccine. Samples from 102 patients were examined.

Table 1. Characteristics of all patients (n=439) and of patients vaccinated with two MCV doses (n=102) in the measles outbreak in Michalovce and Sobrance districts, Slovak Republic 2018.

	Characteristics of all patients in the measles outbreak, the Michalovce and Sobrance districts (n=439)									
	Age group									
Characteristic	**0**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-34**	**35-44**	**45-54**	**TOTAL**
Males	33	27	30	35	38	16	19	10	4	212
Females	48	33	42	30	38	13	12	8	3	227
TOTAL (%)	81 (18.5)	60 (13.7)	72 (16.4)	65 (14.8)	76 (17.3)	29 (6.6)	31 (7.1)	18 (4.1)	7 (1.6)	439 (100.0)
Hospitalized	72 (16.4)	51 (11.6)	52 (11.8)	31 (7.1)	47 (10.7)	18 (4.1)	13 (3.0)	2 (0.5)	2 (0.5)	288 (65.6)
Complications	10 (2.3)	8 (1.8)	6 (1.4)	2 (0.5)	8 (1.8)	1 (0.2)	3 (0.7)	0	1 (0.2)	39 (8.9)
	VACCINATION STATUS (%) (n=439)									
MCV1										
MMR*	0	21 (4.8)	58 (13.2)	15 (3.4)	13 (3.0)	10 (2.3)	6 (1.4)	0	0	123 (28.0)
MM**	0	0	0	0	0	0	1 (0.2)	0	0	1 (0.2)
Mo***	0	0	0	0	0	0	0	2 (0.5)	1 (0.2)	3 (0.7)
All MCV1	0	21 (4.8)	58 (13.2)	15 (3.4)	13 (3.0)	10 (2.3)	7 (1.6)	2 (0.5)	1 (0.2)	127 (28.9)

Characteristic	Age group									
	0	1-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	TOTAL
MCV2										
MMR*	0	0	0	37 (8.4)	52 (11.8)	17 (3.9)	10 (2.3)	2 (0.5)	0	118 (26.9)
MM**	0	0	0	0	0	0	0	1 (0.2)	0	1 (0.2)
Mo***	0	0	0	0	0	0	9 (2.1)	7 (1.6)	2 (0.5)	18 (4.1)
All MCV2	0	0	0	37 (8.4)	52 (11.8)	17 (3.9)	19 (4.3)	10 (2.3)	2 (0.5)	137 (31.2)
All vaccinated	0	21 (4.8)	58 (13.2)	52 (11.8)	65 (14.8)	27 (6.2)	26 (5.9)	12 (2.7)	3 (0.7)	264 (60.1)
Unvaccinated	0	23 (5.2)	14 (3.2)	12 (2.7)	5 (1.1)	1 (0.2)	0	0	3 (0.7)	58 (13.2)
Unvaccinated for age	81 (18.5)	16 (3.6)	0	0	0	0	0	0	0	97 (22.1)
All unvaccinated	81 (18.5)	39 (8.9)	14 (3.2)	12 (2.7)	5 (1.1)	1 (0.2)	0	0	3 (0.7)	155 (35.3)
Unknown	0	0	0	1 (0.2)	6 (1.4)	1 (0.2)	5 (1.1)	6 (1.4)	1 (0.2)	20 (4.6)
	Characteristics of patients vaccinated with 2 MCV doses in the measles outbreak in the Michalovce and Sobrance districts (n=102)									
Males	0	0	0	13	22	7	6	4	1	53
Females	0	0	0	10	23	5	7	3	1	49
TOTAL (%)	0	0	0	23 (22.5)	45 (44.1)	12 (11.8)	13 (12.8)	7 (6.9)	2 (2.0)	102 (100.0)
	VACCINATION STATUS (%) (n=102)									
MCV1										
MMR*	0	0	0	0	0	0	0	0	0	0
MM**	0	0	0	0	0	0	0	0	0	0
Mo***	0	0	0	0	0	0	0	0	0	0
All MCV1	0	0	0	0	0	0	0	0	0	0
MCV2										
MMR*	0	0	0	23 (22.5)	45 (44.1)	12 (11.8)	13 (12.7)	0	0	93 (91.2)
MM**	0	0	0	0	0	0	0	0	0	0
Mo***	0	0	0	0	0	0	0	7 (6.9)	2 (2.0)	9 (8.8)
All MCV2	0	0	0	23 (22.5)	45 (44.1)	12 (11.8)	13 (12.7)	7 (6.9)	2 (2.0)	102 (100.0)

*TRIMOVAX, PRIORIX,
M-M-RVAXPRO
**MOPAVAC
***MOVIVAC

3.2 Laboratory Confirmations

A total of 274 measles cases were laboratory confirmed at Alpha Medical, s.r.o. (microbiological laboratory) from May 4 to October 16.

One hundred and two samples obtained from the measles cases with two-dose vaccination status were tested for IgG antibodies against measles, mumps and rubella at the NRL MMR of the NPHA SR.

For measles, 68 (66.7%) cases had positive IgM antibodies, 33.3% of them were equivocal and 23 (22.5%) had positive IgG. For rubella, only 20 (19.6%) cases had seropositive IgG levels, while for mumps higher positivity was detected in 60 persons (58.8%). The remaining cases had negative test results.

Table 2 contains the proportion of persons with positive and negative serology results for a rubella IgG antibody test. Across all age groups of the measles cases, we can detect only a small percentage with a positive serology result of rubella IgG antibody test, ranging from 10.0% in the age groups of 10–14 and 45-54, and up to 30.0% in the 35-44 group.

Clinical specimens of four laboratory confirmed cases were tested in RKI Berlin. Sequential analysis of two samples showed measles genotype B3, dist. sequence in MeaNS: 5258, identical to Nmed Strain MVs/Bradford. GBR/13.18.

Table 2. The antibodies against measles, mumps and rubella by age group in the measles outbreak, May–October 2018, the Michalovce and Sobrance districts in the Košice region, Slovakia (n=102).

	Positive and cut-off values (n=102) (%)						
Characteristic	**0**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-34**
All cases	23	45	12	13	7	2	102
				MEASLES			
IgM n=68	13 (12.7)	31 (30.4)	8 (7.8)	11 (10.8)	4 (3.9)	1 (1.0)	68 (66.7)
IgG n=23	1 (1.0)	7 (6.9)	3 (2.9)	4 (3.9)	6 (5.9)	2 (2.0)	23 (22.5)
				MUMPS			
IgG n=60	10 (9.8)	28 (27.5)	8 (7.8)	6 (5.9)	6 (5.9)	2 (2.0)	60 (58.8)
				RUBELLA			
IgG n=20	2 (2.0)	3 (2.9)	3 (2.9)	4 (3.9)	6 (5.9)	2 (2.0)	20 (19.6)
	Positive antibodies against rubella and the type of applied combination vaccines (n=20) (%)						
MMR+MMR	2 (10.0)	3 (15.0)	3 (15.0)	1 (5.0)	0	0	9 (45.0)
MM+MMR	0	0	0	3 (15.0)	1 (5.0)	0	4 (20.0)
Mo+Mo	0	0	0	0	5 (25.0)	2 (10.0)	7 (35.0)
TOTAL	2 (10.0)	3 (15.0)	3 (15.0)	4 (20.0)	6 (30.0)	2 (10.0)	20 (100.0)
	Negative antibodies against rubella and the type of applied combination vaccines (n=82) (%)						
MMR+MMR*	21 (25.6)	42 (51.2)	9 (11.0)	9 (11.0)	0	0	81 (98.8)
MM+MMR**	0	0	0	0	0	0	0
Mo+Mo***	0	0	0	0	1 (1.2)	0	1 (1.2)
TOTAL	21 (25.6)	42 (51.2)	9 (11.0)	9 (11.0)	1 (1.2)	0	82 (100.0)

*MMR+MMR: two doses of trivalent vaccine against measles, mumps and rubella
**MM+MMR: one dose of bivalent measles-mumps vaccine, and one dose of trivalent measles-mumps-rubella vaccine
***Mo+Mo: two doses of monovalent vaccine against measles

3.3 Outbreak Control Measures

Staff of the RPHA in Michalovce visited the Roma settlements several times, together with Roma health mediators (RHM), to identify contacts and search for additional cases and close contacts. Close contacts (and especially those 18 years or younger) were invited to GPs for post-exposure prophylaxis. The RPHA informed the local hospital, emergency departments, paediatricians, GPs and the local media, and urged physicians to investigate all suspected measles cases, to isolate them if infectious and to notify cases immediately. Simultaneously, they highlighted a need for verification of the measles immunity status of all unvaccinated hospital staff, and for vaccination of all those susceptible to infection.

Following the risk assessment of the situation related to the reported rising numbers of measles cases in many European countries (mainly in the Czech Republic, May 2017) and the permanent threat of importation of measles cases, the NPHA SR sent out an official warning letter to all RPHAs on May 2017.

During the measles outbreak in 2018, letters with recommended control measures were prepared by the RPHA in Michalovce (repeatedly from May 7 2018), the NPHA SR (May 28 2018), the Crisis Staff of the Michalovce District Office (July 13 2018).

4 DISCUSSION

The measles outbreak in Slovakia in 2018, involving 439 reported measles cases from two Roma settlements in Eastern Slovakia, represents the most serious episode in the country since the elimination of measles in 1999. This revealed and confirmed that pockets of low vaccination coverage do exist in some areas of Košice, particularly among the Roma communities. The estimated total Roma population in Slovakia is around 500,000 (4). They live in overcrowded and often extremely poor sanitary conditions. Another characteristic trait of the Roma is frequent travelling throughout the country and abroad (9, 10).

This outbreak points to the insufficient vaccination coverage of the Roma population in Slovakia. The analysis of the vaccination coverage status of the cases shows a prevalence of individuals having received at least one dose of measles-containing vaccine. It is difficult to monitor the uptake of MMR vaccine among the Roma, but it is known to be low (3). In this outbreak a high level of susceptibility was found among children and adolescents (0–14 age group), confirming a low vaccination uptake. Barriers to the vaccination of the Roma have been previously described (4). The outbreak in their settlements did not spread widely within the communities.

The majority of cases were hospitalized, with the median hospitalization of six days (1–10 days). The same higher proportion with five-day hospitalization (5–6 days) was described in the Irish outbreak in 2016. Of the complications only pneumonia (39 cases) was reported. There were no reported cases of seizures, meningitis or encephalitis, and there were no deaths (11).

The measles monovalent vaccine was introduced in Slovakia in 1969. The combined bivalent vaccine (MM–measles, mumps) was implemented in 1987 and trivalent MMR (measles, mumps, rubella) in 1992. Currently, in accordance with the National Immunization Programme (NIP) of the Slovak Republic, two doses of MMR vaccine are recommended for children (15–18 months and 10 years old). We have noticed a gradual decrease in vaccination coverage, particularly in the cohorts from 2000–2016. However, this decrease is not homogenous and there are differences across the regions. A similar situation was also described in other countries of the European Union (12).

Analysis of IgG antibodies against rubella showed the relatively low prevalence rate of positive values not corresponding with medical records. This finding points to the importance of immunological examinations carried out on a regular base to get a valid picture on the actual situation. We assume that rubella antibodies had to be produced following the vaccination. Their absence in those cases with a stated history of two doses of MMR vaccine suggests that these vaccines could not have been administered, despite the fact that this data was included in the patients' medical records.

A high immunogenicity of PRIORIX (MMR) was demonstrated in the clinical trials with infants and children aged from 12 months to two years. The vaccination with a single dose of PRIORIX induced antibodies against measles in 98.1% of the vaccinated individuals, against mumps in 94.4% and against rubella in 100% of previously seronegative ones. Two years after primary vaccination seroconversion rates were 93.4% for measles, 94.4% for mumps and 100% for rubella. All results after M-M-RVAXPRO and TRIMOVAX were similar (13).

Recently, mumps outbreaks have been reported in these localities. The positivity rate of 54.9% for antibodies may be induced by natural infection, although no case history of illness was either confirmed or disproved.

Sequential analysis of the samples obtained from the early cases in Michalovce showed measles genotype B3, which has been dominantly circulating in Europe (France, Italy and Romania) over the past three years. Mean data from the last two years (2017, 2018) show that measles virus genotype B3 was endemic in several countries worldwide (11, 14, 15).

All contacts received a dose of MMR vaccine as post-exposure prophylaxis within 72 hours of last exposure. The contacts born before 1969 were not advised to get MMR vaccination due to the high probability that they had received natural immunity from childhood infection. Paediatricians and GPs vaccinated 6,076 persons (family members, co-workers and others in contact with patients), out of whom 4,648 were children.

Thanks to relatively high immunization rates (from 97.3% to 100%) among the cohorts of small children (born between 2010 and 2016 in the districts of Michalovce and Sobrance) and to the work done by the RPHA in Michalovce in conducting the contact investigation for cases, vaccination of susceptible persons and household contacts, as well as in implementing isolation measures, the outbreak did not affect the whole region and remained limited.

As a potential limitation of the study it should be mentioned that we were not able to include into the analysis all factors determining epidemic spread. However, the analysis is based on immunological examinations and thus provides a valid picture on the actual situation.

5 CONCLUSION

High infectivity combined with a decrease in vaccine coverage and a dramatic increase in disease prevalence present a risk of a measles outbreak in many EU countries (16). The outbreak examined in this study has highlighted the immunity gaps existing in the Roma population in Slovakia. The risk should not be underestimated, and represents a more serious threat than sporadic cases of susceptible individuals. Susceptible population groups may reintroduce indigenous measles transmission even in those countries confirmed as disease-free or in a population with high vaccine coverage (17).

Efforts are thus needed to improve the methods used to identify the high risk areas and to develop specific strategies within target susceptible groups. An improvement in health services is essential to reach the Roma communities. To achieve this, a more effective communication strategy should be defined to address the subjects objecting to vaccination, and placing this within a wider discussion on their responsibility towards the community. The implementation of catch-up campaigns targeting children and adolescents should also be considered.

CONFLICT OF INTEREST

The authors declare no conflicts of interest exist.

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ETHICAL APPROVAL

The patient information used in this research was collected following ethical principles. All patients signed informed consent forms for each diagnostic intervention and research purpose, according to the related act of the Ministry of Health. Supplementary immunological examinations were approved by the Ethics Committee of the Ministry of Health of the Slovak Republic.

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