

HYGIENE, SANITATION, EPIDEMIOLOGY AND MEDICAL ECOLOGY

Z.V. Maraktaev, V.V. Sidorova, T.A. Bayanova

**MENINGOCOCCAL INFECTION
IN THE REPUBLIC OF BURYATIA:
FEATURES OF EPIDEMIOLOGY
AND SPECIFIC PROPHYLAXIS**

DOI 10.25789/YMJ.2024.87.13

UDC 616.98-022-036-084(571.54)

The article presents manifestations of the epidemic process of MI in the Republic of Buryatia: the dynamics of morbidity in different age groups of the population, mortality, serogroup characteristics of meningococcal strains. An assessment of the state of the level of collective immunity is given based on serological monitoring data and an analysis of immunoprophylaxis against infectious diseases. Period 2021-2023 characterized by a worsening of the epidemiological situation (increasing morbidity and mortality; involvement of different age groups of the population; increase in the number of seronegative individuals). Conducting serological and bacteriological monitoring, increasing the volume of immunization against MI and strengthening awareness-raising work among the population about the possibilities of vaccine prevention of MI will help improve epidemiological surveillance of this infection.

Keywords: epidemiology, meningococcal infection, morbidity, serological monitoring, vaccine prevention.

Introduction. In modern conditions, the problem of meningococcal infection (MI) remains relevant due to its high medical and social significance, due to the high level of mortality and disability [2, 6, 14]. Approximately half a million cases of invasive forms of myocardial infarction are registered annually worldwide, and the incidence varies significantly depending on geographic regions [14]. The relevance of the problem of the spread of MI throughout the world is due to the diversity of sources of infection, serological heterogeneity and variability of the pathogen, and the difficulties of epidemiological surveillance [12]. For a number of years, the Russian Federation (RF) has been characterized by epidemiological well-being in terms of MI. At the same time, in recent years there have been clear signs of a worsening epidemiological situation, including: an increase in the incidence rate, registration of outbreaks with multiple cases of disease, and an increase in the mortality rate [1, 10]. In this regard, the existing systems of epidemiological surveillance and preven-

tion require improvement, primarily at the level of constituent entities of the Russian Federation [1, 3]. In the Republic of Buryatia (RB), the incidence of MI remains a pressing problem [11]. There remain risks of complicating the epidemiological situation, since throughout the country there are signs of the beginning of another rise in morbidity [1,6,8,10]. At the same time, the Republic of Belarus is characterized by a heterogeneous demographic composition, vast territories, and cross-border migration creates the preconditions for the spread of infectious diseases, including such dangerous ones as MI.

Purpose of the study: to study the regional epidemiological features of MI in the context of a selective population vaccination strategy.

Materials and methods of research.

A descriptive epidemiological study was conducted for the period 2014-2023. according to reporting form No. 2 "Information on infectious and parasitic diseases" in the Republic of Belarus; state reports "On the state of sanitary and epidemiological well-being of the population in the Russian Federation", "On the state of sanitary and epidemiological well-being of the population in the Republic of Buryatia". The dynamics of the incidence of MI, including HFMI, by age groups was studied. The structure of morbidity was assessed by the proportion of each age group: the total population, adults, children 0-14 years old. An assessment of the state of the level of collective immunity is given based on serological monitoring data. An analysis of the state of immunoprophylaxis against MI is presented according to the data of reporting form No. 5 "Information on preventive vacci-

nations." Statistical processing of data was carried out using standard methods for calculating intensive and extensive indicators and 95% confidence intervals. Graphic data processing was performed using Microsoft Excel 2016.

Results and discussion. The observation period was characterized by a trend towards a decrease in the incidence of MI and HFMI among the total population of the Republic of Belarus, as well as in the Russian Federation as a whole [10]. For 2014-2019 The average long-term indicator (AMI) of MI of the total population was 0.9 per 100 thousand. The average incidence rate of HFMI of the total population was at the level of 0.6 per 100 thousand. In 2020, no cases of MI were registered. In 2023, the rate increased 2.5 times compared to last year, reaching 0.53 per 100 thousand (Table 1).

Among children, the SMP was 1.7 per 100 thousand of the population, among adults - 0.35 per 100 thousand. The incidence of the child population of the Republic of Bashkortostan during the analyzed period steadily decreased (Fig. 1, Table 1). The average incidence rate of HFMI in children exceeded that among the general population by 3 times, and in adults by 4.6 times. In 2023, the incidence rate in children exceeded the incidence rate in adults by 4 times. Among the child population, the age group at risk for the incidence of HFMI was children under one year old (13.5 per 100 thousand). The incidence of children in other age groups was significantly lower. Thus, the incidence of children 3-6 years old, 1-2 years old, 15-17 years old was 1.4; 2.6; 0.6 per 100 thousand, respectively.

MARAKTAEV Zorikto Vladimirovich – chief physician of the Federal Budgetary Healthcare Institution Center for Hygiene and Epidemiology in the Republic of Buryatia, e-mail: cge@fbuz03.ru; **SIDOROVA Valentina Vasilievna** – epidemiologist, Federal Budgetary Institution of Health Center for Hygiene and Epidemiology in the Republic of Buryatia, e-mail: valvalen@bk.ru; **BAYANOVA Tatyana Aleksandrovna** – PhD, Associate Professor, Associate Professor of the Department of Epidemiology, Irkutsk State Medical University, ORCID:0000-0003-4289-3460; e-mail: bayanova_tanya@mail.ru

Table 1

Dynamics of the incidence of MI and HFMI in the total population of the Republic of Buryatia in comparison with the Russian Federation (per 100 thousand population)

	Years									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Morbidity of the total population										
MI RB	0.92	1.53	0.71	1.02	1.02	0.31	-	-	-	-
MI RF	0.68	0.67	0.5	0.58	0.7	0.75	-	-	-	-
HFMI RB	0.82	1.23	0.61	0.92	1.02	0.31	0	0.21	0.21	0.53
HFMI RF	0.6	0.59	0.43	0.48	0.52	0.59	0.26	0.22	0.43	0.41
Morbidity in children under 14 years of age										
MI RB	2.84	4.14	1.79	3.16	3.57	0.89	-	-	-	-
HFMI RB	2.84	2.76	1.34	3.16	3.57	0.89	0	0.91	0.9	1.38

The lowest incidence rate was recorded in children 7-14 years old - 0.4 per 100 thousand population.

The share of children under 14 years of age in the structure of MI cases prevailed and amounted to 67.0%, the share of adolescents and adults was 4.0% and 29.0%, respectively. Children of all age groups were involved in the epidemic process of MI [8, 13]. At the same time, the largest proportion of cases of MI and HFMI fell on children under one year of age (45.0 and 46.0%, respectively). Among adults, the largest share was among persons 30-49 years old – 38.0% and 18-29 years old – 31.0%.

Registration of HFMI for the analyzed long-term period occurred throughout the year with the largest number of cases in the autumn-spring period, the maximum number of cases was registered in March and October (8 cases each). Perhaps this distribution of morbidity is associated with closer contacts of the population in enclosed spaces, a decrease in the body's resistance, as well as an increase in the circulation of meningococcus during the formation of organized groups.

From 2020, only SFMI are subject to statistical accounting and registration in reporting form No. 2. For 2014-2019 the share of HFMI was 89.0% of the total number of MI diseases. In all foci, one case of HFMI was recorded. Considering the airborne transmission route, which occurs during close contact (within a radius of up to 1 meter from an infected person), it can be assumed that the source of infection was bacteria carriers and patients with meningococcal nasopharyngitis in the patient's environment. Thus, the source of infection in foci of generalized forms was established in 12.3%.

The instability of meningococcus to various environmental factors, the influence of the quality of selection, sample delivery, and sensitivity to chemotherapy do not allow the source of infection to be established in all cases. In addition, according to the provisions of SanPiN 3.3686-21 (section XXXIX Prevention of meningococcal infection), identification of patients with acute nasopharyngitis of meningococcal etiology is carried out in the outbreak for the purpose of treatment. Patients with acute nasopharyngitis in the focus of SFMI are not subject to registration and recording.

It is known that MI has various clinical forms [7]. In the structure of clinical forms of patients with HFMI during the analyzed period, meningitis (53.0%) and meningococcemia (28.0%) predominated; the proportion of mixed forms did not exceed 19.0%.

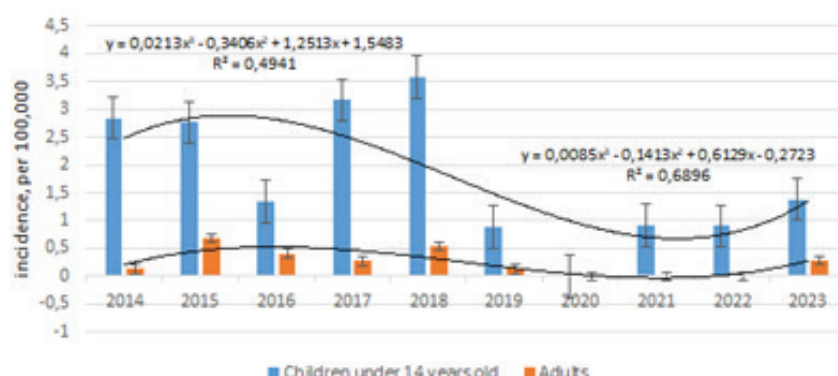


Fig. 1. Dynamics of incidence of HFMI among adults and children in the Republic of Buryatia, 2014-2023.

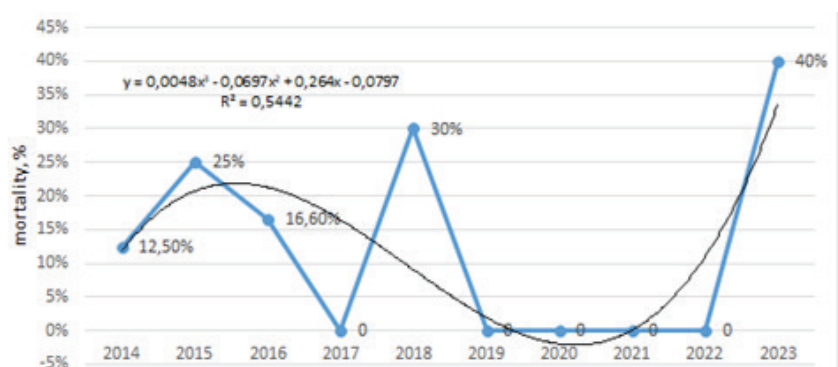


Fig. 2. Dynamics of mortality due to HFMI in the Republic of Buryatia, 2024-2023.

Table 2

Dynamics of immunization volumes against infectious diseases in the Republic of Buryatia and the Russian Federation (absolute values)

Years	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
RF total	35371	55899	62967	119479	175715	299856	374786	435343	476681	841459
RB total:	206	22	8	19	16	53	2168	10468	5020	6690
of which children under 14 years of age	198	21	8	18	16	48	2091	10337	4213	4825

The course of MI is characterized by various forms of the infectious process, which determines the importance of timely diagnosis of the disease [1, 3]. "Meningococcal infection. Meningitis" as the primary diagnosis was made in 68.4% of cases, "ARVI", "Rash of unknown etiology" and other diagnoses - in 17.5; 7.0 and 7.0% of cases, respectively. More than 90.0% of patients were hospitalized on the first day of presentation.

Mortality during this period varied from 12.5 to 40.0% (Fig. 2). Fatal cases were recorded mainly among children: 5 cases – among children under one year old (50.0%), 1 case – in a child 3-6 years old (10.0%), 4 cases – in adults (40.0%). Please note that 50.0% of all deaths occurred among residents of the republic's districts, which amounted to 22.0% of all registered cases, i.e. every 5th case in the district resulted in death. Half of the deaths occurred among residents of Ulan-Ude.

Studying the serogroup landscape of meningococcal strains is a priority for monitoring MI [8, 12, 13]. During the analyzed period, in 49 cases (86.0%) the pathogen *N. meningitidis* was detected in the cerebrospinal fluid of patients; in 8 cases (14.0%) the diagnosis was not confirmed by laboratory tests. In the serogroup characteristics of invasive strains, *N. meningitidis* serogroups A (13 cases; 23.0%), B (12 cases; 21.0%), C (7 cases; 12.0%), Y/W (4 cases; 12.0%) were identified. 7.0%), W (2 cases; 4.0%). In 33.0% of cases, the serogroup characteristics were not determined (19 strains).

Long-term monitoring of the landscape of meningococci isolated from sick people indicates its heterogeneity. Thus, in 2015, meningococcus B dominated predominantly (50.0% of the isolated strains), in 2016 - serogroup W135/Y (80.0% of the isolated strains); in 2017 and 2018, serogroup A was in the lead (71.4 and 50.0% of isolated strains, respectively).

Registration of HFMI for the analyzed long-term period occurred throughout the year with the largest number of cases in the autumn-spring period, the maximum number of cases was registered in March and October (8 cases each). Perhaps this distribution of morbidity is associated with closer contacts of the population in enclosed spaces, a decrease in the body's resistance, as well as an increase in the circulation of meningococcus during the formation of organized groups.

To characterize the immunological structure of the population, annually in the Republic of Belarus, within the framework of the decree "On the organization

and implementation of serological monitoring of the state of collective immunity," monitoring of risk groups is carried out, which makes it possible to track the prevalence of carriage and the landscape of circulating strains on the territory of the republic. Since bacteria carriers are important in the spread of the disease [3, 6], it is important to maintain monitoring among "indicator groups". These studies are carried out on the basis of the bacteriological laboratory of the Federal Budgetary Institution of Health "Center for Hygiene and Epidemiology in the Republic of Belarus" twice a year (September, December) among "indicator" risk groups (students of grades 9-11 of secondary schools, lyceums; persons who have been in contact with a patient with MI; persons living in dormitories, as well as patients with nasopharyngitis). The criterion for selecting a survey area is, first of all, the registration of cases of HFMI in the previous year. To characterize the immunological structure of the population, at least 150 sera are examined annually in the autumn-winter period using the RPGA method with meningococcal erythrocyte diagnostics. Transmission of the MI pathogen, *Neisseria meningitidis*, is carried out by airborne droplets, and the development of healthy carriage is possible, the prevalence of which varies widely [8]. Over a ten-year period from 2014-2023, 2802 biosamples of nasopharyngeal mucus were examined, 13 positive results were identified, which amounted to 0.5%. The years with a high number of positive results are 2014-2016, the share was 76.9%. The highest proportion of positive seedlings was observed in the city of Ulan-Ude - 92.3%.

The results of the study demonstrate an extremely low number of seropositive individuals in the population. Thus, the proportion of seronegative/seropositive to *N. meningitidis* serogroups A and C was 90.2/99.3 and 9.8 and 0.7%, respectively. Over the past 2 years (2022-2023), 100.0% of those examined were seronegative. The predominance of seronegative sera indicates a large number of susceptible ones.

The priority method of combating MI is proactive vaccine prevention [4, 9]. At the same time, the relevance of vaccine prevention of meningococcal infection with multicomponent vaccines is increasing [5].

Before 2020, vaccination coverage against MI was low. Over the past 5 years, there has been a significant increase in vaccination volumes: among the total population by more than 120 times, among children by 100 times. In

2023, the share of children accounted for more than 70.0% of the total number of vaccinated people (Table 2).

Immunization was carried out with the Mencevax and Menactra vaccines, primarily among children, contacts in outbreaks of infectious diseases, and persons subject to conscription for military service.

In order to implement the powers of the Republic of Belarus for immunization of the population within the framework of the Calendar of Preventive Vaccinations for Epidemic Indications and in accordance with the Federal Law of 04/05/2013 No. 44-FZ "On the contract system in the field of procurement of goods, works, services to meet state and municipal needs", in accordance with the Decree of the Government of the Republic of Belarus dated November 19, 2018 No. 644 "On approval of the Procedure for financial provision of immunoprophylaxis according to epidemic indications of the population of the Republic of Buryatia," the Order of the Ministry of Health of the Republic of Buryatia No. 108-r dated February 25, 2021 was initiated on the purchase of immunobiological drugs against MI for immunization of children population from 2 years of age living in an area with a high incidence of MI and persons subject to conscription for military service, as well as vaccination against chickenpox, viral tick-borne encephalitis, rotavirus infection, viral hepatitis A, etc., which led to an increase in vaccination volumes in 2021.

The selection of persons for vaccination was carried out in medical and educational organizations. Vaccination was carried out with the quadrivalent conjugate vaccine "Menactra". Despite the increase in vaccination volumes, a statistically insignificant strong inverse relationship ($\rho = -0.670$, $p > 0.05$) between the number of vaccinated individuals and the incidence of MI was noted over the years. This may be due to insufficient vaccination volumes and does not have a significant impact on the epidemic process.

Conclusion. Despite the downward trend in the incidence of MI, including HFMI, in long-term dynamics, the period 2021-2023. characterized by rising morbidity and mortality rates; involving different age groups of the population; an increase in the number of seronegative individuals. Taking into account the epidemiological features of MI in the Republic of Belarus, in order to improve epidemiological surveillance, it is advisable to continue carrying out serological and bacteriological monitoring to be able to take prompt preventive and anti-epi-

demic measures against MI; increase the volume of immunization against MI [4, 8]; Strengthen awareness-raising work among the population about vaccine prevention of MI.

References

1. Gritsay M.I. E'pidemiologicheskie osobennosti meningokokkovoy infekcii na sovremennom e'tape: Avtoref. dis. ... kand. med. nauk [Epidemiological features of meningococcal infection at the present stage: thesis PhD in Medicine. M., 2022; 23 (In Russ.).]
2. Dostizhenie celej v oblasti bor'by s meningitom na period do 2030 g.: global'naya dorozhnaya karta. Vsemirnaya organizaciya zdorovooxraneniya, 2021 r. [Achieving the meningitis control goals for the period up to 2030: a global roadmap. World Health Organization, 2021. URL :<https://www.who.int/docs/default-source/immunization/meningitis/defeatingmeningitisroadmap.pdf> (11.05.2024) (In Russ.).]
3. Koroleva I.S., Koroleva M.A. Meningokokkovaya infekciya: sovremennyye tendencii [Meningococcal infection: modern trends]. Infekcionny'e bolezni v sovremennom mire: e'voluciya, tekushhie i budushhie ugrozy': Sbornik trudov XV Ezhegodnogo Vserossiyskogo Kongressa po infekcionny'm boleznyam imeni akademika V.I. Pokrovskogo. [Infectious diseases in the modern world: evolution, current and future threats: Proceedings of the XV Annual All-Russian Congress on Infectious Diseases named after Academician V.I. Pokrovsky, Moscow, March 27-29, 2023. Moscow: Limited Liability Company 'Medical Marketing Agency'. 2023; 107-108 (In Russ.).]
4. Koroleva MA, Gritsay MI, Koroleva IS, Akimkin VG, Mel'nikova AA. Gnoynnye bakterial'nyye meningity v Rossiyskoy Federatsii: epidemiologiya i vaksinoprofilaktika [Purulent bacterial meningitis in the Russian Federation: epidemiology and vaccine prevention]. Zdorov'ye naseleniya i sreda obitaniya. [Population health and habitat. 2022; 30 (12): 73–80. doi: <https://doi.org/10.35627/2219-5238/2022-30-12-73-80>. (In Russ.).]
5. Koroleva IS, Koroleva MA, Gritsay MI. Meningokokkovaya infektsiya i aktual'nost' mer profilaktiki. [Meningococcal infection and the relevance of preventive measures]. Poliklinika. [Poliklinic. 2020; 1-2: 47-50 (In Russ.).]
6. Mazankova LN, Tebenkov AV, Rossina AL. Meningokokkovaya infekciya u detej – novyye vy'zovy' [Meningococcal disease in children - new challenges]. Praktika pediatrii [Pediatrician's Practice. 2021; 3: 25-29 (In Russ.).]
7. Markova KV, Skripchenko NV, Lobzin YV, et al. Meningokokkovaya infektsiya v sovremennykh usloviyakh: klinicheskiye, mikrobiologicheskiye i profilakticheskiye aspekty [Meningococcal infection in modern conditions: clinical, microbiological and preventive aspects]. Pediatrician. [Pediatr. 2020; 11 (3): 81–92. <https://doi.org/10.17816/PED11381-92> (In Russ.).]
8. Izvekova I.Ya. [et al.] Meningokokkovaya infekciya v Novosibirske: izmenenie e'pidemiologii i problemy' profilaktiki [Meningococcal infection in Novosibirsk: changes in epidemiology and problems of prevention]. E'pidemiologiya i Vakcinoprofilaktika [Epidemiology and Vaccinal Prevention. 2021; 20(3): 60-75. doi: [10.31631/2073-3046-2021-20-3-60-75](https://doi.org/10.31631/2073-3046-2021-20-3-60-75) (In Russ.).]
9. Lobzin YuV, Skripchenko NV, Gorelik YeYU, et al. Meningokokkovaya infektsiya u detej kak mediko-sotsial'naya problema. [Meningococcal infection in children as a medical and social problem]. Polyclinic. [Poliklinika. 2020; 3:43-46 (In Russ.).]
10. O sostoyanii sanitarno-e'pidemiologicheskogo blagopoluchiya naseleniya v Rossiyskoj Federatsii v 2022 godu [On the state of sanitary and epidemiological well-being of the population in the Russian Federation in 2022]. Gosudarstvenny'j doklad. Moskva: Federal'naya sluzhba po nadzoru v sfere zashchity' prav potrebitel'ej i blagopoluchiya cheloveka. [State report. Moscow: Federal Service for Supervision of Consumer Rights Protection and Human Welfare. 2023. P. 212-214. (In Russ.).]
11. Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha po Respublike Buryatiya ot 13.02.2023 №2 "Ob immunizacii v ramkax Kalendarja profilakticheskix privivok po e'pidemicheskim pokazaniyam". [Resolution of the Chief State Sanitary Doctor for the Republic of Buryatia dated 02.13.2023 №. 2 'On immunization within the framework of the Calendar of preventive vaccinations for epidemic indications' (In Russ.).]
12. Svetlichnaya SV, Elagina LA, Popovich LD. Ocenka potencial'nogo e'konomicheskogo e'ffekta pri rasshirenii profilaktiki meningokokkovoy infekcii u detej na osnove real'ny'x e'pidemiologicheskix danny'x [Assessment of the potential economic effect in expanding the prevention of meningococcal infection in children based on real epidemiological data]. Real'naya klinicheskaya praktika: danny'e i dokazatel'stva [Real clinical practice: data and evidence. 2023. 3(2): 31-41. doi: [10.37489/2782-3784-myrd-34](https://doi.org/10.37489/2782-3784-myrd-34) (In Russ.).]
13. Rychkova OA, et al. E'pidemiologiya i regional'ny'e programmy' profilaktiki meningokokkovoy infekcii v Tyumenskoj oblasti i Yamalo-Nenetskom avtonomnom okruge [Epidemiology and regional programs for the prevention of meningococcal infection in the Tyumen region and the Yamalo-Nenets Autonomous Okrug]. Voprosy' sovremennoj pediatrii [Issues of modern pediatrics. 2020; 19(2): 162-167. doi: [10.15690/vsp.v19i2.2110](https://doi.org/10.15690/vsp.v19i2.2110) (In Russ.).]
14. Tzanakaki G, et al. Invasive meningococcal disease in South-Eastern European countries: Do we need to revise vaccination strategies? Hum Vaccin Immunother. 2024; 20(1): 2301186. doi: [10.1080/21645515.2023.2301186](https://doi.org/10.1080/21645515.2023.2301186).