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Analysis of Infectious Disease Foci in Contemporary Medical-Geographical Research

The article examines the formation of disease foci in medical geography, reviews various approaches presented in the scientific literature, and analyzes the development of diseases within nosogeographic foci across different geographical latitudes. In the context of human adaptation to geographical conditions, particular attention is given to the identification of territorial, social, household, and age groups within endemic foci. The study investigates infectious disease foci in different geographical environments, the biogeographical characteristics of pathogens in spatial and temporal classifications, and the relationship between environmental pollution and human health. Furthermore, it explores disease foci associated with social and lifestyle factors that influence the evolution of infectious systems. The geography of disease foci is considered a complex socio-biological process involving geographical conditions, social lifestyles, sources of infection, and the physiological susceptibility of human populations. The article also highlights variations in the distribution and spread of diseases across different geographical zones and population groups.

Keywords: endemic, foci of diseases, focus, focus of infectious diseases, focus of infection, geographical latitudes, geographical province, nosogeographic.

Introduction

In medical-geographical research, various perspectives have been proposed regarding the formation of infectious disease foci. The concept of a nosogeographic focus is often interpreted as a cluster of diseases occurring in countries located within particular geographical or latitudinal zones. In the context of human adaptation to geographical conditions, territorial, social, household, and age groups are identified within endemic disease foci.

The geographical environment of infectious disease foci comprises spatially and temporally defined epidemic areas. In terms of geographical conditions and population dynamics, these areas are characterized by the presence of a source of infection and by environmental and social conditions that enable pathogen transmission.

There is currently a great need for the systematic study and assessment of infectious disease foci occurring within specific geographical areas and spreading among populations. Such an analytical approach is crucial for understanding the dynamics of disease transmission, identifying potential sources of infection, and implementing effective measures in public health. Through the use of statistical methods and data analy-

sis, the examination of disease dissemination has become highly relevant in the decision-making processes of public health and epidemiology.

The main purpose of this research is to develop a comprehensive approach to the analysis of infectious disease foci, improve environmental conditions, investigate sources of infection within human populations, minimize anthropogenic environmental impacts, and propose measures aimed at protecting public health and increasing public awareness. Given the close relationship between geography and medicine, medical-geographical research on infectious disease foci is of considerable scientific and practical significance.

Materials and methods

In the analysis of disease foci, particular attention was paid to the influence of geographical factors. Based on the findings, preventive measures were proposed using both qualitative and quantitative research approaches, including observation, comprehensive analysis, comparative analysis, and mathematical and statistical methods.

The synthesis of geography and medical sciences over centuries has contributed to the development of medical geography as an academic discipline, including its growing role within Azerbaijani scientific research. Building on medical-geographical studies of disease foci, the present study addresses one of the most pressing global challenges: the continuous emergence of new infectious diseases, their high transmissibility among humans, and associated high mortality rates. Based on analyses of historical epidemic data, public health authorities can develop predictive models and improve response strategies to anticipate potential future outbreaks. This proactive approach is crucial for controlling the spread of infectious diseases and safeguarding population health.

Results and discussion

Although geographical disease foci differ in terms of qualitative differences in infection risk and quantitative variation in disease patterns, they can be interpreted within a probabilistic framework. The primary emphasis is placed on the likelihood of infection in a given place and time. In medical geography, the terms “infectious disease focus” and “focus of infection” are widely used in the relevant literature.

The concept of an “infectious disease focus” is characterized by the disruption of human health and daily life. The existence of such a focus reflects not only the presence of patients but also the circulation of pathogens, thereby representing only one component of a complex phenomenon. Therefore, the term “epidemic focus” is frequently used in the literature. According to [1], an epidemic focus is defined as a geographical area that contains a source of infection under conditions of population susceptibility, along with relevant environmental conditions.

Similarly, in [2], I.I. Elkin defines an epidemic focus as a geographical area characterized by a source of infection, susceptible individuals in the surrounding population, and natural and social factors that facilitate pathogen transmission. Each infectious disease operates within temporal limits defined by its maximum incubation period.

In a broader sense, the term “geography of disease foci” refers to the spatial extent within which diseases occur and may spread across specific territories and within human population groups [3].

The formation and persistence of geographical foci of infectious diseases primarily depend on the presence of a source of infection. In many cases, infectious individuals contribute to the formation of such foci. In zoonotic diseases, animal reservoirs act as the primary sources responsible for the establishment of geographical foci. The duration of activity of a focus largely depends on the infectious period of the source of infection: in acute infectious diseases, this may last for weeks or months, whereas in chronic infections (e.g., tuberculosis and chronic carriers of typhoid fever) the activity of the focus may persist for decades [4].

A disease focus is considered to have ended once pathogen shedding ceases due to the patient’s recovery, hospitalization, or death. The geographical boundaries of a disease focus are determined by the degree of contagiousness, the mode of pathogen transmission, and sanitary and hygienic conditions. For instance, in whooping cough, the boundaries may be limited to the patient’s room, whereas in smallpox, plague, or cholera, the focus may extend to entire urban or regional areas. In other words, the mass spread of an identical infectious disease within a defined population (a city, community, or country), linked to a common source and transmitted through chains of infection across space, is defined as an epidemic [5].

Contagiousness refers to the ability of a pathogen to be transmitted from infected to healthy individuals through direct contact or via contaminated objects. Diseases such as smallpox and classical swine fever are considered highly contagious.

Quantifying the intensity of epidemic processes is challenging, as each epidemic varies in severity across geographical regions. During an epidemic, morbidity in the local population may increase by 2–5, 10–20, or more times, depending on the intensity of the epidemic process. In some cases, a sharp rise in morbidity within a country or region may result from several concurrent but epidemiologically unrelated outbreaks. The spread and development of epidemics are influenced by their origin and prevailing environmental conditions, and they may progress either rapidly or gradually across geographical areas [6].

On a global scale, the geography of infectious diseases occupies a distinct place within human diseases due to their heterogeneity. Human exploration and settlement of new territories, along with contact with various pathogenic microorganisms, parasitic fungi, and arthropods, contribute to the emergence of new diseases. Thus, the human organism, as a host for multiple pathogens, represents a complex host–pathogen system. It is well known that each pathogen requires specific environmental conditions for survival and reproduction: some are adapted to dry climates, while others prefer humid conditions [7].

The spread of diseases among different human populations varies across geographical zones. For example, schistosomiasis, caused by schistosomes, is prevalent among populations inhabiting riverine areas in equatorial and tropical regions. Ticks, which act as vectors of spotted fever rickettsioses, are widely distributed in tropical and subtropical regions.

Medical-geographical studies indicate that many infectious diseases are associated with climatic conditions. For instance, in tropical latitudes with an average temperature of about 27°C, the prevalence of yaws can reach up to 80% in certain populations. By contrast, in regions with mean temperatures of 21–26°C, the prevalence decreases to approximately 20%. The disease is also present in semi-arid zones with annual precipitation of 150–200 mm [8].

Numerous parasitic organisms infect humans and are widely distributed across geographical regions. In arid climates, such as those in Somalia, where the landscape is dominated by thorny shrub vegetation, environmental factors such as sandstorms and intense solar radiation, together with transmission by flies, contribute to the high prevalence of ocular diseases [9].

In the Arctic region, particularly in northern North America, diseases such as salmonellosis and rabies have been reported, sometimes in association with dogs used in traditional transportation systems.

Overall, factors such as malnutrition, protein-energy malnutrition, inadequate sanitation, high population density, inadequate housing, and water supply systems facilitate the spread of infectious diseases.

The term “pandemic” originates from Greek, meaning “widespread among the people”. Influenza, smallpox, plague, and cholera may rapidly spread across vast areas, affecting entire countries or multiple regions. In other words, a pandemic refers to the unusually high epidemic spread of infectious diseases across one or several countries simultaneously [10].

The progression of epidemics in specific geographical settings is often associated with natural disasters, which contribute to the emergence and spread of infectious diseases. For example, cholera pandemics occurred five times in the 19th century, while influenza pandemics occurred several times in the second half of the 20th century.

The restricted distribution of diseases is usually explained not only by geographical and environmental factors but also by low living standards. The initial source of many diseases lies in the geographical range of infection reservoirs or specific vectors. In some climatic zones, pathogens thrive due to favorable abiotic factors such as temperature, humidity, or soil structure [11].

Based on geographical conditions, disease foci can be classified as follows:

1. Foci emerging in specific geographical environments associated with the circulation of infectious agents;
2. Foci classified according to the spatiotemporal and biogeographical characteristics of pathogens;
3. Foci related to the interaction between environmental pollution and human health (biogeography, ecology, etiology);
4. Foci shaped by social and living conditions and the evolution of infectious systems.

In medical-geographical research, disease foci are often understood as clusters of infectious diseases within specific geographical regions where they are endemic. Within these endemic foci, human populations are classified according to territorial, social, household, and age characteristics [12].

Thus, the concept of geographical disease foci encompasses spatiotemporally distributed epidemic processes. In this context, a disease focus refers to an area containing a source of infection and an environment where pathogen transmission can occur.

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In general, a disease focus refers to the human living environment that supports the persistence of disease transmission. In this case, the spatial and temporal boundaries of the geographical environment are determined by the territorial, social, household, and age-related characteristics of human activity. Human infection with zoonoses is associated with enzootic processes [13].

The geography of disease foci represents a complex socio-biological process, which includes the following components:

1. The geographical environment;
2. Human social lifestyle;
3. The source of infection;
4. Physiological susceptibility of the human organism.

Classification criteria consist of a sequence of interrelated events that manifest in a systemic manner as disease foci. In general, in the study of the geography of disease foci, special attention has been given to cholera and malaria, as historically these diseases have been widely spread across the world.

References to cholera-like diseases appear in ancient Indian medical texts, particularly in the works attributed to the physician Susrut, dating approximately to the early centuries BCE. In the 16th century, cholera was documented in India by Correa. At the beginning of the 19th century, cholera spread beyond India for the first time, persisting for over a century (1817–1925) [14].

According to historical records, the origin of cholera is believed to be the Ganges River basin in India, from which the disease spread in epidemic waves across Asia. Subsequent pandemics originating in India reached Asia, Europe, Africa, and the Americas. According to WHO data, by early 1984 the number of reported cases had reached 1.3 million, with peak incidence recorded in 1971; by 1983 the cumulative figure had increased to 64.0 million.

In 1973, the first reported cholera case in the United States during the modern period was recorded. Between 1960–1970, 89.4% of the world's cholera cases were concentrated in South Asia (India, Bangladesh, Nepal) and Southeast Asia (the Philippines, Malaysia, Burma, Thailand). In several African countries (Zaire, Burundi, Ghana, etc.), stable endemic foci have formed, where widespread cholera outbreaks are observed annually. Even today, new cholera cases continue to emerge in different parts of the world [14]. Figure 1 shows the countries where cholera was recorded during 2010–2015

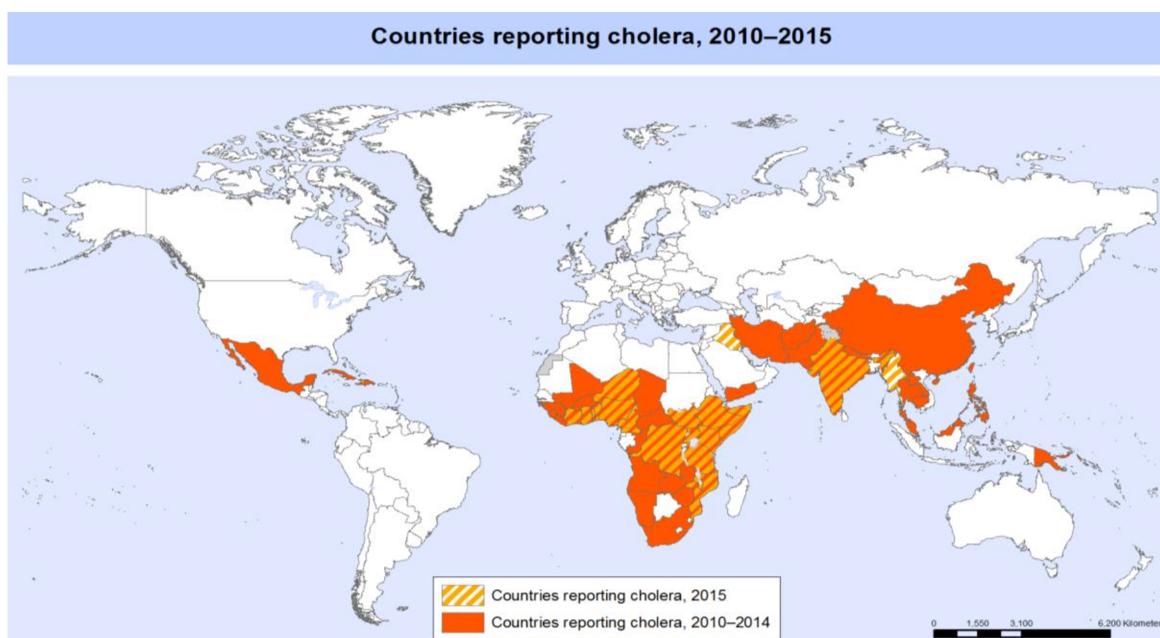

Figure 1. Countries where cholera was recorded in 2010–2015
Source: World Health Organization [14]

Malaria has been mentioned in ancient Chinese and Egyptian manuscripts, as well as in Greek and Roman literary sources. The discovery of mosquitoes preserved in amber necklaces (40–60 million years old) further supports this history. Hippocrates distinguished malaria from other febrile illnesses, linking it to "humid climates" and "unhealthy water". Due to its unique characteristics, malaria differs from other acute

febrile diseases and was described as an independent disease in Hippocrates ’works (460–377 BC). In 1640, Juan del Vego introduced the use of the bark of the cinchona tree (a plant endemic to South America) for malaria treatment. The term malaria itself derives from Italian (“mala” - bad, “aria” - air) [9].

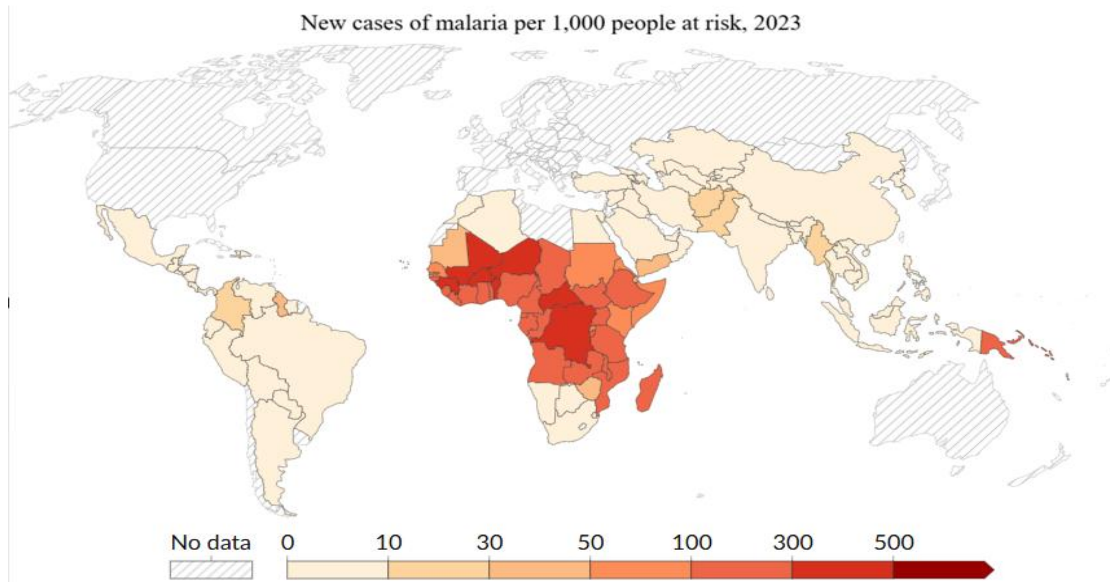

Figure 2. New cases of malaria per 1,000 people in the population at risk in 2023
Source: Our World In Data, 2025 [7].

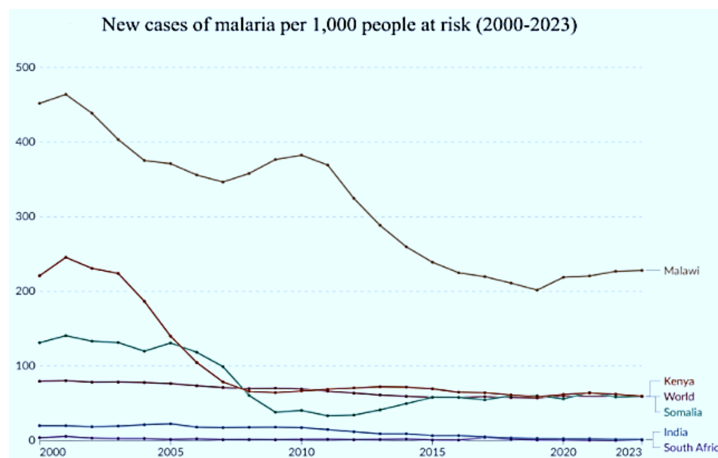

Figure 3. New cases of malaria per 1,000 people at risk
Source: Our World In Data, 2025 [7].

In the modern era, malaria has spread across 107 countries, with more than half located in Africa, Latin America, and Southeast Asia. According to WHO, over 3 billion people worldwide are at risk of infection, with 300–500 million new cases annually. Malaria not only hampers physical and mental development but also poses a significant barrier to the socio-economic development of many countries (Fig. 2).

Reported cases of malaria are distributed as follows: 95.7% in Africa, 3.85% in Asia, 0.27% in the Americas, 0.07% in Europe, and 0.1% in the western Pacific. The mechanism of malaria transmission is geographical and natural, occurring via vectors [3].

Ongoing research and development aimed at improving methodologies and data integration make the future of disease analysis promising. With increasing global interconnectedness, the potential for rapid disease spread also rises, further emphasizing the relevance of infectious disease studies (Fig. 3).

Continuous investment in public health infrastructure, data collection, and analytical tools will be crucial in strengthening epidemic response capacity and safeguarding global health in the years to come.

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Conclusion

The conducted research shows that the study of infectious disease foci is not limited only to epidemiological indicators, but is also closely related to geographical conditions, ecological factors and social lifestyle. This approach allows for a deeper understanding of the spatio-temporal dynamics of diseases, identification of risk factors and preparation of scientific bases for preventive measures in public health. The obtained results prove that medical-geographical analysis is of great importance for predicting the spread of diseases, strengthening early diagnosis and developing preventive strategies. This makes a scientific contribution to the prevention of infectious diseases, increasing the resilience of healthcare systems and protecting the health of the population on both a national and global scale.

References

1 Вернадский В.И. Химическое строение биосферы Земли и ее окружения / В.И. Вернадский. — М.: Наука, 2001. — 376 с.

2 Элькин И.И. Очерки по теории эпидемиологии / И.И. Элькин. — М.: Медицина, 1960. — 312 с.

3 Гомель Б.П. Природные очаги болезней человека / Б.П. Гомель, Б.П. Савицкий. — М.: Медицина, 2004. — 256 с.

4 Русев И.Т. Природные очаги инфекций: структура, размеры, иерархия, таксономия / И.Т. Русев, Е.В. Алексеев // Ученые записки Таврического национального университета им. В.И. Вернадского. Серия «Биология, химия». — 2013. — Т. 26 (65), № 2. — С. 168–177.

5 Вернадский В.И. История природных вод / В.И. Вернадский. — М.: Наука, 2003. — 248 с.

6 Агаев И.А. Эпидемиология / И.А. Агаев, К.И. Халафли, Ф.Ш. Тагиева. — Баку: [б. и.], 2012. — 400 с.

7 Покровский В.И. Инфекционные болезни и эпидемиология / В.И. Покровский, С.Г. Пак, Н.И. Брико, Б.К. Данилкин. — М.: Медицина, 2004. — 816 с.

8 Смирнова С.С. Вспышки инфекционных заболеваний в медицинских организациях: вопросы эпидемиологической диагностики / С.С. Смирнова, Т.С. Южанина, Л.Г. Вяткина, А.А. Голубкова, А.В. Алимов // Эпидемиология и инфекционные болезни. — 2019. — Т. 24, № 5-6. — С. 204–212. DOI: 10.17816/EID34790.

9 Ющук Н.Д. Эпидемиология / Н.Д. Ющук, Ю.В. Мартынов. — М.: Медицина, 2003. — 512 с.

10 Рзаева, С.И. Влияние экогеографических факторов окружающей среды и экогеохимических условий на здоровье человека / С.И. Рзаева. — Баку, 2018. — 220 с.

11 Рзаева С.И. Методический анализ географических очагов заболеваний / С.И. Рзаева. — Баку, 2023. — 180 с.

12 Генис Д.Е. Медицинская паразитология / Д.Е. Генис. — М.: Медицина, 1991. — 240 с.

13 Чобанов Р.А. Простейшие человека / Р.А. Чобанов. — Баку: [б. и.], 2006. — 150 с.

14 World Health Organization. — [Электронный ресурс]. — Режим доступа: https://www.who.int (дата обращения: 14.04.2026).

Ф.А. Джабраилова

Заманауи медициналық-географиялық зерттеулердегі жұқпалы аурулардың ошақтарын талдау

Мақалада медициналық-географиялық зерттеулердегі ауру ошақтарының қалыптасуы, ғылыми әдебиеттерде ұсынылған әртүрлі тұжырымдамалар, сондай-ақ географиялық ендіктер бойында орналасқан елдердегі нозогеографиялық ошақтардан туындайтын аурулардың пайда болуы талданған. Адам ағзасының географиялық жағдайларға бейімделу үдерісі аясында эндемиялық ошақтар шегіндегі халықтың аумақтық, әлеуметтік, тұрмыстық және жас ерекшеліктеріне байланысты топтарына сипаттама берілген. Ауру ошақтарының географиялық жағдайлары, қоздырғыштардың нақты ошақтары, олардың кеңістіктік-уақыттық жіктелудегі биогеографиялық ерекшеліктері, қоршаған ортаның ластануы мен оның адам ағзасымен байланысы, сондай-ақ инфекциялық жүйелер дамыған елдердегі әлеуметтік өмір салтымен байланысты географиялық ошақтар зерттелген. Аурулардың таралу географиясын күрделі әлеуметтік-биологиялық диалектикалық үдеріс ретінде қарастыру, географиялық жағдайлар мен адамның әлеуметтік өмір салтының ықпалы, инфекция қоздырғыштарының көздері және адам ағзасының физиологиялық сезімталдығын қамтамасыз ету мәселелері негізгі назарға алынған.

Кілт сөздер: ауру ошақтары, эндемиялық ошақ, географиялық ендіктер, географиялық провинция, нозогеографиялық ошақ, жұқпалы аурулар ошағы, инфекция ошағы.

Ф.А. Джабраилова

Анализ очагов инфекционных заболеваний в современых медико-географических исследованиях

В статье анализируется возникновение очагов болезней в медико-географических исследованиях, различные идеи, выдвинутые в научных источниках, а также возникновение болезней, происходящих из нозогеографических очагов в странах, расположенных вдоль географических широт. Дано определение территориальным, социальным, бытовым и возрастным группам людей в границах эндемичных очагов в рамках циркуляции и адаптации организма человека к географическим условиям. Изучены географические условия очагов заболеваний, конкретные очаги возбудителей, биогеографические характеристики возбудителей в пространственно-временной классификации, загрязнение окружающей среды, его связь с организмом человека, а также географические очаги, связанные с социальным укладом жизни в стране, где развивались инфекционные системы. На первый план выдвигаются такие вопросы, как география вспышек заболеваний как сложный социально-биологический диалектический процесс, географические условия, социальный образ жизни человека, источник болезнетворной инфекции, обеспечение физиологической чувствительности организма человека.

Ключевые слова: очаги заболеваний, эндемичный, географические широты, географическая провинция, нозогеографический очаг, очаг инфекционных заболеваний, очаг инфекции.

References

1 Vernadsky, V.I. (2001). *Khimicheskoe stroenie biosfery Zemli i ee okruzheniia* [Chemical structure of the Earth's biosphere and its environment]. Moscow: Nauka [in Russian].

2 Elkin, I.I. (1960). *Ocherki po teorii epidemiologii* [Essays on the theory of epidemiology]. Moscow: Meditsina [in Russian].

3 Gomel, B.P., & Savitsky, B.P. (2004). *Prirodnye ochagi boleznei cheloveka* [Natural foci of human diseases]. Moscow [in Russian].

4 Rusev, I.T., & Alekseev, E.V. (2013). Prirodnye ochagi infektsii: struktura, razmery, ierarkhiia, taksonomiia [Natural foci of infections: Structure, size, hierarchy, taxonomy]. *Uchenye zapiski Tavricheskogo natsionalnogo universiteta imeni V.I. Vernadskogo. Seriia Biologiia, khimiia — Scientific Notes of V.I. Vernadsky Taurida National University. Biology and Chemistry Series, 26*(65), 2, 168–177 [in Russian].

5 Vernadsky, V.I. (2003). *Istoriia prirodnykh vod* [History of natural waters]. Moscow: Nauka [in Russian].

6 Aghayev, I.A., Khalafli, K.I., & Tagiyeva, F.Sh. (2012). *Epidemiologiia* [Epidemiology]. Baku [in Russian].

7 Pokrovsky, V.I., Pak, S.G., Briko, N.I., & Danilkin, B.K. (2004). *Infektsionnye bolezni i epidemiologiia* [Infectious diseases and epidemiology]. Moscow: Meditsina [in Russian].

8 Smirnova, S.S., Yuzhanina, T.S., Vyatkina, L.G., Golubkova, A.A., & Alimov, A.V. (2019). Vspyshki infektsionnykh zabolevanii v meditsinskikh organizatsiiakh: voprosy epidemiologicheskoi diagnostiki [Outbreaks of infectious diseases in medical organizations: Issues of epidemiological diagnostics]. *Epidemiologiia i infektsionnye bolezni – Epidemiology and Infectious Diseases, 24*(5-6), 204–212. https://doi.org/10.17816/EID34790 [in Russian].

9 Yushchuk, N.D., & Martynov, Yu.V. (2003*). Epidemiologiia* [Epidemiology]. Moscow: Meditsina [in Russian].

10 Rzayeva, S.I. (2018). *Vliianie ekogeograficheskikh faktorov okruzhaiushchei sredy i ekogeokhimicheskikh uslovii na zdorove cheloveka* [The impact of ecogeographic environmental factors and ecogeochemical conditions on human health]. Baku [in Russian].

11 Rzayeva, S.I. (2023). *Metodicheskii analiz geograficheskikh ochagov zabolevanii* [Methodical analysis of geographical foci of diseases]. Baku [in Russian].

12 Genis, D.E. (1991). *Meditsinskaia parazitologiia* [Medical parasitology]. Moscow: Meditsina [in Russian].

13 Chobanov, R.A. (2006). *Prosteishie cheloveka* [Human protozoa]. Baku [in Russian].

14 World Health Organization. (n.d.). *www.who.in*. Retrieved from https://www.who.int

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