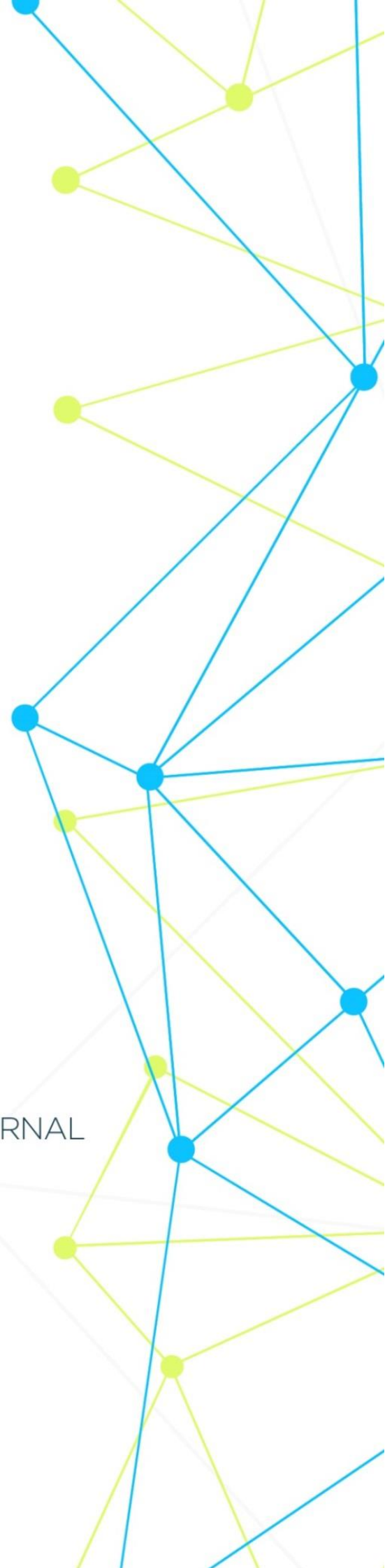


INTERNATIONAL MEDICAL SCIENTIFIC JOURNAL

# **ART OF MEDICINE**



**Art of Medicine International Medical Scientific journal**

Founder and Publisher **Pascual Izquierdo-Egea**  
Published science May 2021 year. Issued Quarterly.  
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## **Features of the episodic process in the territory of natural focuses of the plague of the cis countries**

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**Abstract:** aEpizootological manifestations of the plague in 2011-2020 were registered on the territory of 11 states. Data on the Central Part of the Kyzylkum natural desert plague outbreak indicate a reduction in major and minor plague carriers. In the conditions of mountainous and high-altitude landscapes, the impact of modern climate warming on the state of parasitic systems of the mountain and high-altitude natural plague foci is less pronounced. The epizootic potential of many autonomous biological principles of the gopher and sandy type has significantly decreased in the current century.

**Keywords:** epizootic activity, natural plague focus, Central Kyzylkum, giant gerbil, *Y. pestis*.

In 2011-2020, the total number of plague cases was 6743, of which 906 (13.4%) were fatal. A high incidence of the population was observed in Africa: in the Republic of Madagascar (5451), the Democratic Republic of the Congo (608), the Republic of Uganda (74) and the United Republic of Tanzania (61). In South and North America, cases of infection have been reported in the Republic of Peru (67), Bolivia (4), and the USA (51). Sporadic morbidity was recorded in Asia in the People's Republic of China (14), Mongolia (16), the Russian Federation (3), and the Kyrgyz Republic (1). The most difficult epidemiological situation in 2011-2020 was on the territory of the Republic of Madagascar, where a significant outbreak of pneumonic plague took place in 2017. In 2020, 535 cases were registered in four countries of the world (148 patients in six countries in 2019), of which 37 were fatal. Epidemiological problems were noted in the territories of the Democratic Republic of the Congo (520 cases; 31 deaths), the People's Republic of China (4 cases; 2 deaths), Mongolia (6 cases; 3 fatal), and the USA (5 cases of the disease; 1 terminal). In total, epizootological manifestations of the plague in 2011-2020 were registered on the territory of 11 states;

On the territory of the Russian Federation and other CIS countries, the presence of 45 natural plague foci of various biocenosis structures has been confirmed to date, the functioning of which is associated with the circulation of *Yersinia pestis* strains of medieval and ancient biovars, Caucasian and Central Asian subspecies. The total area of the plague-enzootic territory of the CIS countries

is 2101288 km<sup>2</sup>. The total area of the historical range of *Y. pestis* strains of the medieval biovar 2.MED1 is 1959965 km<sup>2</sup> - 93.3% of the entire enzootic plague territory of the CIS countries. Epizootic manifestations were registered on an area of 352731 km<sup>2</sup> (18.0%), the epidemic – on a site of 47241 km<sup>2</sup> (2.4%).

Within the boundaries of the historical range of *Y. pestispestis* of the phylogenetic branch 2.MED1, 33 autonomous natural foci are currently located on the territory of the Caspian and Turanian lowlands, as well as the Caucasus and Transcaucasia, including sandy (25), gopher (6), marmot (2) types. The natural foci of the gopher type with the circulation of *Y. pestispestis* strains of the medieval biovar 2.MED1 is 221347 km<sup>2</sup>; gerbil type - 1728676 km<sup>2</sup>; marmot type - 18442 km<sup>2</sup>.

The pulsations of epizootic activity observed in the XX century of individual autonomous natural foci of *Y. pestispestis* of the medieval biovar 2. climatic and anthropogenic factors entirely determined MED1. It should be assumed that it was the high ecological plasticity of *Y. pestispestis* strains of the medieval biovar 2.MED1 decided the possibility of their distribution in populations of a broad species spectrum of rodents living in the territories of the Caspian and Turanian lowlands.

In the current century, due to the influence of modern climate warming, the epizootic potential of many autonomous natural foci of the gopher and sandy type with the circulation of *Y. pestispestis* strains of the medieval biovar has significantly decreased. In 2011-2020 years in the Russian Federation, strains of this branch were isolated only in 2013-2015 years on the territory of the Caspian gerbil natural hearth. On the Republic of Kazakhstan territory at the beginning of this century in the desert, autonomous natural foci with the circulation of *Y. pestispestis* of the medieval biovar, the last finds of infected animals took place in the Volga-Ural interfluvium. Until now, in the Northern subzone of the desert zone of the Republic of Kazakhstan, only the North-Aral and Aral-Karakum desert natural foci have retained epizootic activity. In the Central part of the desert zone of Kazakhstan, the last manifestations of epizootic activity also took place on the territory of the Betpakdalinsky desert hearth – in 2014. A sharp decrease in epizootic activity occurred on the territory of the Republic of Turkmenistan (Kopetdag desert hearth – since 1969, Kara-Kum desert hearth – since 2005) and the Republic of Uzbekistan (the southern part of the Kyzylkum desert hearth – since 2012). In the southern and southeastern regions of the Republic of Kazakhstan, high epizootic activity was recorded only in the Balkhash, Moynkum, Taukum desert, and Ili intermountain natural foci of *Y. pestispestis* of the medieval Biovar. In the western part of the Pamir-Alai mountain system, within the boundaries of the Hissar natural focus of the vole type with an area of 400 km<sup>2</sup> (0.2% of the total area of the plague-enzootic territory of the CIS countries), the circulation of *Y. pestis* strains of the Hissar biovar of the Central Asian subspecies 0.PE4h was registered. The last findings of infected animals were recorded here in 1991.

In the last decade, the activation of the epizootic process in mountainous and high-altitude natural foci of *Y. pestispestis* of the ancient biovar of phylogenetic branches 0.ANT5 (Kyrgyz Republic), 4. ANT (Russian Federation) has been noted. On the territory of the Russian Federation in 2011-2020 years in the Tuva Mountain

and Gorno-Altai high-mountain natural foci with the circulation of *Y. pestispestis* strains of the ancient biovar of the phylogenetic branch 4. ANT, the preservation of a tense epizootic and epidemiological situation was noted. In 2020 on the territory of the Russian Federation, local plague epizootics have been registered on the Altai Republic, as well as the Republic of Tyva. Plague epizootics were detected on the territory of two (Gorno-Altai highland and Tuva mountain) of 11 natural plague foci of the Russian Federation. In the course of further expansion of the range of *Y. pestispestis* of the ancient biovar of the phylogenetic branch 4. ANT in the western direction, it is impossible to exclude the possibility of forming a new cross-border focal territory within the boundaries of the Southern Altai ridge, located at the junction of the borders of four states - Russia, Mongolia, China, and Kazakhstan.

In the conditions of climate warming in the current decade, it is expected to maintain a multidirectional trend in the dynamics of epizootic activity of natural foci with the circulation of *Y. pestispestis* strains of the medieval biovar of the phylogenetic branch 2. MED1 and the ancient biovar of the phylogenetic branches 0.ANT5, 4. ANT. On the territory of the Russian Federation, the parasitic systems of lowland natural foci of gopher and sandy-type plague with the spread of *Y. pestispestis* of the medieval biovar branch 2.MED1 will continue to remain in a state of deep depression. An increase in the temperature of the winter months is accompanied by frequent thaws icy phenomena, which increase the risks of death of rodents, including a wide species spectrum of gerbils of the genus *Meriones*. An increase in temperatures in January-February leads to an early, undulating exit from the hibernation of ground squirrels of the genus *Spermophilus*, which disrupts the rut, leads to the death of animals from starvation, delays the breeding period. High temperatures insufficient precipitation in the spring and summer months provoke dry winds vegetation burnout, which negatively affects the state of the rodent food supply and the generative potential of their populations. In the conditions of mountain and high-altitude landscapes, the impact of modern climate warming on the state of parasitic systems of the mountain and high-altitude natural plague foci due to the high mosaic of landscapes is less pronounced.

In the plague-enzootic territory of the Russian Federation, following the long-term epizootological forecast, the preservation of a tense epidemiological situation is expected in the Gorno-Altai highland and Tuva mountain natural foci of the plague. The favorable epizootological prognosis also extends to the biological principles of *Y. pestispestis* of the medieval biovar of the phylogenetic branch 2.MED1 - Transcaucasian plain-foothill, Priaraxin low-mountain, and *Y. pestis* of the Caucasian subspecies of the phylogenetic branch 0.PE2 is a Transcaucasian highland located in the Republic of Azerbaijan, Georgia, and the Republic of Armenia. On the territory of the Republic of Kazakhstan, the preservation of high epizootic activity is predicted in the North Aral, Aral-Karakum, Balkhash, Moyinkum, Taukum desert, and Ili intermountain natural foci with the circulation of *Y. pestispestis* strains of the medieval biovar of the phylogenetic branch 2.MED1. In the Kyrgyz Republic, the development of plague epizootics was caused by *Y. pestispestis* of the antichnogobiovar of the phylogenetic branch 0.ANT5 is expected on the territory of

the Saryjaz and Verkhnenarynsky high-altitude natural foci. There are no data on the state of natural plague foci in the Republic of Turkmenistan, the Republic of Uzbekistan, and the Republic of Tajikistan [1].

The Kyzylkum natural foci of the plague, according to 2020, covers an area of 385,000 km<sup>2</sup> is the most significant in epidemic terms; the territory with epidemic manifestations occupies 6700 km<sup>2</sup>. The most important part of the stationary objects of supervision of the Anti-Plague Station of the State Institution "Navoi Mining and Metallurgical Combine Fund" of the Republic of Uzbekistan is located on the territory of the Kyzylkum natural meso-plague outbreak, in its central part.

The Kyzylkum natural plague center is localized on the physical and geographical district of the same name, almost in the very center of the flat part of Central Asia, which is associated with its truly desert landscape. It includes the western part (belonging to Uzbekistan) of the Kyzylkum desert (its northern and eastern parts are located on the territory of Kazakhstan). In the north, the district borders with Kazakhstan, in the southwest - with Turkmenistan, in the east is the Mirzachul district, in the southeast - Zarafshan and in the west — the Lower reaches of the Amu Darya.

The surface of the area decreases slightly in the direction from the southeast to the northwest. The average height is 200-300 m; in the southeast, the size reaches 350-400 m, in the northwest - only 100 m. The lowest point is the Mingbulak depression at 12 m below sea level. The highest point is the Aktau Peak (height 922 m) of Tamdytau Mountain.

The relief of the Kyzylkum district is diverse. There are plains, Remnant Mountains, and depressions located between the mountains. But most of Kyzylkum is made up of tables with an absolute height of up to 200 m. The central part of the plain is occupied by sand ridges, sandhills, dunes, takyrs. Dunes are found mainly along the banks of the Amu Darya and around wells. Plants anchor sand ridges and hills. Takyrs occupy the inter-row depressions.

The mountains Bukantau (764 m), Auminzatau (695 m), Etymtau (571 m), Tamdytau (922 m), Kuljukttau (785 m), Sultan-Uwais (473 m) are located mainly in the central part of Kyzylkum. Between these mountains are the depressions of Mingbulak, Karakata, Mullali, Ayakagitma. The lowered areas of these depressions are occupied by salt marshes, takyrs, sand massifs. [2,3].

The vegetation cover is dominated by perennial and sagebrush phytocenoses, psammophilic and halophilic communities are widespread, fragments of tugai vegetation are found. Ephemera and ephemerides with a short spring growing season prevail among them: bulbous bluegrass, sedge, Dantonina bonfire, tulips, snowdrops, xiolirion, small-fruited cousins. Juzgun, white saxaul, Celine, sandy acacia, kandym grow on the fixed sands. Wormwood and weeds are common on gray-brown soils. Black saxaul, tamarisk, fleshy solyanka, sarisazan grow on saline, saline-marsh soils, and sheep's cleavage grows on takyrs. Tugai plants grow in the Amu Darya Valley.

On the territory of the Central section of the Kyzylkums, it is noted that the threshold for experiencing rodent depression caused by internal mechanisms of self-regulation was passed in 2016-2017. 2018-2020 indicates a decrease in the number of

significant and minor plague carriers after the positive dynamics that appeared in 2016-2017, concerning both reproduction and the numerical composition of rodents.

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