

# PREVENTIVE AND SOCIAL MEDICINE

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Scientific Article

UDC 616.91/.93-036.2 (470.61)

DOI: 10.17816/pmj423154-163

## CURRENT FEATURES OF THE EPIZOOTIOLOGICAL AND EPIDEMIOLOGICAL SITUATION OF CRIMEAN HEMORRHAGIC FEVER IN THE ROSTOV REGION

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## СОВРЕМЕННЫЕ ОСОБЕННОСТИ ЭПИЗООТОЛОГО-ЭПИДЕМИОЛОГИЧЕСКОЙ СИТУАЦИИ ПО КРЫМСКОЙ ГЕМОРРАГИЧЕСКОЙ ЛИХОРАДКЕ В РОСТОВСКОЙ ОБЛАСТИ

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**Objective.** To identify the current features of the epizootiological and epidemiological situation of Crimean hemorrhagic fever (hereinafter referred to as CHF) in the Rostov region to improve the strategy of preventive (anti-epidemic) measures.

**Materials and methods.** The data from the Reference Center for monitoring the causative agent of CHF of the Federal Medical Institution Stavropol Anti-Plague Institute of Rospotrebnadzor and the Office of Rospotrebnadzor in the Rostov region are used in the work. Methods of epidemiological analysis, laboratory diagnostics, statistical methods were applied.

**Results.** The data on the epizootic activity of natural foci of CHF in the Rostov region in recent years were obtained, the features of the natural foci formation were analyzed, the main sources and carriers of the infectious agent were determined, and the epidemiological profile of the epidemic process of CHF in the Rostov region was compiled. A conditional classification of municipal divisions of the Rostov region (cities and districts) according to the degree of epidemic activity has been developed and proposed.

**Conclusions.** As a result of the studies, the main current features of epizootic and epidemic processes of CHF in the Rostov region were identified, considering them an additional complex of preventive (anti-epidemic) measures aimed at preventing the population morbidity with CHF was proposed. It was determined that 40 administrative territories out of a total 55 of the region were involved in the epidemic process, the expansion of the endemic area (nozoareal) of the natural focus was proved.

**Keywords.** Crimean hemorrhagic fever, epidemic process, epizootiological monitoring, natural foci, Rostov region.

**Цель.** Выявить современные особенности эпизоотолого-эпидемиологической ситуации по Крымской геморрагической лихорадке (далее – КГЛ) в Ростовской области для совершенствования тактики профилактических (противоэпидемических) мероприятий.

**Материалы и методы.** Использованы данные ФКУЗ «Ставропольский противочумный институт» Роспотребнадзора – референс-центра по мониторингу за возбудителем КГЛ и Управления Роспотребнадзора по Ростовской области. Применены методы эпидемиологического анализа, лабораторной диагностики, статистические методы.

**Результаты.** Получены данные об эпизоотической активности природных очагов КГЛ в Ростовской области за последние годы, проанализированы особенности формирования природных очагов, установлены основные источники и переносчики возбудителя инфекции, составлена эпидемиологическая характеристика эпидемического процесса КГЛ в Ростовской области. Разработана и предложена условная классификация муниципальных образований Ростовской области (городов и районов) по степени эпидемической активности.

**Выводы.** В результате проведенных исследований выявлены основные современные особенности эпизоотического и эпидемического процессов при КГЛ в Ростовской области, с учетом которых предложен дополнительный комплекс профилактических (противоэпидемических) мероприятий, направленных на предупреждение заболеваемости населения КГЛ. Установлено, что в эпидемический процесс вовлечены 40 административных территорий области из общего количества – 55, доказано расширение нозоареала природного очага.

**Ключевые слова.** Крымская геморрагическая лихорадка, эпидемический процесс, эпизоотологический мониторинг, природные очаги, Ростовская область.

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## INTRODUCTION

Epidemiological situation with tick-borne transmissible infections remains tense in the south of European Russia [1]. Crimean hemorrhagic fever, a particularly dangerous natural focal arboviral infection, poses a serious threat among this group of infections. The main carrier of the pathogen is the *Hyalomma marginatum* tick [2; 3]. Between 1999 and 2017, epidemic outbreaks of CHF were recorded in two federal districts of Russia – Southern and North Caucasus – in 9 out of 15 constituent entities [4]. In addition to the annual detection of multiple cases of the disease, there is a pronounced trend toward the northward shift and expansion of the pathogen's range, which creates a risk of the Crimean-Congo hemorrhagic fever (CCHF) virus spreading beyond the southern regions of the country [5].

Currently, the issue of improving CHF prevention measures among the population of the Rostov Region (hereinafter referred to as RR) is highly relevant, given that CHF ranks first in terms of prevalence and epidemiological risk to humans among the natural focal infectious diseases. This is confirmed by the presence of animal donors and carriers of the infection, which enable the circulation of the CCHF pathogen, as evidenced by the results of published laboratory studies [6].

CHF has been recorded in Russia since 1944, when the disease was first described by M.P. Chumakov in Crimea [7; 8]. The first cases of CHF in humans in the Russian Federation were recorded in 1963, and in subsequent years, the incidence of CHF was recorded both sporadically and in the form of outbreaks.

Currently, taking into account the varying intensity of the epidemic process and the spe-

cifics of organizing epidemiological surveillance for CHF, data from epizootological monitoring and epidemiological analysis in areas of natural foci are of particular importance for improving the complex of preventive and anti-epidemic measures. Such studies are important for regions where cases of CHF are registered annually among the population [9, 10].

*The aim of the study* is to identify current features of the epizootic and epidemiological situation regarding Crimean hemorrhagic fever in the Rostov region in order to improve preventive (anti-epidemic) measures.

## MATERIALS AND METHODS

Materials from the reports “On the state of sanitary and epidemiological well-being of the population of the Rostov Region for 2014–2023” were used, data from the reference center for monitoring the CHF pathogen – Federal State Budgetary Institution “Stavropol Anti-Plague Institute” of Rospotrebnadzor, published in open sources [1–4].

In order to assess the intensity, dynamics, and structure of the CHF epidemic process, methods of operational and retrospective epidemiological analysis were used. To characterize the etiological agents, published results of laboratory diagnostic methods were used: serological, molecular genetic analysis (polymerase chain reaction – PCR), enzyme-linked immunosorbent assay (ELISA).

## RESULTS AND DISCUSSION

An analysis of CHF incidence in the Russian Federation over a ten-year period from 2014 to 2023 revealed pronounced peaks with the highest number of patients in 2015 (139 cases), 2016 (162 cases), 2019 (134 cases)

(Fig. 1), while in 2022 and 2023, 59 cases (including 6 fatalities) and 26 cases of CHF (including 3 fatalities) were identified, respectively. The highest number of cases was registered in the Stavropol Territory (10 people) and the Rostov Region (6).

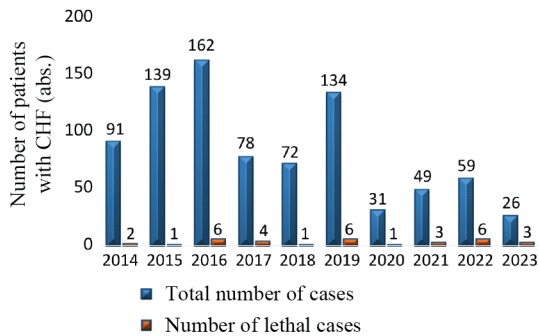


Fig. 1. Registration of CHF cases in Russia from 2014 to 2023

It was established that among CHF patients, the majority were citizens who were temporarily unemployed (40 %), as well as farmers with cattle on their farms, agricultural workers, and shepherds, who accounted for 20 % each. People became infected while performing agricultural work or being in natural biotopes. Transmissible mechanism of CCHF virus transmission prevailed in 80 % of cases: through tick bites – 64 %, through contact with ticks – 16 % [3].

An analysis of the dynamics of CHF incidence among people in the Rostov Region for the period 2014–2023 showed that the maximum number of cases was detected in 2015 (79 cases, an indicator of 1.8 per 100,000 population), as well as in 2016 (57 cases; 1.34), in 2014 (54 cases; 1.28), and in 2019 (48 cases; 1.14) (Fig. 2), with the minimum number of cases in 2023 (6 cases; 0.14). A total of 365 laboratory-confirmed cases were registered during the period under review, with a mortality rate of 4.4 % (16 cases).

Peaks in CHF incidence were observed in 2015, 2019, and 2022, which were presumably due to favorable weather conditions conducive to the growth of tick populations.

The average annual rate of decline in CHF incidence was –21.7 %.

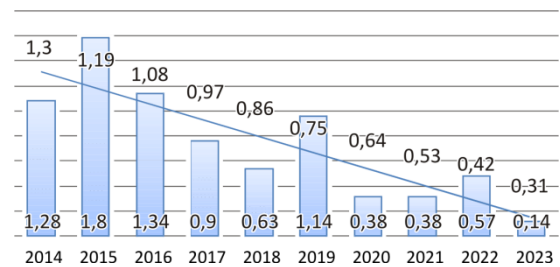


Fig. 2. Dynamics of CHF incidence in the Rostov Region from 2014 to 2023.

When analyzing the distribution of morbidity by district in the region for the specified period (from 2014 to 2023), it should be noted that 40 administrative territories of the region out of a total of 55 were involved in the epidemic process, with the highest number of cases registered in three districts in the east of the region, including the Salsky District (83 cases; 22.7 % of the total number of cases), Zimovnikovskiy District (33 cases; 9.0 %), and Proletarskiy District (27 cases; 7.4 %). In terms of incidence, Zimovnikovskiy District ranks first (102.7 per 100,000 population), followed by Remontnenskiy District (85.3) and Proletarskiy District (81.3).

An important contemporary feature of the epizootic and epidemiological situation with regard to CHF in the Rostov Region in recent years (2014–2023) is the heterogeneity of the natural focus territory in terms of the degree of epizootic and, as a result, epidemic activity, the presence of administrative territories with varying degrees of epidemic activity of natural CHF foci, in particular, there are territories where cases of CHF among the popula-

tion were registered almost annually (Dubovskiy, Zimovnikovskiy, Orlovskiy, Salskiy districts, etc.), and there are territories where single cases have been reported or no cases have been registered at all. Taking into account the number of years of CHF incidence registration among the population, we propose a conditional classification of municipalities (municipal territories) according to the degree of epidemic activity of the natural focus for the control period of 10 years: Group I – territories with a high level of epidemic activity (seven or more years of CHF incidence registration) – 7 territories, Group II – territories with an average level of epidemic activity, where CHF incidence was registered for four to six years – 15 territories, Group III – territories with a low level of epidemic activity (up to three years) – 18 territories, of which four municipalities (Azov, Kagalnikskiy, Tatsinskiy districts, and the city of Zverevo) registered one case of the disease for the first time, which indicates the expansion of the CCHF virus nosoarea.

A separate group of territories has been identified where CHF has not been registered among the population over the past 10 years – 15 territories.

This classification makes it possible to monitor the status and dynamics of epidemic activity in natural foci and to organize the focus and scope of anti-epidemic measures in a timely manner.

An analysis of the average annual incidence of CHF for the period 2014–2023 showed a spring-summer seasonal pattern, with the maximum number of cases in June – 43.6 % of the total number of cases, followed by May – 29.0 %, and July – 18.6 %. The seasonality index was 11.4. Thus, the seasonal increase rate was 88.2 %, which is especially important for timely action in natural foci of infection.

The incidence of CHF was mainly registered among the adult population, with the proportion of people aged 50 years and older accounting for 48.5 % of the total number of patients. Single cases of infection in children aged 0 to 14 years were registered in 2015–2017.

In terms of professional composition, 24.4 % of CHF patients out of the total number of cases are people whose professions are associated with the likelihood of the implementation of the transmission mechanism of infection (field workers, farmers, cattlemen, shepherds, machine operators, general workers of agricultural enterprises), as well as unemployed citizens involved in agricultural work (35.6 %), and pensioners (21.1 %) who have cattle and small livestock on their farms.

The primary mechanism of infection in CHF patients in the Rostov region was transmissible, with transmission routes being inoculation—via tick bites—in 62.4 % of cases, and contamination—in 16.9 %, primarily through tick removal from animals. The route of infection was not determined in 10.4 % of cases, but an undetected tick bite cannot be ruled out.

A characteristic feature of the clinical course of CHF in the Rostov region was the absence of hemorrhagic manifestations in 71.2 % of patients, with a predominantly moderate course in 78.4 % of cases, and severe disease in 18.6 %. In one case, a co-infection of COVID-19 and CHF was observed, with a favorable outcome.

Biological specimens from patients were sent to the Scientific and Methodological Center for Monitoring the CHF Pathogen at the Stavropol Anti-Plague Research Institute of Rosпотребнадзор. Whole-genome and fragment sequencing of CHF virus strains and RNA isolates was performed using clinical specimens from CHF patients in Moscow (an imported case

from Georgia), Rostov region, Stavropol Territory, the Republic of Kalmykia, the Republic of Dagestan, and the Astrakhan region. The studied RNA isolates, strains circulating in Russia in 2023, are assigned to genetic subgroups Va (Stavropol – Rostov – Astrakhan), Vb (Volgograd – Rostov – Stavropol) and Vc (Astrakhan-2), genetic line "Europe-1" (V), characteristic of the territory of the Southern and North Caucasian Federal Districts of the Russian Federation, which confirms the "local nature" of the origin of the pathogens.

The Rostov region maintains a record of individuals affected by tick attacks. In 2023, the number of victims was 6,795, including 2,317 children (34.1 %). Therefore, educating the public about the need to seek medical attention early if exposed to ticks is a crucial preventative measure.

In reviewing the epizootological situation for CHF in the Rostov Region, it should be noted that the circulation of the CCHF pathogen in small mammal (SM) populations and their vectors is monitored annually

throughout the region. SM abundance in forest-shrub habitats, open and closed meadow-field habitats, and near-water habitats was less than 5 % of the total, with the pygmy wood mouse, gray vole, and house mouse predominating. Based on SM counts in human-built structures, the abundance was over 15 %, with the house mouse predominating in the catches.

The number and species composition of the tick population were monitored during the tick season. Between 2014 and 2023, the number of administrative territories surveyed increased from 30.6–36.4 % to 100% (table).

Thus, over the past five years (2019–2023), epizootological monitoring was carried out annually to detect markers of the CCHF pathogen in all 55 municipalities of the Rostov region, followed by 37.3 % (2022), indicating significant tick infection with the CCHF pathogen. Positive findings were detected in tick pools collected in different years in 32–38 administrative districts, which likely form the natural CHF focal zone in the Rostov region.

#### **Data on the results of the study of *H. marginatum* ticks caught in natural foci in the Rostov region for the period 2014–2023**

| Year | Number of samples tested | Of these, samples with positive results / % | Number of surveyed districts/% of the total number in the Rostov region | Of these, the number of districts in which <i>H. marginatum</i> was detected/% of the total number of surveyed districts in the Rostov region |
|------|--------------------------|---------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 2014 | 298                      | 36/12.0                                     | 17/30.9                                                                 | 13/76.5                                                                                                                                       |
| 2015 | 297                      | 57/19.2                                     | 17/30.9                                                                 | 16/94.1                                                                                                                                       |
| 2016 | 302                      | 75/24.8                                     | 18/32.7                                                                 | 14/77.8                                                                                                                                       |
| 2017 | 311                      | 58/18.6                                     | 19/34.5                                                                 | 17/89.4                                                                                                                                       |
| 2018 | 328                      | 39/11.9                                     | 20/36.4                                                                 | 11/55.0                                                                                                                                       |
| 2019 | 301                      | 99/32.9                                     | 55/100.0                                                                | 36/65.5                                                                                                                                       |
| 2020 | 300                      | 86/28.7                                     | 55/100.0                                                                | 38/69.1                                                                                                                                       |
| 2021 | 302                      | 84/27.8                                     | 55/100.0                                                                | 35/63.6                                                                                                                                       |
| 2022 | 300                      | 112/37.3                                    | 55/100.0                                                                | 32/58.2                                                                                                                                       |
| 2023 | 301                      | 55/18.2                                     | 55/100.0                                                                | 33/60.0                                                                                                                                       |

laboratory testing for CHF within 300 pools of *H. marginatum* ticks collected in the territory of natural foci. The proportion of samples with positive results ranged from 11.9 % (2018) to

In addition, an analysis of the abundance indices of the *H. marginatum* tick on cattle by month was conducted. During the study period, the maximum abundance indices of the *H. marginatum* tick on cattle were determined in May (0.928) and June (0.622) and were 2.3 and 1.5 times higher than the seasonal average (0.411), respectively. Exceeding the seasonal average in July was observed in 2014 and 2018, and in April 2022.

In order to prevent the spread of CHF in enzootic territories of the Rostov region, acaricidal treatments of farm animals and natural biotopes, deratization were carried out annually, including in 2023.

Acaricidal measures were carried out in all municipal districts of the Rostov Region in the 2023 season; the area of treated epidemic-significant areas of the territories increased to 16,750.02 hectares against 15,639.61 hectares in 2022. Taking into account the frequency of treatment, 1,203,091 (247.2 %) heads of small cattle and 1,564,626 (420.0 %) heads of cattle were covered by anti-tick treatment.

It should be emphasized that the persistently high numbers of *H. marginatum* ticks, the constant detection of CCHF virus markers, the registration of CHF cases with a predominance of moderate (78.4 %) and severe forms (18.6 %) of the disease, as well as the continuing expansion of the boundaries of the natural CHF focus, may contribute to the development of an unfavorable epidemiological situation in the Rostov region and further expansion of the nosorange if preventive measures are unsatisfactory and untimely. The obtained data must be taken into account

when planning measures, including those aimed at reducing the number of donor animals in open stations and carriers of the CCHF pathogen, increasing public awareness of the disease prevention issues when staying in natural foci of infection and caring for farm animals.

## CONCLUSIONS

1. The conducted epidemiological analysis allowed us to identify the current features of the epizootological and epidemiological situation for CHF in the Rostov region. In total, 365 laboratory-confirmed cases were registered during the analyzed period (from 2014 to 2023), with a mortality rate of 4.4%. It was established that epidemic activity over the past 10 years was observed in 40 municipalities out of 55.

2. An important feature of the epizootological and epidemiological situation for CHF in the Rostov region in recent years (2014–2023) is the heterogeneity of the territory of the natural focus in terms of the level of epizootic and, as a consequence, epidemic activity, the presence of administrative territories with varying degrees of epidemic activity of natural foci of CHF.

3. A conditional classification of municipalities of the region according to the degree of epidemic activity of the natural focus (according to the epidemiological analysis for the control period of 10 years) has been developed: Group I – territories with a high level of epidemic activity (seven or more years of registration of cases of CHF), Group II – territories with an average level of epidemic activity, where the incidence of CHF has been registered for four to six years, Group III – territories with a low level of epidemic activity (up to three years). This classification allows us to analyze the state and

dynamics of the epidemic activity of the natural CHF focus in various municipalities and to promptly and purposefully carry out anti-epidemic measures.

4. As the results of the epidemiological analysis showed, among patients with CHF, the majority were people whose professions are associated with the likelihood of the transmissible method of the infection spreading (field workers, farmers, cattlemen, shepherds, machine operators, general workers of agricultural enterprises), as well as unemployed citizens involved in agricultural work (35.6 %), and pensioners (21.1 %) who have cattle and small livestock on their farms.

5. The primary mechanism of pathogen transmission was transmissible, with the inoculation route being the primary route of transmission (62.4 %), which determined the prevalence of the disease in the spring and summer season. A characteristic feature of the clinical course of CHF in the Rostov region was the absence of hemorrhagic manifestations in 71.2 % of patients, with a predominance of moderate (78.4 %) and severe (18.6 %) forms.

6. Monitoring of carriers for the presence of the CCHF pathogen showed their significant infection rate (11.9–37.3 %), an increase in the number of surveyed territories, which led to an expansion of the natural focal zone of CHF in the Rostov region.

7. The obtained results substantiated the need to develop an additional set of preventive (anti-epidemic) measures aimed at preventing the incidence of CHF in the population, in particular:

- implementation in the territory of municipalities, primarily in those with established epidemic and epizootic activity, according to epidemiological (epizootological) indications, of timely, including in the early spring period (March-April), acaricidal treatments of livestock and natural biotopes using highly effective insectoacaricides approved for use;

- continuation of epizootological monitoring of the territory of the natural CHF focus in the Rostov region to determine potential risks, the number and level of infection with the CCHF virus of ticks, mouse-like rodents, and cattle through interdepartmental interaction of interested services and departments;

- ensuring the level of readiness of medical organizations for the early detection of CHF patients and timely provision of qualified care to them;

- compliance with biological safety measures in all areas of the natural CHF focus in the Rostov region when working with patients and biomaterial from CHF patients;

- conducting mass information and explanatory work with the population on measures to prevent CHF by specialists from Rosposrebnadzor institutions and medical workers.

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**Funding.** The study had no external funding.

**Conflict of interest.** The authors declare no conflict of interest.

**Author contributions** are equivalent. All authors approved the final version of the paper.

**Limitation of the study.** A positive conclusion was received from the local ethics committee of the Rostov State Medical University, protocol No. 8/25 dated April 24, 2025, for the publication of the article.

Received: 10/09/2024

Revised version received: 05/10/2025

Accepted: 05/23/2025

Please cite this article in English as: Logvin F.V., Kovalev E.V., Erganova E.G., Nenadskaya S.A., Leonenko N.V., Koreneva A.D., Batashev V.V., Vodyanitskaya S.Yu., Chernaya A.S., Voloshka A.A., Samsonova D.A. Current features of the epizootiological and epidemiological situation of Crimean hemorrhagic fever in the Rostov region. *Perm Medical Journal*, 2025, vol. 42, no. 3, pp. 154-163. DOI: 10.17816/pmj423154-163