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CHARACTERISTICS OF THE SPREAD OF HEMORRHAGIC FEVER WITH A RENAL  
SYNDROME IN UFA AND EPIDEMIOLOGICAL EFFICACY OF RAT EXTERMINATION

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## TECHNICAL TRANSLATION

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**CHARACTERISTICS OF THE SPREAD OF HEMORRHAGIC FEVER WITH A RENAL  
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by

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CHARACTERISTICS OF THE SPREAD OF HEMORRHAGIC FEVER WITH A RENAL SYNDROME IN UFA AND EPIDEMIOLOGICAL EFFICACY OF RAT EXTERMINATION

A disease of hemorrhagic fever with renal syndrome has been officially registered in Bashkir since 1957. At the present time natural foci of this disease has been established in the forest and forest-steppe regions of the Republic, and also in the mountain-taiga zone of the Southern Urals, distributed in the boundaries of BASSR (Martsinkevich, 1965). In previous years, hemorrhagic fever was observed in ten out of seventeen cities in the Republic, and about half of them are administrative districts.

There are especially intensive and persistent foci of this infection in the Bashkir capitol UFA, where more than 1500 persons were stricken in ten years, which accounts for approximately two-thirds of all illness in the Republic. Among the sick inhabitants of UFA, more than 65% were effected with the fever in the municipal territory, which is connected with a specified natural and social-economic conditions. A significant part of the administrative territory of the town is occupied by forests planted in the form of continuous solid masses, parks, orchards, gardens, where a large number of rodents live, among which 80 to 90% are red field mice - the basic carriers of the virus in nature. Because of the vigorous development of industry, the population of UFA has increased more than two times in the past ten years. In the town, large forested tracts have been taken for industrial and residential building. All of this promotes constant and close contact of the inhabitants, especially the incoming, non-immune population, with the forest rodent-virus carriers.

Because hemorrhagic fever with renal syndrome has been little studied, and because of the absence of means for its specific profilaxis, the first plan at the present time is the introduction of a system of rat exterminating measures (Vishnyakov et al., 1965), directed at protecting the people in their residences from forest rodents. In 1965-1966, with the forces of the Republican and Municipal Sanitary-Epidemiological Institutions with the direct methodological assistance of workers of the Central Disinfection Institute, extensive rat extermination treatment of forested sections was carried out in UFA, the results of which are presented in the present work.

The capitol of Bashkir is located on the Belaya River at the site where it flows into the UFA and Gema Rivers. The town occupies in the area of about 450 km<sup>2</sup>, the population on January 1, 1964 was 650,000 persons (Maslov and Tsvetayev, 1965). UFA is divided into three distinct and clearly demarcated parts in natural and social-economic conditions: the old city, the new (industrial) city and the part of the town on the other side of the river.

The old town, situated between the Belaya and UFA, is characterized by hill and gully topography with steep cliffs towards the river. A large area is occupied by forested tracts, which extend along the Belaya River to Pribel'skiy and along the coast from UFA to Novikozskiy. The overall area

equals 3500-4000 hectares. In these woods there are many rest homes, sanitariums, and childrens hospitals. Moreover, in the old town there are many parks and gardens. In this part of UFA, along with contemporary buildings there are many frame houses, located in the woods or near the woods. The new industrial part of UFA (the former city of Chernigovsk) is also between the rivers, farther north than the old part. The terrain here is more uniform, less wooded, and the forests are mainly distributed on the bank of the UFA. From the north to this part, the Blagoveshenskiy forest adjoins, which extends for tens of kilometers from the town boundaries. A large area in the new city is occupied by collective orchards and gardens of the workers and employees of the industrial companies. In the industrial part of UFA, well organized buildings of contemporary architecture predominate, but on the outskirts barracks and frame houses of the rural type are still encountered (settlements of Novoaleksandrovskiy, villages of Timashevo, Maksimovka, etc.). The part of UFA on the other side of the river is marshy, covered in the spring flood by meadows and insular forests. Here there are some settlements and villages, the largest of these are the settlements of Dema at the railroad station of the same name. The part on the other side of the river is a favorite spot for recreation with the towns people.

During the past ten years (1957-1966) morbidity from hemorrhagic fever has constantly been registered in the town, but the number of patients has changed greatly in individual years. An especially large outbreak was registered in the town and in the Republic in 1964, a pronounced increase in morbidity was observed in 1959 and 1966, the lowest number of cases of the fever was noted in 1957 and 1961.

All large outbreaks of hemorrhagic fever in UFA and Bashkir occur, as a rule, under conditions of massive propagation of forest rodents; however, a complete correlation between the level of their numbers and the size of the outbreaks has not been established. As Martsinkevich (1965) notes, the large outbreak in 1964 was preceded by a high level in the numbers of red field mice (in the range of 50-53% were trapped in the autumn). In agreement with our observations the number of forest rodents was higher in 1965 and lower in 1966; however, the morbidity from fever in 1965 proved on the other hand to be lower than in 1966. A large outbreak of hemorrhagic fever in 1964, along with a high number of rodents, coincided with an extremely rainy and inclement autumn, which caused much migration of forest rodents. This increased the possibility of their contact with the population and led to an increase in domestic contamination. The outbreak of 1959 was characterized by an increase in cases of contamination in factories which should be placed in direct dependence on the wide adoption in the indicated year of large wooded tracts for industrial building. In years with sporadic morbidity, the prevalent

conditions of infection were hunting, fishing, tourists travel, agricultural work, etc. Thus, dependent on changes in the natural and social-economic factors the seasonal variation changed with the years, and the structure of the morbidity at the natural focus of hemorrhagic fever was renal syndrome.

Similar changes in the epidemiological characteristics of the focus may also be traced for various parts of the above mentioned town and regions of the Republic where the towns people were infected. In Figure 1 conditions are given of infection and seasonal variation in morbidity in UFA over a ten year period. During this period in the town on the whole infection under conditions of fishing and hunting accounted for more than half of all cases. The seasonal variation in morbidity was represented by a bimodal curve with the smaller peak in July and the larger in November-December. For the old town during these years infection was also characteristically in living conditions in sanitariums, rest homes and childrens hospitals located in the Novikovskiy forest. The remaining cases were only one-fourth of the infection. The morbidity was registered here in the autumn from the peak to December. In the new city infection in the factory, under living conditions while working in collective orchards and gardens prevailed, and consisted of more than four-fifths of all cases. In contrast to the old city, the peak in morbidity here occurred in November; moreover, the small peak occurred in June. In the part of UFA on the other side of the river domestic infection predominated, and also cases of infection in hunting, fishing, on walks in the forest and while working in the orchards and gardens. The curve of seasonal variation of morbidity has two equal peaks in October (infection in the forest) and December (domestic infection), a third insignificant peak occurs in June.

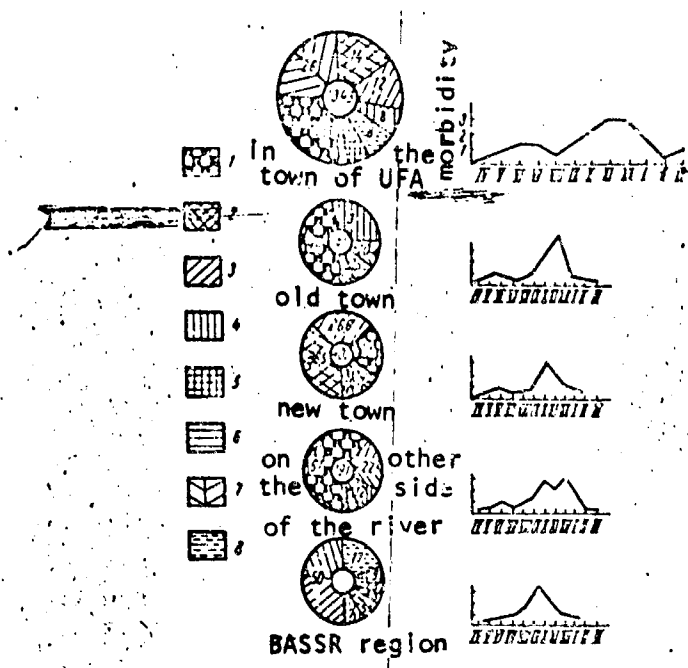


Figure 1. Conditions of infection in seasonal variation in hemorrhagic fever in various parts of the town from 1957-1966.

Conditions of infection:

- 1 - domestic; 2 - industrial; 3 - while working in collective orchards and gardens; 4 - in childrens health institutions, in rest homes, and sanitariums; 5 - in pioneer camps and bases; 6 - other; 7 - during brief contact with the forest (fishing, hunting, walking, etc.); 8 - planting potatoes and harvesting crops near the forest.

Cases of infection of the inhabitants of the town during visits to regions of the Republic were distributed in the following way: two-thirds of the patients were infected while hunting or fishing, and also while harvesting crops, the remainder - in construction work, at pioneer camps, walks, and while working in orchards and gardens.

One peak in October, which is associated with hunting and harvesting of crops, characterizes the illness of towns people stricken in regions of the Republic.

Distinctions in epidemiological characteristics of the natural focus of hemorrhagic fever in various parts of UFA have confirmed the leading role of rodents (red field mice) and the distribution of the given infection has also indicated the great variety of conditions of contact of the population with the forest rodents.

In the spring of 1965-1966 in Novikovskiy and Pribel'skiy forest tracts - the basic sites of infection in the old town - rat extermination was carried out with the help of poisoned bait (93% oats, 5% vinc phosphide and 2% vegetable oil), which was placed in the forest by hand at 2 kg per hectare. As a result of the treatment carried out in an area of about 4,000 hectares, a sharp and steady reduction was achieved in the number of red field mice in these parts. After three months in the treated area only three to four per cent were hit in the traps, and in the control- forty to fifty per cent (Vishnyakov et al., 1966). In the autumn seasons of these years additional treatment was carried out in the town in an area up to 1,000 hectares around homes bordering the forest, and in collective orchards.

Moreover, every year a single complete rat extermination is carried out in the houses.

As a result, despite the large peak in morbidity from hemorrhagic fever in 1966 in the Republic, in the territory of the town the number infected in that year was significantly reduced: before treatments in the town foci 70% of the UFA residents were infected, in 1965 - 48%, and in 1966 - 31%. The most effective proved to be the complete treatment of the forests in the old town, where in 1964, before the beginning of treatment, 178 persons, or 23% of all affected towns people were infected, in 1965 - only eight, or 8.7% of all affected, and in 1966 at the general peak of morbidity the number stricken had decreased to 3.2%. In rest homes and sanitariums located in the Novikovskiy forest, over a period of two years after the beginning of treatment only two persons were infected, although previously every year many cases of infection had been noticed here.

One must note that the number of infected UFA residents in regions of the Republic before 1965 consisted of 20% of all those stricken in the town, and in 1965-1966 it became relatively higher - 44.4 and 62.2% respectively (Figure 2). In 1966 154 inhabitants of UFA were infected outside the town, and during the large outbreak in 1964 - 189 persons, or only 35 cases more. This gives a basis for assuming that in the old town, if rat extermination had not been carried out, the peak morbidity would have occurred in 1966. However, thanks to implementations of the measures, the number infected with hemorrhagic fever in this year was reduced 22 times in comparison to 1964.

Along with the sharp reduction of number infected in the UFA territory, the two year treatment also radically changed the epidemiological characteristics of the natural focus of the town. After rat extermination the number of domestic and industrial infections which had previously dominated here, were sharply decreased. As for the change in conditions of infection, a change in the seasonal variation of morbidity in the town occurred. The highest number of patients in 1965-1966 occurred in October, i.e. at an earlier period than before carrying out rat extermination.

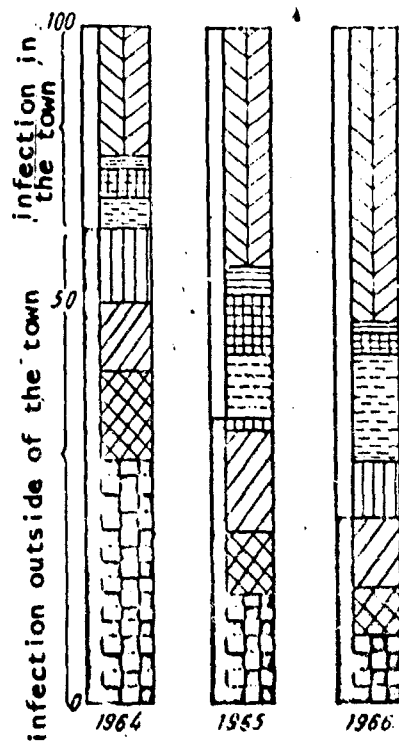


Figure 2. Change in conditions of infection with hemorrhagic fever as a result of rat extermination of forests

Labelling as the same as in Figure 1

Thus, rat extermination in the city of UFA has led to a sharp reduction in the number of patients with hemorrhagic fever with renal syndrome, has



caused a change in the epidemiological characteristics of the focus and its seasonal variation.

The data obtained indicate a real possibility for successful conquest of the little studied infection and complete suppression of the natural focus in the territory of the town.

#### Conclusions

1. There is an active focus of hemorrhagic fever with renal syndrome in UFA, which is characterized by a great variety of conditions of infection of the population. Over a ten year period about 1500 persons have had this disease in UFA, while 65% of them were infected in the territory of the town.

2. Large outbreaks of hemorrhagic fever in UFA and Bashkir, noted in 1959, 1964, and 1966, occurred in conjunction with high propagation of rodents (red field mice); however, a complete correlation between the size of the outbreaks and the level of propagation has not been established.

3. As a result of rat extermination carried out in the forested tracts of UFA (in an area of 4,000 hectares) in 1965 and 1966, with the help of poisoned bait a sharp and stable reduction occurred in the propagation of forest rodents and a reduction in infection with hemorrhagic fever - approximately 22-fold in comparison to untreated control territories. Moreover, the epidemiological structure of the disease (reduction of cases of infection in homes and factories) and seasonal variation sharply changed.

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