

# Cartographic assay of nozoareal bovine tuberculosis in the Republic of Tatarstan

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**Abstract.** The paper presents the results of studying the dynamics of the number of cattle unsuccessful for tuberculosis in the Republic of Tatarstan for the period from 2000 to 2018. As a result of the analysis of this cartogram, we found that the unsuccessful points for tuberculosis are geographically confined to a certain area: i.e. settled mainly in the south, and scattered (in small groups – "foci") in the central part of the republic. A steady decline in the incidence of cattle with tuberculosis has been observed since 2016. By the end of 2018, no new foci of tuberculosis in the territory of the republic were identified, systematically conducted anti-epizootic measures ensure stabilization of the epizootic situation.

## 1 Introduction

Despite the successes achieved in the fight against tuberculosis of farm animals, this infection remains one of the leading, most complex and economically significant among infectious diseases, causing huge damage to the national economy and representing a serious danger to the population [1–3].

Development, continuous improvement and implementation of a system of veterinary anti-tuberculosis measures in our country has made it possible to localize and eliminate this disease in many regions, and to significantly improve the epizootic situation somewhere.

However, the ability of *Mycobacterium tuberculosis* to persist for a long time in environmental objects, their high resistance to various adverse factors, as well as susceptibility of almost all vertebrates to the causative agent, birds and humans make this infection difficult to eradicate. In addition, the complexity of the fight against this disease lies in the absence of specific therapeutic and reliable preventive means for protecting young animals, the inferiority of the veterinary and sanitary measures taken and the insufficient effectiveness of existing control measures [4, 5].

The epizootic situation of tuberculosis is not stable and is constantly changing depending on many factors; the risk of tuberculosis introduction from adjacent territories remains. Hidden carriage of the pathogen is widespread in foci of prolonged distress, which leads to repeated illness of animals under provoking conditions.

The main causes of prolonged trouble are the unsatisfactory implementation of organizational,

economic, veterinary and sanitary and special measures, ineffectiveness of rehabilitation measures [6, 7].

The intensity of the development of indicators of the epizootic process (the number of dysfunctional points, the incidence rate of animals, etc.) is determined by the activity of the links of the epizootic chain. They are directly influenced not only by natural and geographical factors, but are largely determined by economic, economic-and-organizational conditions, characteristics of animal husbandry and the level of ongoing anti-epizootic measures. Therefore, it is necessary to systematically study and analyze the epizootic situation, to find out the epizootic state of specific territories for individual infectious diseases of animals.

Ensuring the well-being of farms and livestock complexes is achieved through the implementation of regulated organizational and economic and veterinary measures. Among these measures, a significant place is occupied by the timely detection and isolation of animals sick with tuberculosis, and in farms that are successful in this infection, the differentiation of para-allergic tuberculin reactions from specific ones [8, 9].

At present, taking into account changes in the epizootic situation for tuberculosis, it seems very important to analyze the prevalence of tuberculosis, the results of the fight against tuberculosis in various regions of the Republic of Tatarstan, and the characteristics of the manifestation of the epizootic process in various zones of the republic over a 58-year period of large-scale health-improving measures (1960-2018).

The results of a retrospective analysis of the epizootic process of bovine tuberculosis in various regions of the republic will allow us to evaluate the

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effectiveness of the anti-epizootic measures taken, to determine the main directions for improving the complex of measures for the prevention, rehabilitation for bovine tuberculosis and maintaining stable epizootic well-being of the territory of the Republic of Tatarstan.

Purpose and research objectives. The aim of the work was a cartographic analysis of bovine tuberculosis nosareal in the Republic of Tatarstan.

To achieve this aim, the following tasks were defined:

- to monitor and analyze the epizootic situation of bovine tuberculosis in the Republic of Tatarstan from 1960 to 2018;
- to study the trends in the epizootic process in bovine tuberculosis, to make a cartogram and to determine the nosoreal disease in Tatarstan;
- to identify the causes of the tensions of the epizootic situation in the country for bovine tuberculosis.

## 2 Materials and methods

Monitoring of the epidemiological situation of bovine tuberculosis in the republic was carried out by studying the veterinary reporting of the Main Veterinary Administration of the Cabinet of Ministers of the Republic of Tatarstan. The intensity of epizootic indicators was determined by the number of dysfunctional points, incidence and infection of animals. The analysis of the collected information was carried out according to the guidelines and training manuals on the procedure for conducting epizootological studies of agricultural enterprises [10, 11].

To map permanently dysfunctional points, we used a topographic basis – an electronic map of the Republic of Tatarstan (M 1: 100 000). The trends in the dynamics of registration of primary dysfunctional points, on the basis of which conclusions were drawn about the expected changes in the levels of morbidity and mortality, were built in the program Microsoft Excel 2010.

## 3 Results

We have carried out monitoring and analysis of the epizootic situation of bovine tuberculosis in the Republic of Tatarstan. As a result of the study, it was established that in the past, many areas of the republic, to varying degrees, were unsuccessful for tuberculosis. Extensive allergy testing of livestock for tuberculosis started in the republic in 1934, when 150,370 animals were investigated, and continued in 1935, covering 223,383 animals. Tuberculosis was found in 355 villages. A significant number of disadvantaged items for bovine tuberculosis were identified in subsequent years. At this time, the allergic method of diagnosis was still poorly introduced into the veterinary practice, therefore, official statistics did not reflect the true epizootic situation of bovine tuberculosis in the Tatar Autonomous Soviet Socialist Republic. But these incomplete data indicate a widespread infection.

The Great Patriotic War caused serious damage to the veterinary and sanitary state of public animal

husbandry. During the four years of the war, only 625,896 animals were subjected to tuberculinization. Moreover, the largest number of reacting animals (5100 heads) was pick out in 1945.

In the postwar years, there was an increase in the number of detected disadvantaged points. So, as of January 1, 1949, 380 disadvantaged points were registered in the republic, and 318 were again found during the year.

Every year, cattle sick with tuberculosis remained on overexposure in farms, reaching in some years 43.7 % (1955), 46 % (1958). Of the total number of animals studied until 1963, an average of 25 % of the positively reacting cattle remained in winter rooms the next year without proper isolation.

Thus, the reasons for the spread of bovine tuberculosis were: the lack of isolators meeting veterinary and sanitary requirements; livestock movement without taking into account the epizootic situation; use for replenishment of the herd of young animals obtained from sick animals; poor sanitation of livestock buildings and farm territory.

In the future, the fight against bovine tuberculosis in the region continued with varying success. During this period, the epizootic situation of bovine tuberculosis in the republic remained tense. The prescription and multiplicity of foci of infection, as well as the systematic infection of animals, due to the violation of preventive measures by farms, reduced the effectiveness of the health measures taken.

Over 40 years (from 1960 to 2000), 726 cattle dysfunctional tuberculosis items were improved, in which 130479 animals fell ill. The most difficult, in the epizootic relation, for the republic was the period from 1960 to 1975. During this period, in the republic as a whole, more than 50 unfavorable points were registered annually. In addition, new items were added to the specified number of disadvantaged locations every year (Fig. 1).

As can be seen from figure 1, there was a cyclical nature of the emergence of new foci of tuberculosis infection, which was recorded at intervals of 5–7 years. The long-term trend line of bovine tuberculosis ill-being, i.e. the overall unidirectional trend of changing the intensity of the epizootic process in the republic, sought to decrease.

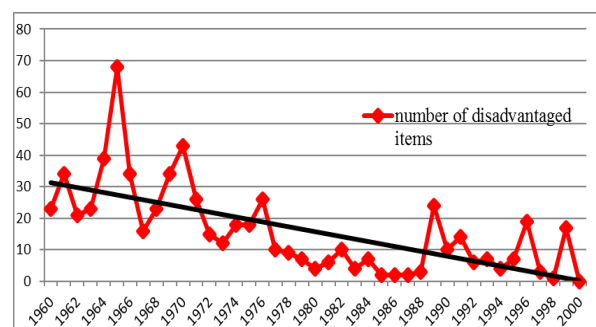


Fig. 1. The annual dynamics of registration of primary disadvantaged items for bovine tuberculosis in the Republic of Tatarstan (1960-2000).

The maximum number of dysfunctional bovine tuberculosis sites was identified in 1965 and 1966. By the beginning of 1966, there were 138 dysfunctional points in 20 of the 36 regions of the Republic of Tatarstan. During the year 54 points were healed of tuberculosis, 34 were re-identified, in which 1,024 animals fell ill, i.e. 1.5 % of the number studied. Thus, only in 2 years (1965–1966), about 20,498 sick animals were detected, which, according to "current standards", can be compared with the livestock of 2–3 districts of the republic.

From year to year, quite a large number of sick cattle remained in overexposure farms. He was placed in completely insulating sanitary facilities. It should be noted that by the end of 1987 the epizootic situation was becoming less tense. So, during this year only 2 dysfunctional points were identified, 7 were rehabilitated. For the first time at the beginning of 1988, there was no overexposure of sick cattle and there was not one point dysfunctional for tuberculosis. This period was characterized by the successful implementation of a complex of anti-TB measures.

However, during 1988, 3 dysfunctional points reappeared, which were the beginning of a new increase in the number of dysfunctional points and cattle responding to tuberculin. If at the beginning of 1991 there were 13 dysfunctional points, then by January 1, 1995 there were already 21 of them, in 1997 – 31, but by 2000 – there were 18 left.

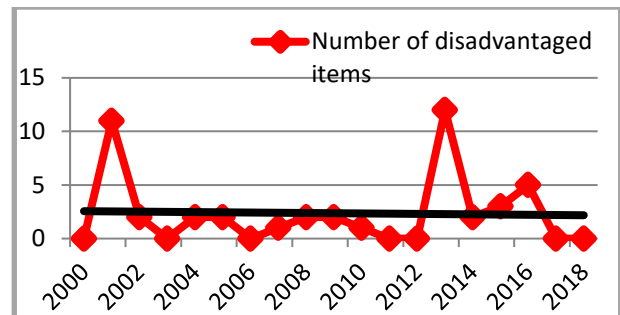
Long-term observations of the spread of bovine tuberculosis in the republic led to the conclusion that the ongoing anti-tuberculosis measures are not effective and the course of the epizootic process is objective. Despite the very successful performance of rehabilitation measures, the epizootic situation of tuberculosis remained stably unsuccessful, a problem arose of long-term dysfunctional farms, where tuberculosis was registered for 10–15 years in a row, and it was not possible to improve such enterprises by generally accepted methods.

In the period from 1995 to 2000, preventive measures were taken to protect prosperous farms from introducing tuberculosis infection into them, and measures were strictly taken to timely and completely identify and remove sick and infected animals from the herd. All previously dysfunctional bovine tuberculosis sites were under strict veterinary control, especially the farms of the Bavlinsky, Verkhneuslonsky, Drozhzhanovsky, Kamsko-Ustyinsky, Muslumovsky, Novosheshminsky and Cheremshansky districts of the Republic of Tatarstan, where tuberculosis has been widespread and has been registered for several decades.

In farms that have long been dysfunctional, with severe livestock damage by tuberculosis, complete replacement of the uterine population with healthy young animals has proven more effective. As a result of the work carried out by the veterinary service of the republic, by 2000, the last 18 points unsuccessful for tuberculosis had been improved, no new points were found this year.

Between 2000 and 2018, the fight against bovine tuberculosis in the Republic of Tatarstan proceeded with

mixed success. Based on the results of epizootological monitoring of bovine tuberculosis in the Republic of Tatarstan, in the period from 2000 to 2018, we constructed an epizootic curve that reflects the annual changes in the dynamics of the epizootic process in a given disease, as a reflection of the change in the number of new dysfunctional items for the study period (incidence) (Fig. 2).



**Fig. 2.** The annual dynamics of registration of primary disadvantaged points for bovine tuberculosis in the Republic of Tatarstan (2000–2018)

According to the results shown in Figure 2, it can be seen that the epizootic situation with bovine tuberculosis, in comparison with the previous study period (1960–2000), has improved significantly. During the 18 years of observation in the republic, 45 unfavorable points were revealed. Of the 43 districts of the republic, tuberculosis was registered only in 16.

The maximum number of unfavorable points was registered in 2001 and 2013, when 11 and 12 points were found, respectively. By the number of unsuccessful primary points, the “leader” was Cheremshansky district, in which for 16 years 9 foci of infection were identified, 8 of them were registered in 2013.

During the study period, there were years when new dysfunctional centers for bovine tuberculosis were not registered in the republic (2000, 2003, 2006, 2011 and 2012), but even at that time there were dysfunctional farms in which the disease was previously registered.

As can be seen from Figure 2, the epizootic curve over the observation period has a very wide amplitude. The line of the multi-year trend, i.e. The general unidirectional tendency of changing the epizootic process (ill-being) in case of bovine tuberculosis in the republic has a slight tendency to decrease.

This may be due to a number of factors: the unsatisfactory implementation of general anti-epizootic and veterinary-sanitary measures; violation of special anti-epizootic measures; uncontrolled delivery of breeding young stock from regions that are unfavorable for this disease; late diagnosis of tuberculosis and delayed anti-tuberculosis activities.

As a result of studying the dynamics of the number of down-trodden bovine tuberculosis items for the period from 2000 to 2018, in order to determine the nosoareal disease, we have compiled a map of the geographical location of the points of concern for this disease (Fig. 3).

As a result of the analysis of this cartogram, we found that points unsuccessful for tuberculosis are



geographically confined to a specific area: i.e. located mainly in the south, and scattered (in small groups – "centers") in the central part of the republic.

So, in the areas of the Pre-Volga and Predkamye regions (Arsky, Atninsky, Baltasinsky, Vysokogorsky, Zelenodolsky, Kukmorsky, Sabinsky, Tyulyachinsky,

etc.), cattle disease occurs in the form of enzootia or manifests itself sporadically. In such farms, after removal of the diseased animals, complete recovery of the herds and rarely when relapses of the disease are observed.



**Fig. 3.** Cartogram of the epizootic situation of bovine tuberculosis in the regions of the Republic of Tatarstan for the period from 2000 to 2018.

Tuberculosis infection, which is more severe in breadth of the number of livestock and in the number of dysfunctional points, is observed in the Trans-Volga and Zakamye. These are Alkeevsky, Alekseevsky, Drozhzhanovsky, Leninogorsk, Cheremshansky, Chistopolsky and other areas. In these zones, pronounced mosaic damage of certain territories and livestock farms is recorded. Conducting rehabilitation measures in a number of farms in this zone is associated with great efforts and significant costs. It was here that previously there were stationary dysfunctional centers and, as a rule, relapses of the disease were again recorded in farms that were healed of tuberculosis after 3–5 years.

#### 4 Conclusion

Bovine tuberculosis in the Republic of Tatarstan is stationary, the long-term trend line tends to decrease. Over 40 years (1960–2000), 726 cattle-affected tuberculosis dysfunctions were recovered. Between 2000 and 2016, 45 new epizootic foci were identified in 16 of 43 districts of the republic. In the areas of the Pre-Volga and Pre-Kama regions, the infection proceeds in the form of enzootia or appears sporadically. The course of the epizootic process, which is more intense in breadth

of the number of livestock and in the number of dysfunctional sites, is observed in the regions of Zavolzhye and Zakamye. It was here where stationary dysfunctional sites were previously located, and, as a rule, relapses of the disease were again recorded in farms that were cleared of tuberculosis after 3–5 years.

Over the past decades, much work has been done in the Republic of Tatarstan to study and improve the diagnosis of animal tuberculosis. Veterinary specialists are constantly working to prevent the introduction of the causative agent of tuberculosis into the herds of animals and ensure their well-being, constant veterinary supervision of regrouping, admission and disposal of livestock, and compliance with veterinary and sanitary rules on farms is carried out.

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