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## **EPIDEMIOLOGICAL MONITORING THE PESTE DES PETITS RUMINANTS IN THE REPUBLIC OF KAZAKHSTAN**

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### **Abstract**

Peste des petits ruminants (PPR) is a highly contagious viral disease of sheep and goats, as well as wild small ruminants, occurring mainly in acute or subacute clinical forms. PPR causes great economic damage to the small-scale sheep and goat farming and as the whole states. The article presents epidemiological monitoring and analysis of preventive measures carried out in Kazakhstan against PPR. The country's territory is conditionally divided into two safe zones (territories with and without vaccination). Specific PPR prevention is carried out in a safe zone with vaccination (buffer zone), which includes five regions and a city of republican significance (Almaty, Zhambyl, Zhetysu, Kyzylorda, Turkestan regions and Shymkent). In 2018-2022 from 3225570 to 6733974 sheep and goats were vaccinated in buffer zones annually. At the same time, vaccination coverage from the total number of susceptible animals was 15.2-36.8%.

Planned monitoring diagnostic studies have confirmed the epidemiological well-being of the country in terms of PPR. Over the past 5 years, 86,830 serological and 482 molecular genetic studies have been conducted, with negative results in all cases. Serological monitoring of «risk zones of possible infection» for the presence of antibodies to the PPR virus in susceptible pets also confirmed the absence of infection in the studied territories.

**Key words:** Epidemics situation; epidemiological monitoring; Kazakhstan; peste des petits ruminants; prevention; small ruminants.

## Introduction

Peste des petits ruminants (PPR) – belongs to the group of cross-border infections, characterized by rapid spread, high contagiousness and mortality. The economic damage caused by this infection to goat and sheep farming is also enormous. In the most unfavorable cases, the incidence rate of PPR is 100%, and the mortality rate reaches 90%. The most susceptible to PPR is goats, among which mortality can reach 95%. In endemic areas, the mortality rate of the epidemic may be low, but there, too, the disease causes significant damage to herd productivity [1, 2].

Direct costs arise due to the death of animals, reduced productivity (dairy products, meat quality and weight gain, the inability to remove wool and fluff), as well as the cost of quarantine measures. According to FAO estimates, the annual economic damage from this disease is more than \$2 billion [3].

The Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) are mobilizing the international community as part of a new global initiative to eliminate PPR by 2030. The purpose of this FAO is to continuously improve the farming systems of small cattle by contributing to the eradication of this infection, strengthening food security and increasing the resilience of the population to external shocks of livelihoods in rural areas [4, 5].

In the official OIE data, 2018-2022, 54 countries of the world recognized as unfavorable and endemic by the PPR. During the specified period of time, 36 states were recognized as dysfunctional on the African continent, in Asia, PPR were registered in 16 countries and two more states (Bulgaria, Turkey) are located on the European continent. Out of 54 countries, China, Bhutan, Maldives, Kenya, Tunisia, Comoros and Uganda are considered

endemic [6].

Currently, special attention is paid to China among the countries that are disadvantaged by the PPR, since this country has extensive common borders with Kazakhstan and bilateral trade and economic cooperation is very developed. The trade turnover between the countries, including the turnover of livestock products, is growing every year. Transport logistics is actively developing. All these factors increase the risk of infection entering the country from a neighboring state [7, 8]. In addition, a high risk of infection remains on the territory of the country, from countries such as Mongolia, Iran, India, Turkey, Afghanistan and Kyrgyzstan and Tajikistan, where the outbreak of the epidemic was previously recorded, which are unfavorable according to the PPR. The reason for this is the close geographical location and close trade and economic relations of Kazakhstan with these countries [9, 10].

In addition, the FAO reported that in recent years, the number of outbreaks of PPR detected on a global scale has decreased by two-thirds. This, reflecting the determination of the international community to defeat this highly contagious animal disease, gives hope that the goal of its elimination worldwide will be achieved by 2030.

The decrease in the foci of PPR is explained by the effectiveness of large-scale vaccination campaigns conducted in more than 50 countries. These measures were implemented with the support of FAO and its partners, funded by state secretaries, and in 2015-2018 alone, more than 300 million sheep and goats were vaccinated in 12 states [11, 12].

In many states bordering Kazakhstan (Kyrgyzstan, Turkmenistan, Iran, China) and countries with close trade and economic relations with us (Mongolia, Georgia, Turkey), mandatory vaccination

of small cattle against the PPR is carried out. Such a measure is also carried out in Kazakhstan, in areas at risk of infection. The border zones with a high number and density of wild animals exposed to the plague of small cattle and small ruminants are the most dangerous for the penetration of the PPR [13].

The high degree of disadvantage of the countries bordering with Kazakhstan due to this epidemic, the PPR force to organize and carry out preventive measures to prevent penetration and spread on the

### **Materials and Methods**

The initial materials for the study were formed at the expense of their own data collected during visits to economic entities, as well as district and regional territorial inspections. In addition, reporting and review data of the Committee for Veterinary Control and Supervision of the Ministry of Agriculture of the Republic of Kazakhstan and statistical data of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan were used as materials. When assessing the epidemic situation of small ruminant plague in the world and countries adjacent to the territory of Kazakhstan, official data of the World Animal Health Organization posted on the Rosselkhoznadzor website were used [16].

### **Results**

Analysis of the epidemic situation of small ruminant plague in the world and trends in the spread of diseases in recent years in countries bordering the Republic of Kazakhstan indicates the presence of a high risk of small ruminant plague entering the territory of our country. Among them, the epidemic situation in Mongolia and China, as well as in Georgia, Turkey and Iran is of particular concern.

Based on the epidemic situation in these states regarding the PPR and the

territory of the country. Therefore, taking into account the peculiarities of animal husbandry in Kazakhstan and the need to combat this dangerous epidemic, it is very important to study and monitor the spread of the pathogen of the PPR, as well as to improve control measures [14, 15].

In this regard, the purpose of these studies was epidemiological monitoring and evaluation of the effectiveness of anti-plague measures of small ruminants carried out on the territory of the Republic of Kazakhstan.

To conduct epidemiological studies on the PPR and to analyze the epidemic situation, a comprehensive method of epidemiological studies was used. Monitoring studies aimed at identifying vectors of the plague virus in sick animals and small ruminants were conducted in a favorable vaccination zone. To do this, blood serum samples were taken from small cattle of different ages and sexes (from 2 to 6 months). In total, 1000 samples were taken from various farms of Almaty, Zhambyl regions and the city of Shymkent, including from one epidemiological unit to 30-50-100 samples. Studies, Id screen <sup>®</sup> PRO Competition (ID.VET, France) was conducted by competitive enzyme immunoassay (ELISA) using a test system.

determination of the identified risk factors and possible routes of infection, given that our country is officially healthy for this infection, in accordance with the requirements of the World Organization for Animal Health, the territory of the Republic of Kazakhstan conditionally refers to 2 favorable zones, that is, vaccinated and unvaccinated territories (Fig. 1).

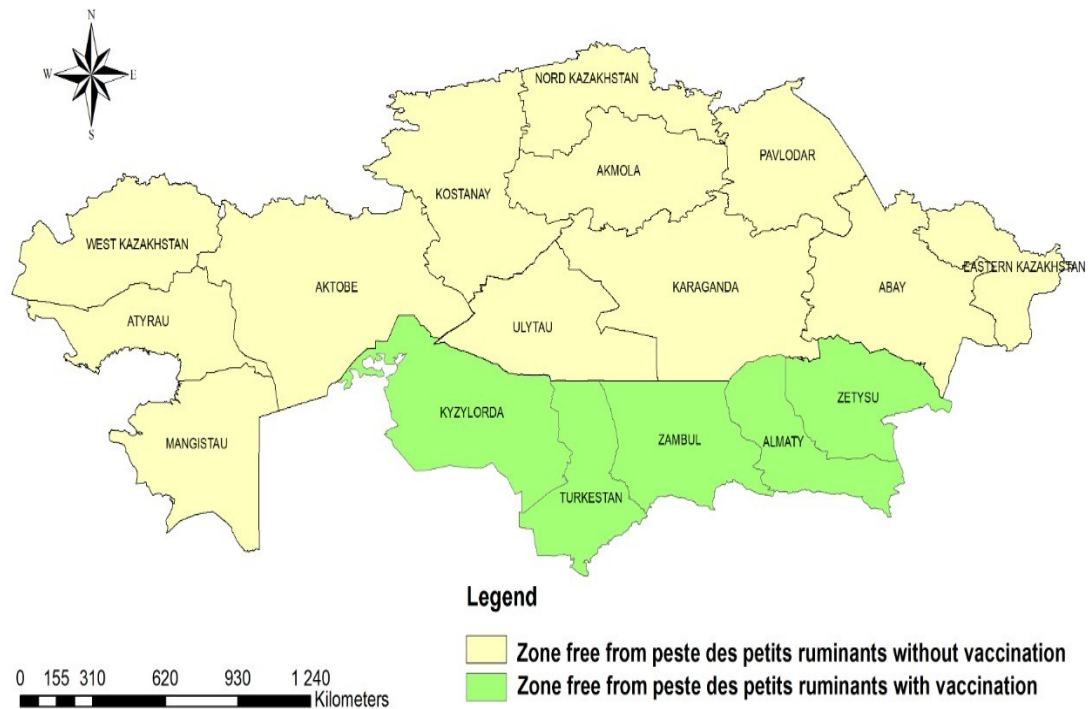


Figure 1 - Division of the territory of the Republic of Kazakhstan into vaccinated and non-vaccinated zones in relation to the PPR

The territory of the country, favorable without vaccination for the PPR, is the first zone and includes 12 regions of the republic: Abai, Akmola, Aktobe, Atyrau, East Kazakhstan, West Kazakhstan, Karaganda, Kostanay, Mangystau, Pavlodar, North Kazakhstan and Ulytau regions. The second favorable zone for the PPR (buffer zone), in which mandatory vaccination is carried out, includes the remaining 5 regions of the country and 1 city of republican significance (Almaty, Zhambyl, Zhetysay, Kyzylorda, Turkestan regions and the city of Shymkent). In accordance with the recommendations of the World Animal Health Organization, in the regions included in the favorable vaccination zone, (Table 1).

susceptible animals are isolated from the rest of the country and neighboring countries with a different veterinary and sanitary status, in order to prevent the penetration of the PPR, taking into account geographical and physical barriers. Vaccination of susceptible animals in the buffer zone against the PPR is included in the list of mandatory voice measures and is funded by the state. Vaccination coverage of susceptible livestock, proper planning, organization and timely implementation of this event are the key to maintaining epidemiological well-being. In this regard, we evaluated the effectiveness of therapeutic measures in the country over the past 5 years (

**Table 1 - Vaccination of sheep and goats against PPR on the territory of the Republic of Kazakhstan (2018-2022)**

Name of the region	2018			2019			2020			2021			2022		
	Number of sheep and goats, thousand heads	Number of vaccinated animals, thousand heads	Vaccination coverage, %	Number of sheep and goats, thousand heads	Number of vaccinated animals, thousand heads	Vaccination coverage, %	Number of sheep and goats, thousand heads	Number of vaccinated animals, thousand heads	Vaccination coverage, %	Number of sheep and goats, thousand heads	Number of vaccinated animals, thousand heads	Vaccination coverage, %	Number of sheep and goats, thousand heads	Number of vaccinated animals, thousand heads	Vaccination coverage, %
Abai	-	-	-	-	-	-	-	-	-	-	-	-	1 131,5	0	0
Akmola	511,2	0	0	522,2	0	0	530,2	0	0	539,4	0	0	573,4	0	0
Aktobe	1 074,5	0	0	1 109,4	0	0	1 127,1	0	0	1 153,4	0	0	1 312,0	0	0
Almaty	3 411,1	1450900	42,5	3 419,4	1 000,0	29,2	3 510,0	822,0	23,4	3 659,7	259,9	7,1	2 354,6	0	0
Atyrau	542,6	0	0	559,9	0	0	567,2	0	0	579,7	0	0	597,0	0	0
West Kazakh. region	1 155,6	0	0	1 147,9	0	0	1 130,6	0	0	1 188,8	0	0	1 306,6	0	0
Dzhambul	2 610,5	1163000	44,5	2 788,4	1 532,1	54,9	2 861,8	1 974,4	69,0	3 055,5	921,4	30,15	3 446,6	1 116,3	32,4
Zhetysu	-	-	-	-	-	-	-	-	-	-	-	-	1 701,5	0	0
Karaganda	933,1	0	0	930,8	0	0	924,5	0	0	950,9	0	0	738,5	0	0
Kostanay	436,6	0	0	454,4	0	0	463,6	0	0	471,5	0	0	465,7	0	0
Kyzylorda	586,7	240000	40,9	612839	151,5	24,7	620,9	151,7	24,4	698,6	151,2	21,6	731,6	224,3	30,7
Mangystau	373,2	0	0	387,3	0	0	384,4	0	0	419,9	0	0	311,0	0	0
Pavlodar	526,8	0	0	536,9	0	0	551,6	0	0	565,5	0	0	657,0	0	0
North Kazakh. region	386,6	0	0	404,2	0	0	419,3	0	0	433,4	0	0	463,2	0	0
Turkestan	4 112,0	3860074	93,9	4 088,2	2 371,0	58,0	4 290,6	2 438,7	56,8	4 602,5	2 045,8	44,4	4 530,1	1 870,0	41,3
Ulytau	-	-	-	-	-	-	-	-	-	-	-	-	266,7	0	0
East Kazakh. Region	1 663,5	20000	1,2	1 598,7	0	0	1 611,7	0	0	1 619,3	0	0	603,8	0	0
Astana	2,5	0	0	1,7	0	0	1,5	0	0	1,1	0	0	1,8	0	0
Almaty	2,4	0	0	2,3	0	0	1,5	0	0	4,5	0	0	1,7	0	0
Shymkent	-	-	-	113,2	63,1	55,8	95,4	65,6	55,8	109,3	80,0	73,2	82,6	15,0	18,2
Total:	18 329,0	6 734,0	36,8	18 677,9	5 117,8	27,4	19 092,0	5 452,4	28,6	20 042,0	3 443,2	17,2	21 276,8	3 225,6	15,2

As can be seen from the table, vaccination of susceptible animals against the PPR was carried out only in places included in the buffer zone. It should be noted here that the regions where vaccination was carried out changed in different periods. For example, due to the division of the Almaty region into two parts, the Zhetysu region is also included in the vaccination zone as a separate administrative unit, but neither the Almaty region nor the Zhetysu region are included in the vaccination plan for sheep and goats against the PPR for 2022. In addition, in 2018 the city of Shymkent was awarded the status of a city of republican significance and in connection with its separation from the Turkestan region, since 2019 the city of Shymkent as a separate administrative unit has been included in the action plan to combat the PPR.

In the period from 2018 to 2022, from 3,225,570 to 6,733,974 sheep and goats were vaccinated in buffer zones for 1 year. At the same time, up to 15.2-36.8% of the total number of susceptible animals were vaccinated.

The highest rate of vaccination coverage of animals prone to PPR was recorded in 2018 – 54.38%. This year, predisposed animals of Almaty, Zhambyl and Turkestan regions were mainly

vaccinated and vaccination coverage in Almaty and Zhambyl regions amounted to 42.5-44.5%, in Turkestan region this figure reached 93.9%.

In 2019-2022, we are witnessing a general decrease in the number of vaccinations of susceptible livestock against the PPR. For example, in 2022, only 15.2% of the total number of susceptible animals were vaccinated. Separately, by region, vaccination coverage in Almaty region decreased from 42.5% (2017) to 0%, in Zhambyl region - from 69.0% (2020) to 32.4%, in Turkestan - from 93.9% (2018) to 41.3%.

In order to constantly confirm the epidemic well-being of the country, planned monitoring studies are conducted annually by the state for each notified infection. Based on this, at the next stage, we analyzed monitoring wax studies on the PPR conducted on the territory of the Republic of Kazakhstan in 2018-2022. These studies are conducted by the Republican State Enterprise on the right of economic management «National Reference Center for Veterinary Medicine» Federal State Budgetary Educational Institution of Higher Professional Education of the Ministry of Agriculture of the Republic of Kazakhstan and the results of their analysis are presented in Table 2.

Table 2 - Number of diagnostic studies of PPR in 2018-2022

Years	Number of serological research	Among them, the positive result	Number of molecular genetic research	Among them, the positive result
2018	33	0	115	0
2019	6063	0	140	0
2020	211	0	139	0
2021	41013	0	75	0
2022	41510	0	61	0
Total	86 830	0	482	0

As can be seen from the table, the number of studies varies greatly by year. As for serological reactions, if in 2018-

2020 from 33 to 6063 samples were studied annually in the republic, then in 2021-2022 41013 and 41510 studies were

conducted respectively. In total, 87027 blood serum samples of small cattle have been examined over the past 5 years and negative results have been obtained in all cases.

Also, in accordance with the monitoring research plan, it is planned to conduct molecular genetic studies. These studies were carried out by polymerase chain reaction (PCR) using special diagnostic kits. Data analysis showed that 482 molecular genetic studies have been conducted over the past 5 years. At the

same time, from 61 to 140 samples are studied annually, and it should be noted here that all studies have shown negative results.

As already noted, over the past 2 years, the number of monitoring serological studies has significantly increased in order to strengthen control over the current epidemic situation of small ruminant plague. Data on the analysis of diagnostic studies for 2022 in the context of the regions of the state are presented in Table 3.

**Table 3 - Analysis of monitoring studies of PPR conducted at the level of regions of Kazakhstan (2022)**

Name of the region	Number of serological research	Among them, the positive result	Number of molecular genetic research	Among them, the positive result
Akmola	616	0	22	0
Aktobe	2 723	0	3	0
Almaty	6 074	0	3	0
Atyrau	444	0	0	0
West Kazakh. region	2 228	0	5	0
Dzhambul	5 165	0	4	0
Karaganda	1 922	0	5	0
Kostanay	1 731	0	6	0
Kyzylorda	3 896	0	0	0
Mangystau	1 871	0	0	0
Pavlodar	2 530	0	2	0
North Kazakh. region	1 884	0	7	0
Turkestan	5 363	0	1	0
East Kazakh. Region	5 063	0	3	0
Total	41 510	0	61	0

The table shows that sampling for serological studies from the regions was carried out taking into account the number of susceptible animals in each region and the presence of an area in the buffer zone where vaccination is carried out. So, in 2022, 50.0% of the studies (20,498 samples) were conducted by samples from Almaty, Zhambyl, Kyzylorda and Turkestan regions. The largest number of

studies were conducted in Almaty (6074), the smallest - in Atyrau (444) regions. It should be noted that of the 61 planned studies on molecular genetic research, 22 (36.1%) were conducted with samples from the Akmola region. In addition, in the West Kazakhstan region, Karaganda, Kostanay and North Kazakhstan regions, 5-7 PCR samples were studied. As already mentioned, all serological and molecular

genetic studies have shown negative results.

The World Organization for Animal Health, in accordance with the recommendations of Article 1.4.6 of the Continental Code of Animal Health (2018), should conduct surveillance (passive or active) on the PPR in order to confirm the historical suitability of the territory, state, proof of the absence of disease or source of infection. In this regard, in accordance with the tasks set, we conducted serological monitoring of the presence of antibodies to the PPR (unvaccinated sheep and goats) in susceptible domestic animals kept in farms of various forms of ownership (personal subsidiary farm, peasant farm) «in dangerous areas of possible manifestation of infection».

Blood serum samples of small cattle of different ages and sexes (from 2 to 6 months) the study, ID Screen® PRO Competition (ID.VET, France) was conducted by competitive enzyme immunoassay (ELISA) using a test system.

To conduct monitoring studies for the detection of antibodies to the PPR from neighboring countries, 1000 samples of blood sera from 2 regions (Almaty, Zhambyl) and Shymkent, belonging to the zones of increased risk of disease penetration, were selected (Table 4).

So, a total of 300 samples were taken in the Almaty region. Of these: Talgar district, Alatau rural district, Bereke village-23, Almalyk village – 42, Orman village – 14, Ryskulova village - 71 samples (total 150 samples for the district); Azat rural district of

Enbekshikazakh district – 26, Rahat rural district-58, Uryktinsky rural district – 34. Kaynazarsky rural district district – 32 samples (150 samples in total for the district).

Zhambyl region-300 samples. Of these: Baizak district, Koktal village – 47, Sarykemer village – 53, Kostobe village – 31, Kyzylzhuldyk village - 33, Buryl village – 31 samples (total for the district 195 samples). Zhambylsky district rural district Birlesu – 35, Zhasorken rural district – 40, Enbek rural district – 30 samples (total of 105 samples in the district).

There are 400 samples in the city of Shymkent, of which: Abai, Al-Farabi, Karatau and Enbek districts, 100 samples were taken from each administrative district.

According to the results of the work, All serological studies for the determination of antibodies against the PPR in the blood serum samples taken for the study showed a negative result.

That is, serological monitoring of the territory of the republic belonging to the buffer zone for the PPR confirms that at present these regions are favorable for the above infection, but at the same time, given the presence of risk factors contributing to the outbreak of the epidemic, there is a need to continue surveillance of the situation and conduct systematic screening studies.

**Table 4 - Results of serological monitoring of buffer zones of the Republic of Kazakhstan by enzyme immunoassay, the presence of antibodies to the PPR in the body of small cattle**

№	Region	District	Rural district	Locality	Type of ownership	Number of studies, heads		
						Total	Of these	
							negative	positive
1.	Zha	Baiza	Koctal	Koctal	PF (Kozhagulov M.)	47	47	0



2.	mbyl	k	Sarykemer	Sarykemer	PF (Tumashev)	53	53	0
3.			Kostobe	Kostobe	PF (Umirbekov)	31	31	0
4.			Krasnaya Zvezda	Krasnaya Zvezda	PF (Kostai A.)	33	33	0
5.			Buryl	Buryl	PF (Tumaev E.)	31	31	0
6.	Zhambyl		Birlesu	Birlesu	PF (Kukeev M.)	35	35	0
7.			Jasorken	Jasorken	E. Beitkhanov	40	40	0
8.			Yenbek	Yenbek	PF (Shangiev B.)	30	30	0
9.	Almaty	Talgar	Alatau	Bereke	PF (Baibolov A.)	23	23	0
10.			Alatau	Almalyk	PF (Zhakhanbekov Sh.)	42	42	0
11.			Alatau	Orman	PF (Dzhaparov N.)	14	14	0
12.			Alatau	Ryskulov	PF (Kotelnikov V.)	71	71	0
13.	Enbekshikazak		Azat	Azat	PF (T. Nusipov)	8	8	0
14.			Azat	Azat	PF (Abdullayev A.)	18	18	0
15.			Raxat	Raxat	PF (Bukenov)	58	58	0
16.			Orikti	Orikti	PF (Dauletov O.)	34	34	0
17.			Kainazar	Kainazar	PF (Ashimov B.)	32	32	0
18.	Shymkent	Abay	-	-	PF (Orhan zh.)	100	100	0
19.		Al-Farabi	-	-	PSF («Lapiev»)	100	100	0
20.		Karatau	-	-	PF (Oralbayev)	100	100	0
21.		Enbekshi	-	-	PF (Mavlanov A.)	100	100	0
22.	TOTAL					1000	1000	0

Note: <sup>1</sup> PSF is a personal subsidiary farm; <sup>2</sup> PF is a peasant farm.

## Discussion

The results of the conducted studies show that the presence of factors contributing to the penetration of the PPR, such as the disadvantage of border states and institutions-economic partners, population density and density of susceptible farm animals, depending on the region of the state, can have a significant impact on the current epidemic situation and the dynamics of the

epidemic process of PPR.

This is especially true in regions with a high risk of pathogen penetration from neighboring countries. In such regions of the country (Almaty, Zhambyl, Turkestan regions), along with a high density of susceptible animals, there is a high density of population and settlements. In this regard, the most important thing for the veterinary service

of the country is systematic and purposeful work to prevent the importation of infection from outside and the formation of a buffer zone consisting of immune livestock in areas with the greatest risk of epidemic penetration.

To confirm the epidemiological well-being of the country, routine monitoring diagnostic studies for each notified infection are mandatory. The analysis of monitoring studies conducted in the territories of Almaty, Zhambyl

### **Conclusion**

The results of the study confirm the epidemiological suitability of the country's territory for the PPR. Currently, the PPR special control measures are the most effective way to prevent the penetration and spread of infection in controlled areas. The analysis of vaccination of susceptible animals in the territories included in the buffer zone showed that the level of vaccination coverage of susceptible animals varies annually, which is usually associated with a predictive assessment of the risk or reduction of the growing tension of the epidemic situation for the

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regions and Shymkent showed that these regions are free from the PPR. Our research is confirmed by annual monitoring studies conducted by the Republican State Enterprise on the right of economic management «National Reference Center for Veterinary Medicine» in the state municipal enterprise on the right of economic management of the Ministry of Agriculture of the Republic of Kazakhstan.

PPR in the region. In general, the downward trend in the proportion of vaccinated animals in the buffer zone over the past 2 years is based on a significant reduction in the intensity of the epidemic situation in the territories of disadvantaged countries bordering Kazakhstan (China) with Kazakhstan, and is economically justified. But such dynamics can also lead to unfavorable conditions, because as the number of unvaccinated animals increases, the risk of infection from the outside increases proportionally.

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