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Nosogeography and Etiological Structure of Leptospirosis Focuses in the Republic of Kazakhstan

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Abstract: The article considers nosogeography of leptospirosis focuses and analysis of different animal species disease incidence in the Republic of Kazakhstan with composition of nosographical and etiological map on spread of the diseases among cattle and pigs. Different animals' leptospirosis is registered serologically and bacteriologically almost in all geographical zones: in the majority of cases among cattle and pigs, in a less degree among horses and sheep, in singularity among camels. Incidence of people disease with availability of natural and zoonotic focuses of leptospirosis infection has been studied on the territory of Kazakhstan Republic.Identity of leptospirosis etiological structure of people, farm animals and rodents, which is generally presented by leptospirosis serogroups Grippotyphosa, Pomona, Tarasovi, Hebdomadis at the leading significance of the first two, has been detected. In accordance with the rules of international sub-committee on taxonomy and nomenclature of Leptospira, identification of local Leptospira strains isolated from people and animals in Kazakhstan has been carried out for the first time. It was established that Leptospira of people and animals are caused by 7 serotypes (Grippotyphosa, Tarasovi, monjakov, sorex-jalna, sejroe, Saxkoebinq, Canicola) from 6 serogroups (Grippotyphosa, Tarasovi, Pomona, Iavanica, Hebdomadis, Canicola).

Key words: Nosogeography · Strains · Adsorption · Cutaneous leptospirosis

INTRODUCTION

Currently animal and human leptospirosis has wide spread occurrence. According to the data of many researches, this infection is registered in all countries of the world including the Republic of Kazakhstan [1-3].

Economic damage caused to the animal breeding by leptospirosis is heavy enough. With reference to the economic damage we should touch on a question on expenses related to the improvement of diagnostics, medical assistance and need to create special conditions for management of diseased animals. Besides, leptospirosis is dangerous to human health, by the same token, preventing leptospirosis infective episode we can solve social problem. Particularly, workers of meat-processing plants, poultry plants, operating personnel of fish farms, rice fields, marsh rabbit catchers and also persons engaged with slash clearing are subjected to the infection risk by this dangerous zoonotic disease. This is also informed by foreign scientists [4-10].

In this connection, study of nosogeography and etiological structure of leptospirosis focuses is the issue of the day.

From the above reasoning, the authors have set the following objectives:

- Explore spread of leptospirosis among different animal species with composition of nosographical map;
- Determine etiological structure of animal leptospirosis in the Republic;
- Substantiate connection between leptospirosis spread among farm animals and human disease incidence.

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MATERIALS AND METHODS

Complex research methods have been used in the present work: epizootological investigations of animal leptospirosis in different regions of the Republic of Kazakhstan, reports and statistical materials of oblast agricultural departments veterinary sections, information of sanitary and epidemiological stations of the Republic, serologic examinations on leptospirosis of cattle, pigs, sheep, horses, camels have been analyzed, analysis of district, oblast veterinary laboratories works for the last 30 years and experimental researches have been carried out.

Prepared by us antigenic erythrocytic leptospirosis diagnosticum in incomplete hemagglutination reactionhas been used in serologic diagnosis in common with existingmicroagglutination and lysis reaction.

RESULTS AND DISCUSSION

Complexity of the etiological structure of leptospirosis focusesin the Republic of Kazakhstan depends on natural conditions conditioning variety of species composition of fauna, wild mammals and influencing on specialization of animal husbandry, as certain species of wild and farm animals are owners of certain Leptospira serogroups. We have established (1981 – 2012) that infection in natural focuses is possible only to the extent of forest areas of the Republic (East-Kazakhstan and Akmola oblasts), that is conditioned by signified stress of epizootic situation among animals Leptospira vehicles. In forest-steppe and steppe zones (North-Kazakhstan, Pavlodar, Almaty, Zhambyl, South-Kazakhstan oblasts) this process is characterized by low stress, as the disease episodes depending on natural-nidal character have not been sufficiently defined or not known yet. In such natural-geographic landscapes, farm animals, especially cattle and pigs, are the main sources of the infection in the epidemiology and epizootiology of leptospirosis.

Leptospirosis of these animals caused by germs of some serotypes is followed by long-term and intensive urinous leptospirosis. We refer to them L. grippotyphosa, L.pomona, L. tarasovi and also some representatives of L. Hebdomadis group. By this it is explained occurrence possibility of zoonotic focuses in the regions of developed animal husbandry.

Long-term and constant availability of such focuses is conditioned by management features of animal husbandry in the Republic regions (seasonal and sometimes year-round grazings, watering and dipping ofanimals in the open reservoirs and a number of violations of veterinary-sanitary rules for management of animals).

Mostly cattle, pigs, less frequently dogs and other species of farm animals and also rodents take part in formation of the constant zoonotic focuses.

According to our complex investigations it has been established that people in the East-Kazakhstan, Akmola, North-Kazakhstan and Zhambyl oblasts suffer from L. grippotyphosa, L.pomona, L. tarasovi because of the lack of drinking water, often use industrial or irrigation water, or water from open reservoirs, which directly connected with zoonotic focuses and also with diseases of these germs among pigs and cattle.

In other (Almaty, West-Kazakhstan, Karaganda) oblasts of Kazakhstan with different hydrologic conditions, where people are provided by drinking water satisfactorily suffer rare, sporadically. In these regions, people usually suffer at cattle management, at work in slaughters.

Analysis of animal leptospirosis disease incidence in the Republic of Kazakhstan for the last 30 years is indicative of a wide spread of the infection on the whole territory of Kazakhstan. For the stated period, leptospirosis cases were detected almost in all oblasts in the form of epizooty generally with clinically intensive forms (Fig. 1).

It has been established by long-term observations that cattle (226 ill-behaved points) and pigs (102 ill-behaved points) are mostly susceptible to leptospirosis, sheep and horses, correspondingly 24 and 15 ill-behaved points, are less susceptible to leptospirosis. All age-sex groups suffer, generally growing stock and animals from leptospirosis problem farms.

According to our data cattle leptospirosis is mostly wide spread in the south zone (incidence of the disease is 6, 31%) and in the east zone (4, 14%) and in the north and west zones rate of the disease incidence is 3, 1% and 2, 3% correspondingly; in the central zone the disease incidence is only 0, 81% (Fig. 2).

Pigs leptospirosis in the Republic at the same period of time had a wide spread in the west and south zones (the disease incidence was 5, 08% and 5, 33% correspondingly) and insignificant – in the central zone, 0, 21% (Fig. 3).

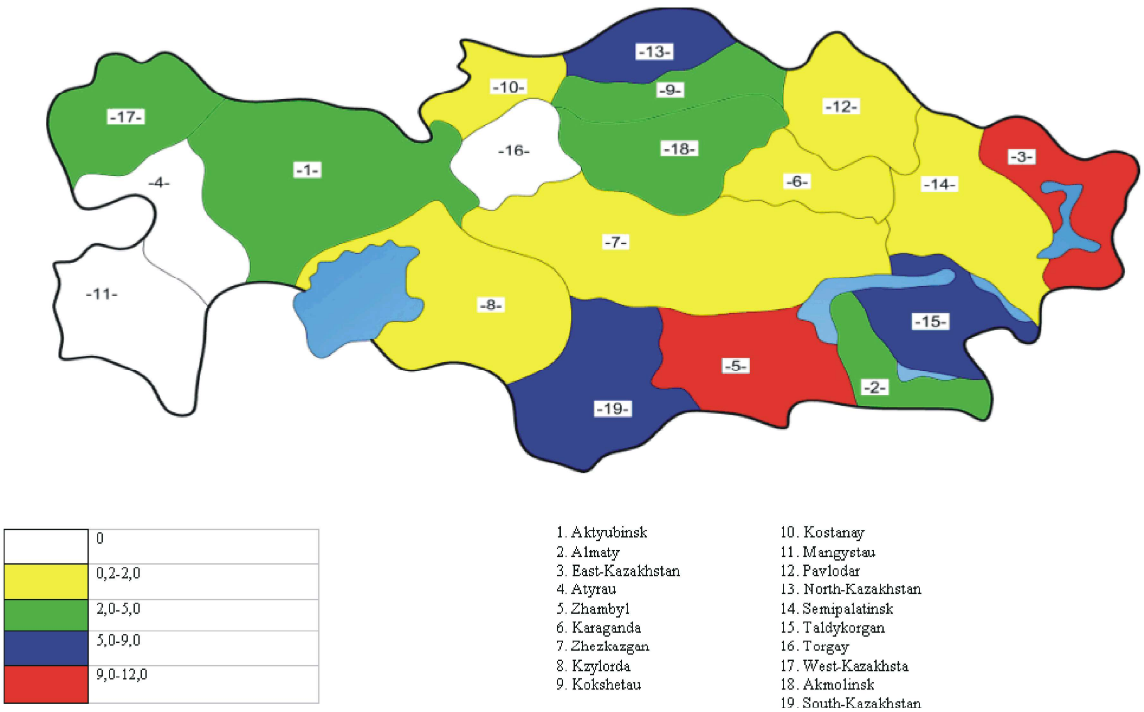

Fig. 1: Spread of farm animals leptospirosis in Kazakhstan

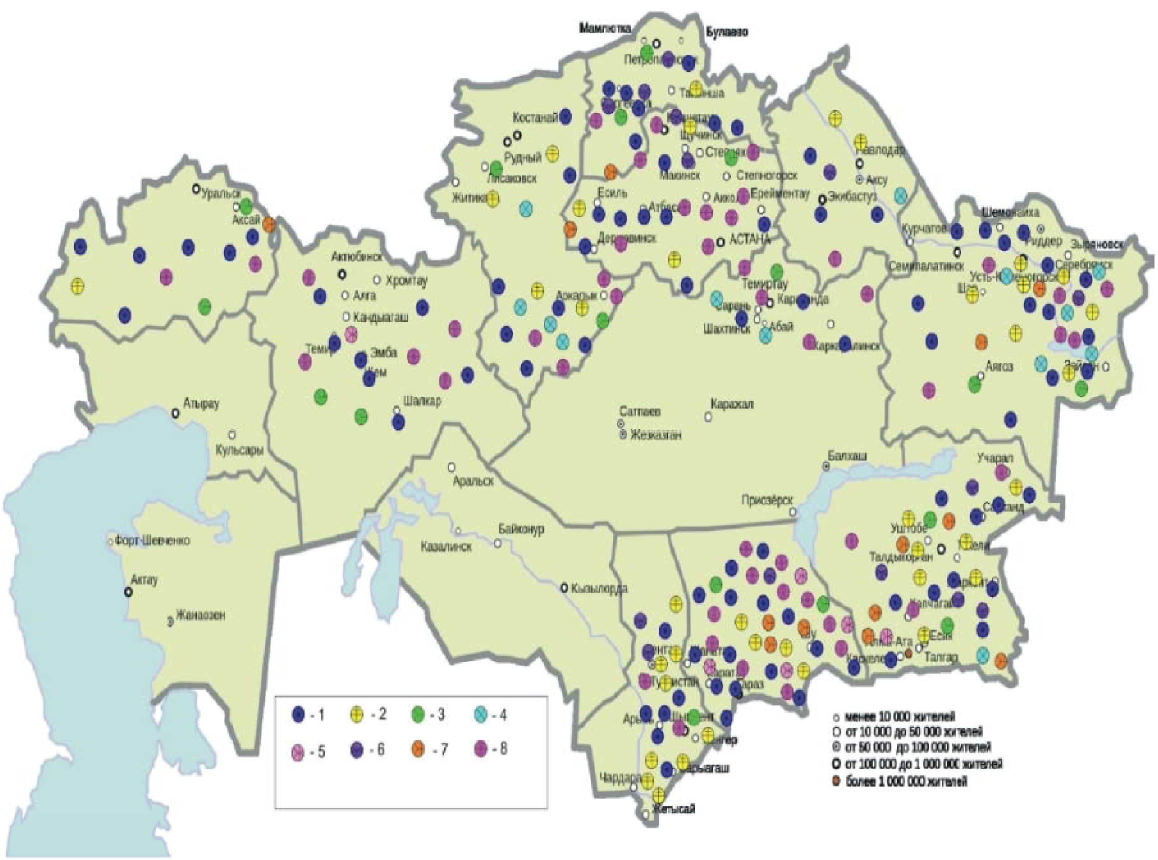

Fig. 2: Etiological structure of cattle leptospirosis on the Republic of Kazakhstan territory

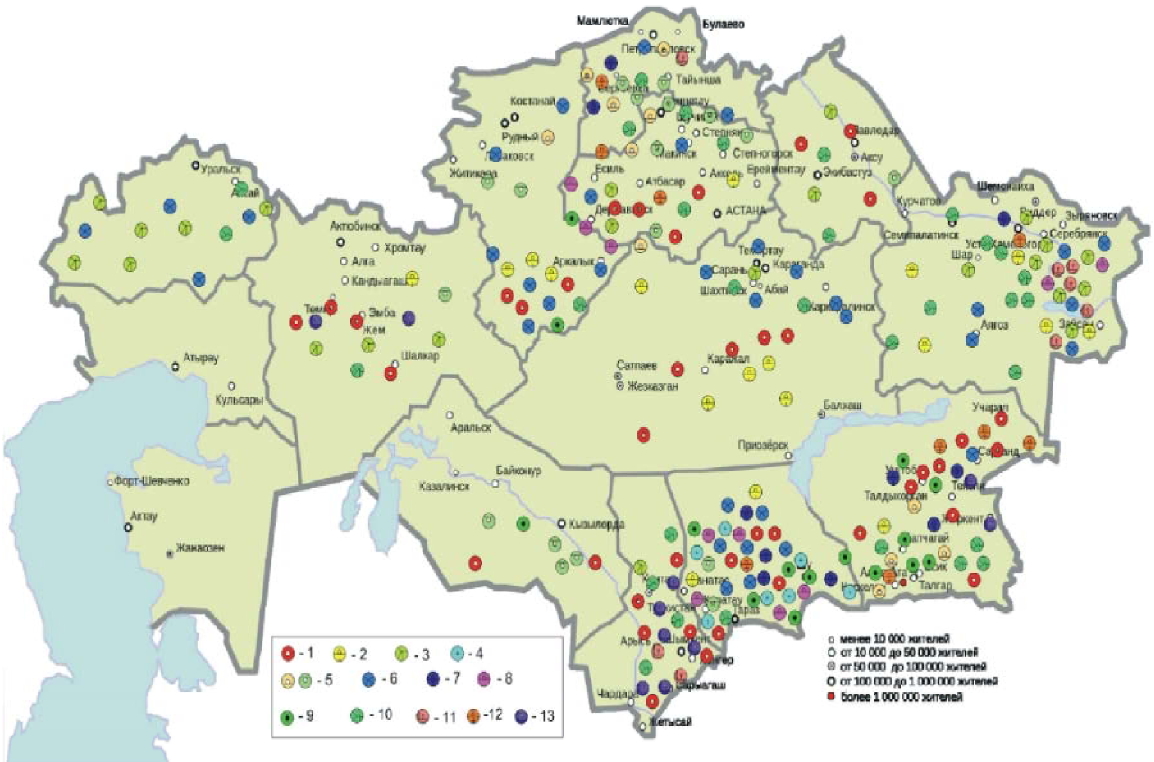

Fig. 3: Etiological structure of pigs' leptospirosis on the Republic of Kazakhstan territory

For the first time in Saryagash region of South-Kazakhstan oblast, serologically we have diagnosed camels' leptospirosis. Only 4 camels from the examined 50 had positive results.

Leptospirosis of cattle and pigs caused by different serogroups of germs has no any distinguishing clinical features.

The disease incidence of animals by leptospirosis has strongly markedseasonality; for example in Almaty oblast cattle more often suffer in March and August. Maximumquantity of animals suffering by leptospirosis among cattle has been noted in April (12, 69%); with seasonality index 2, 60; horses – in March (17, 4%); with seasonality index 2, 08; pigs – in August (17, 74%); with seasonality index 1, 77.

Besides farm animals, mammals of the order Rodentia also suffer from leptospirosis and in many oblasts of Kazakhstan people become infected from rodents.

Natural pre-immunization from leptospirosis focuses has been observed by us among horses at Almaty hippodrome, where there are synanthropic mammals in horse stables. Leptospirosis episodes at the contact between susceptible animals and occupants of natural leptospirosis focuses have been established at farm units of the West-Kazakhstan and Aktyubinsk oblasts, where carriage of pathogenic Leptospira has been noted in Arvicola terrestis and Microtus arvalis. At the same time in these oblasts, leptospirosis episodes were registered among people and farm animals.

Observations during a series of years allowed us establish that in the farm units conditions of Akmola oblast affected pigs, murine rodents and water of stagnant reservoirs are the main sources for spread of leptospirosis germs. At free mating infection of breeding sows from boars affected by leptospirosis is not inconceivable.

Natural leptospirosis focuses are often detected in more moisture places (water factor) with availability of field rodents and other mammals. 120 rodents trapped in the bottom of Kurkeles river (house mice, tamarisk gerbil, cricetids) and on the territory of farm houses in Saryagash district of South-Kazakhstan oblast (Rattus nozveqicus) have been serologically and bacteriologically examined for leptospirosis. From 75 sewer rats examined by serological method 20 species have Leptospira of L.pomona, L.hebdomadis and L. autumnalis serogroups[11-15].

In causation of animal and people diseases specific weight of separate serotypes can influence on characteristics of Leptospira biological properties (degree of stability in the ambient, virulence, biochemical, cultural and other properties). Leptospira beyond the pale even of one serological type possess by wide virulence. From the moment of discovery of leptospirosis germs it was established that Leptospira vary in agglutination reactions, i.e. they differ by serological properties. Stability of Leptospira antigenic properties served as a basis for development of serological diagnostics methods and became the basis for classification of Leptospira.

Different modifications of adsorption reaction are widely used for typing of Leptospira in many laboratories of foreign countries. This allowed determine strains found on the territory of CIS to the level of serotype and compare them with the world models [16- 20].

In this connection during leptospirosis study, we consider it is necessary both allocate not only strains and study them using modern research methods, particularly in the reaction of immunological adsorption. Determination of serotype view of leptospirosis germs allows open their true etiological structure, find ways for circulation ofLeptospira in the focuses and establish leading role of certain animal species as the main sources of leptospirosis infection.

Study of Leptospira strains identified in South-Kazakhstan and Akmola oblasts of Kazakhstan by immuno-adsorption analysis allowed for the first time determine etiological structure of Leptospira circulating on the territory of the Republic to the level of serological type. Antigenic analysis of local Leptospira strains pertaining to 6 serological groups showed that leptospirosis of people and animals in Kazakhstan is caused by Grippotyphosa serotype from Leptospira serogroup of the same name, by monjakov serotype from pomona serogroup, tarassovi serotype from serogroup of the same name, sorex-jalna serotype from Iavanica serogroup, canicola serotype from canicola serogroup, saxkoebinq and sejroe serotype from hebdomadis serogroup[21 - 24].

The next Leptospira serogroups are the main leptospirosis germs of animals: L. grippotyphosa, L.icterohaemorrhaqiae, L.pomona, L. tarasovi, L.canicola, L. Australis.

Certain serogroups dominate in different animal species:

- L.hebdomadis (55, 82%) andL.tarasovi (29, 46%) in cattle;
- L.pomona(78, 32%) andL.tarasovi (15, 2 %) in pigs;
- L. icterogaemorrhagiae (44, 11 %) and L.grippotyphosa (27, 96%) in horses;
- L.tarassovi (29, 69%); L.icterogaemorrhagiae (28, 99%); and L.grippotyphosa, (20, 95%) in small cattle;
- Anti-leptospirosis antibodies in rodents were detected in 100 % of cases to L.grippotyphosa serogroup.

Incourse of time etiological structure of cattle and pigs experienced significant transformations: L.grippotyphosa Leptospira was prevalent in the 70-80's, L.hebdomadis and L.tarassovi Leptospira was prevalent in the 90's; L.tarassovi serogroup in the beginning of the period and L.pomona serogroup at the end of the period were prevalent as the main leptospirosis germs of pigs.

Zonal features can be observed in the etiological structure of animal leptospirosis:

- cattle's: in the east zone –L.hebdomadis (56, 78 %); L.pomona (25, 72%) serogroups; in the west zone – L.hebdomadis (63, 13 %);L.tarassovi (16, 5%) serogroups; in the central zone – L.pomona (44, 28%); L.tarassovi (47, 2%) serogroups; and in the south zone – L.pomona (79, 37%); and L.tarassovi (13, 74%) serogroups; in the north zone – L.hebdomadis (64, 94 %);L.tarassovi (13, 74%) serogroups;
- pigs': in the east zone –L.pomona (63, 75%); L.tarassovi (19, 82%) serogroups; in the west zone – L.pomona (92, 9%) serogroup; in the north zone – L.pomona (58, 45%); L. tarassovi (18, 71%) serogroups; in the central zone – L.pomona (97, 14%) serogroup; and in the south zone – L.pomona (79, 37%); and L.tarassovi (12, 62%) serogroups[25- 28].

Registration of human leptospirosis in the Republic began in 1953. But from 1954 this disease sharply reduced almost in all oblasts of the Republic due to the timely actions taken (from 649 cases in 1954 to 14 in 1997). At that from 1973 to 1980 human leptospirosis in the Republic was low, while in 1980 its indexes increased in 3 times. In 1981 countrywide indexes of the disease were 2, 3 times higher than in the previous eight years and in 1982 index of the disease reduced in 1, 4 times. The episode sources are small rivers and channels infected by Leptospira from cattle and pigs. Infection of people occurred due to these water reservoirs. In 1982 – 1983, after Russia and Ukraine, Kazakhstan took third place among CIS-countries on quantity of human leptospirosis. The most of ill-behaved places were registered in these republics (Russia – 115, Ukraine – 34 and Kazakhstan – 26 cases).

In Kazakhstan in 1983, in 3 from 7 cases substantiated by laboratory researches there was detected human leptospirosis of L.icterohaemorrhaqiae serogroup at significant leptospirosis of farm animals in the Republic.

Meanwhile, in 1983 from the number of examined animals for microagglutination and lysis reaction in Almaty oblast 2, 3% were positive, in Taldykurgan oblast – 0, 4%, in West-Kazakhstan oblast – 1, 8%, in North-Kazakhstan – 35, 5%. According to these data, we can see that there was no contact between oblast sanitary and epidemiological stations and oblast vet-bac-laboratory.

In Kazakhstan human diseases in villages are not registered almost, that is explained by unsatisfactory diagnostics for this infection. So, in 1984 during retrospective laboratory examination by bodies of the republican sanitary and epidemiological station of cattle-raisers, cases when cattle-raisers suffered from leptospirosis were established in North-Kazakhstan oblast.

In the following 6 years (1989) 5 cases of human leptospirosis were registered in the Republic, index of the disease per 100 thousand of people was 0, 03% (1 case in East-Kazakhstan oblast – 0, 1%; 1 case in Akmola oblast – 0, 1%; and 3 cases in Almaty city – 0, 3%).

In 1994 only 1 sick was registered in the Republic in Almaty city. At the same time amount of positive results in the sample of material was 77 (3% from the whole amount of researches) and 65 positive results were at the research of blood serum in the incomplete hemagglutination reaction in North-Kazakhstan oblast. Positive results of blood sample were also detected in East-Kazakhstan oblast (11 samples).

In 1995, according to the data of the Republican sanitary and epidemiological station, 2 cases of leptospirosis were registered in the country: in Karaganda oblast and in Almaty city that does not correspond to the amount of positive results at carrying out of laboratory investigations. Special attention should be paid on the current situation in North-Kazakhstan oblast where during two years there was noted rising of titers both in the incomplete hemagglutination reaction and in the microagglutination and lysis reaction of several respondents.

Human leptospirosis in the Republic for the last 5 years was noted in the form of episode that was connected with presence of constant natural and also zoonotic focuses of this infection in several oblasts, unsatisfactory carrying out of animal disease control in the focuses of this disease and degree of infectiousness of farm animals.

Dynamics of the disease from 2007 on the oblast looks like as follows: 2007 – 68 cases of the disease that is 4, 5%, accordingly in 2008 – 84 cases of the disease that is 5, 72%, in 2009 – 33 cases – 2, 26%, in 2010 – 28 cases – 1, 94%, in 2011 – 14 cases – 0, 98%, in 2012 – 8 cases – 0, 97%.

In 2012 in the Republic of Kazakhstan 8 cases of leptospirosis among people were registered and index of the disease was 0, 05% per 100 thousand of population and 14 cases (0, 09%) were registered in 2011. 5 cases of leptospirosis among children were registered in 2012 and 4 cases in 2011. Reduction of the disease level in 2 times was noted in 2012 in comparison with 2011. All 8 cases of human leptospirosis were registered in East-Kazakhstan oblast where index of the disease was 0, 97%. 14 cases of the disease were registered in 2011 in this oblast.

Leptospirosis disease incidence in East-Kazakhstan oblast in 2012 was noted in all seasons of the year: 4 cases in Ust-Kamenogorsk city, 2 – in Ridder city, 1 – in Glubokovsk district and 1 – in Shemonaikha district. Most of all suffered children – the youngsters till 14 years old, index of the disease was 1, 82%. Lethaloutcome of the disease was not noted. People of all ages and professions suffered.

Wide spread of the germs was noted in the ambient medium of districts and oblastduring investigation of leptospirosis germs. Positive results of the researches on determination of antibodies and antigens have been obtained in 12 administrative territories of the oblast.

The research results allowed detect that the infection is carried over by food stuff, contaminated excrements of rodents – 5 cases (71, 4%), consumption of raw milk – 1 case (14, 2%), raw drinking water – 1 case, raw eggs – 4 cases (14, 2%).

By specific weight and view of leptospirosis cultures the detected cultures of Leptospira look as follows: L.grippotyphosa7(21, 8%), L. serotype ivanica 4 (12, 5%), L.pomona 4 (12, 5%), etc. and 12 kinds of germs have been detected.

At serological research of serum of suspicious diseases of human leptospirosis, positive results have been detected in 83 cases (6, 2%) from 1330 samples. Leptospirosis antigens have been detected in 3 samples at the research of 32 rodents.

CONCLUSIONS

- Leptospirosis of different animals in the Republic of Kazakhstan is registered serologically and bacteriologically almost in all geographical zones: in most cases among cattle and pigs, in less degree among horses and sheep, in individual case among camels. The disease incidence is the most widely spread in the south zone – 6, 1%, in the east zone – 4, 14%, in the north zone – 3, 1%, in the west zone – 2, 3%, in the central zone – 0, 8%.

- Identity of leptospirosis etiological structure of people, farm animals and rodents, which is generally presented by leptospirosis serogroups Grippotyphosa, Pomona, Tarasovi, Hebdomadis at the leading significance of the first two, has been detected.
- In accordance with the rules of international sub-committee on taxonomy and nomenclature of Leptospira, identification of local Leptospira strains isolated from people and animals in Kazakhstan has been carried out for the first time. It was established that Leptospira of people and animals are caused by 7 serotypes (Grippotyphosa, Tarasovi, monjakov, sorex-jalna, sejroe, Saxkoebinq, Canicola) from 6 serogroups (Grippotyphosa, Tarasovi, Pomona, Iavanica, Hebdomadis, Canicola).
- Thus, sizeable fluctuations in the frequency of animals' contamination by zones of the Republic and distinctiveness of the agents' etiologic structureare, apparently, conditioned by natural-climatic factors and specificity of the cattle management. Analysis of available by the issue works, personal investigations and observations, reports of local veterinary physicians allow state that episodes of the leptospirosis infections, i.e. geography of the leptospirosis, showed that this infection, as against other natural focal diseases, are met almost in all zones of the Republic of Kazakhstan. In correlation of animals' disease incidence by the leptospirosis with the map of Kazakhstan, a confinedness of diseased animals to the definite territories has been detected. Among the landscape zones, in amount of the registered diseased animals, the North zone (a forest steppe) bears the bell, then the South zone (pastures of mountainous area) and the West zone (steppe).

In some oblasts, such as Atyrau and Mangistau, the disease is not registered at all, in Karaganda and Kzylorda oblasts it is registered in small amounts. Territories of these oblasts are arid, a river net is poorly developed, rivers are typically steppe, in summers they usually dry, fall into separate pools with strongly mineralized saline water destructively influencing on generation and persistence of Leptospira. In conclusion, it is necessary to recognize that in future scientific researches a special attention should be paid to the spread of leptospirosis infection in the previously mentioned oblasts (Atyrau and Kzylorda).

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