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## PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY (Report VIII): Structure of a Zoonosis Nosoareal

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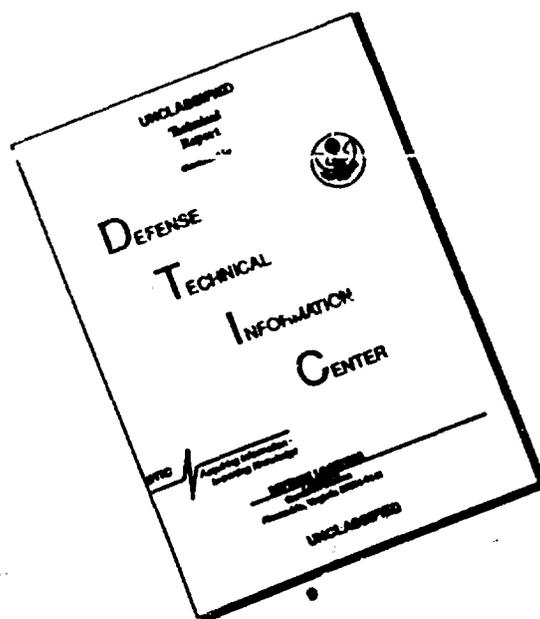
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PROBLEMS OF EPIDEMIOLOGICAL GEOGRAPHY  
Report VIII

Structure of a Zoonosis Nosoareal

[Following is the translation of an article by I. I. Yelkin and V. K. Yashchkul, I Moscow Medical Institute imeni I. M. Sechenova, published in the Russian-language periodical Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology) No. 12, 1966, pages 10-14. It was submitted on 22 June 1966. Translation performed by Sp/7 Charles T. Ostertag, Jr.]

The Main structural indices of a nosoareal are the focalness in the distribution of infectious diseases of man and their causative agents. The problem of the focalness of infections has been developed for quite a long time in the field of parasitology and is a very important division of contemporary epidemiology (Ye. N. Pavlovskiy, 1939, 1944, 1955, 1960, 1961, 1964; L. V. Gromashevskiy, 1941, 1949, 1965; I. I. Yelkin, 1951, 1960, 1962; P. A. Petrishcheva, 1955, 1959, 1965; V. N. Beklemishev, 1956, 1959, 1961; Yu. M. Rall, 1958, 1965; V. V. Kucheruk, 1959, 1960, 1965; A. G. Voronov, 1965, and others). For the resolution of this problem the greatest importance belongs to working out problems dealing with the population structure of the parasitic species, since there is a profound inner bond between the distribution of the infectious disease and the populations of the causative agent (V. N. Beklemishev, 1959, 1961).

The smallest territorial groupings of parasitic species are the elementary populations (according to V. N. Beklemishev, micropopulations and hemipopulations), which represent the population of parasites of a specific species in the individual organism of a host.

It is clear that an organism, populated by a concrete elementary population, may turn out to be the source of infection for other susceptible organisms, and with the realization of a concret mechanism of transmission may become an individual link in the epidemic or epizootic process. As a result of this, such an organism (source of infection) along with the susceptible organisms surrounding it, who are threatened by the danger of transmission of the infection, become the smallest elementary territorial unit of the epidemic or epizootic process. Such a territorial unit is defined as an epidemic (epizootic) focus.

A peculiarity of epidemic foci of zoonoses is mainly that here the source of infection are infested animals, as a result of which such a focus turns out to be a connecting link between infested animals and the

susceptible human collective, and the epidemic process of zoonoses will consist of a combination of individual cases of the infection of humans from animals (combination of epidemic foci), not connected with the common chain of human sicknesses (M. N. Solovev, 1955). It is true, in individual cases for a certain time under specific conditions the causative agents of zoonoses may be spread from man to man, minus the animal. For this reason the epidemic process changes its nature, becoming a chain of epidemic foci connected with each other (for example, during an outbreak of pneumonic plague, during severe forms of ornithosis). However, not having the conditions for maintaining the continuity of existence in human collectives, the causative agent in these cases inevitably dies and the epidemic process is interrupted.

Being a separate link of the epidemic process, highly migratory and variable, the epidemic focus cannot be the basis for the definition of the structure of a nosoareal. As M. N. Solovev (1955) correctly noted, concepts concerning an epidemic focus are connected not only with the source of infection and the territories within which there is the possibility of the realization of the transmission of the causative agent, but also with the very diverse and highly changeable conditions of the environment which determine its development. It is clear that the high degree of irregularity of these conditions means that in actuality the epidemic focus turns out to be extremely mobile, changing its territorial limits relatively rapidly, and rapidly springing up and disappearing. Due to this it cannot be accepted as the basic territorial (geographical) unit of structure for a nosoareal (V. K. Yashkul, 1965).

At the present time the concept is widely disseminated that the basic structural unit for the nosoareal of a zoonosis is the enzootic focus (during naturally focal zoonoses - natural focus). These concepts originated in connection with the fact that parasitologists, while studying enzootic (including natural) foci, for a long time concentrated their attention on the epizootological aspect of the problem, as a result of which for all practical purposes the epidemic process was lost from vision (V. N. Beklemishev, 1961). Epidemiologists also viewed the enzootic focus mainly from the positions of a source of infection, for which reason the structural units of a nosoareal of higher rank than an epidemic focus were practically not taken into consideration in their investigations. At the present time the epizootology and geography of the natural foci of many infections are being studied wholeheartedly as a matter of principle (see, for example, the investigations of N. G. Olsufyeva, 1960, 1965; Yu. M. Rall, 1958, 1965; V. V. Kucheruka, 1959, 1960, 1965; Ye. I. Ignatyeva, 1959, 1961, 1964; B. B. Prokhorova, 1964, 1965), but the nosogeography of naturally focal diseases in the main has been studied fragmentarily. In particular, when studying the nosogeography of naturally focal zoonoses, the territories within which the epidemic process is developing have dropped from the field of vision of the investigators.

In examining the epidemic process as a process of the interaction

between the human collective and the populations of causative agents, V.N. Beklemishev (1961) proposed that the problem of the geography of vector diseases of man be resolved from positions dealing with the formation of the causative agent populations in human collectives. Nevertheless a huge step was made forward in the area of studying the nosogeography of zoonoses. V. N. Beklemishev viewed foci of infection from the point of view of a complex spatial and functional differentiation into enzootic foci, forming among animal-hosts in the wild environment and in populated places, and also into foci, developing in human collectives (pseudofoci in "blind alley" zoonoses and dependent foci in zoonoses, the causative agents of which are capable for a certain period of time of spreading among humans). B. N. Beklemishev stressed that the study of such foci (for example, foci of cutaneous leishmaniasis of the agricultural type in populated points) and pseudofoci (for example, accumulations of micropopulations of the causative agent among humans during tick-borne encephalitis, Japanese river fever, tick-borne rickettsioses, etc.), their epidemiological analysis and inventory are the best methods for the selection of prophylactic measures and organizing an overall plan for improving the sanitary conditions of the territory.

Stemming from these virtually correct concepts concerning the formation of populations and pseudopopulations of zoonosis causative agents during the development of the epidemic process, we consider it necessary to turn special attention to the collective of humans, interacting in the epidemic process of zoonoses with the populations of the causative agent, to a study of the conditions and regularities in the development of the epidemic process of zoonoses. Here it is necessary to take into consideration that the epidemic process of zoonoses develops not only within enzootic foci, but also beyond their limits as a result of the infection being carried out by accidental carriers, as a result of the export of the products and raw materials from commercial animals, etc. It is also necessary to take into consideration that the complex and diverse activity of the human collectives condition very complex and diverse interactions with the enzootic foci. These interactions bear qualitatively peculiar features and are not subordinated to the regularities of development of the epizootic process. As V. N. Beklemishev (1961) noted, it is necessary to "sharply differentiate the epidemiology and epizootology of naturally focal infections".

At the present time the anti-epidemic service is carrying out extensive measures for preventing outbreaks of zoonoses among collectives of persons who are threatened with infection, regardless of whether or not those collectives are within a natural focus or beyond its limits. Here the main indication for carrying out prophylactic measures is not the area of distribution of the causative agent, but the collectives of people, entering in some way or other into an interaction with the causative agent. However, theoretically this problem has not been studied sufficiently (for example, when practice outstrips the progress of scientific investigations).

Thus, when studying the geography of zoonotic diseases of man, one cannot be limited to just the fixation of the prerequisites of the disease (enzootic foci). It is ~~just as~~ important to separate out the areas of interaction between the populations of the causative agent and the collectives of people, ~~in respect to which~~ it is necessary to carry out complex anti-epidemic measures. It is primarily these areas of interaction which are the main structural units of a zoonosis nosoareal. Since human incidence is concentrated mainly within the limits of such areas of interaction, they can be defined as nosofoci.

Designated as nosofoci should be those populated concrete geographical territories of a human collective, which on the strength of specific conditions of material life interact with the populations of the zoonosis causative agent.

The territorial interrelations of a nosofocus with an enzootic focus can be presented in the form of a diagram (see drawing). The enzootic focus in this diagram is represented in the form of an area of constant enzootics, surrounded by sectors of migration of the causative agent into neighboring territories (sectors for carrying out of epizootics), preserving, however, the continuity of the epizootic process. Epidemiological significance may also be had by cases of the "blind alley" carrying out of an infection beyond the limits of the enzootic focus (defined on the diagram by the dotted line), during which the epizootic process is broken in the end result.

It is apparent that the interaction between the human collectives and the populations of causative agent may be carried out within the entire enzootic focus, as a result of which such an enzootic focus turns out to be completely within the nosofocus (for example, anthropurgic enzootic foci or brucellosis). However, here the nosofocus may cover a considerably greater territory and thus not coincide with the borders of enzootic foci. Thus, a nosofocus of brucellosis may cover not only the territory within which the animal raising economy is located, but also those populated points outside of it which are supplied with the corresponding agricultural products.

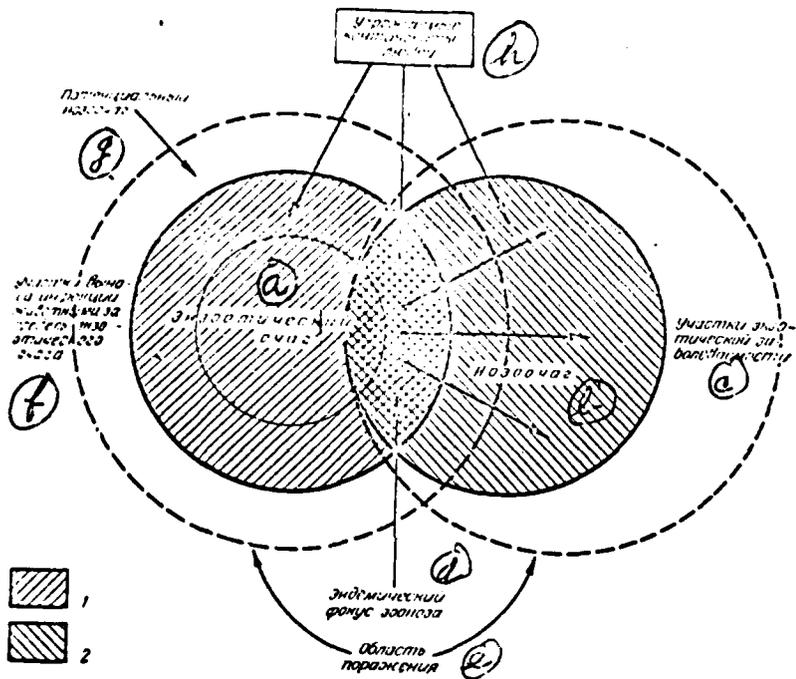
Together with this, cases when an enzootic focus is completely included in a nosofocus in a territorial respect are observed quite often. Considerably more often the interaction between the human collectives and the populations of the causative agent is carried out only within part of the enzootic focus (see diagram), while its remaining territory represents a potential nosofocus, and the epidemiologically active sectors - an endemic focus (center) of the zoonosis. It is namely the endemic focus of the zoonosis which is the basis of existence of the nosofocus, since within it the causative agent is being reproduced constantly.

When studying the geography of zoonoses it is necessary to distinguish the area of affection, that is, the aggregate of territories within which the given causative agent is encountered. Apparently this area turns out to be situated primarily within the nosofocus and the potential nosofocus. However, the causative agent of a particular zoonosis may be detected beyond its limits, in territories where the infection has been carried out both by animals beyond the borders of the enzootic focus and by man beyond the borders of the nosofocus.

In the formation of a nosofocus particular importance belongs to the threatened contingents of humans, which at the present time are not interacting with the populations of causative agents, and consequently are not included in the composition of the nosofocus, however, on the strength of the presence of specific social-economic conditions such an interaction may prove to be realized in the near future (for example, members of geological prospecting parties while out prospecting, in a number of cases day workers, and also migrants, etc.). By entering into an interaction with the populations of the causative agent, such collectives may increase the quantitative indices of the nosofocus (for example, morbidity), change its borders or create a new nosofocus.

There is no doubt that the conditions and paths of formation of nosofoci, and also the factors stipulating their borders, are very unique for each zoonotic infection. They will depend both on the distribution of the enzootic focus and the nature of the epizootic process, and on the social-economic conditions of life of the people entering into the interaction with the enzootic focus. Here the very same social-economic conditions during different infections, and sometimes with the same infections in different territories, exert a different influence on the formation of a nosofocus. For example, the nature of industrial activity may be leading in the formation of nosofoci of tularemia and brucellosis, the nature of dwellings - in the formation of nosofoci of rodent plague, and habits and customs of the population - in the formation of nosofoci of opistorchosis. In its time the use of Mongolian bobak meat as food was one of the most important factors in the formation of several nosofoci of plague in eastern Eurasia, while in India the basis for the formation of plague nosofoci turned out to be the peculiarities of the dwellings, which permitted them to be occupied on a large scale by rats and fleas.

There is a significant theoretical and practical importance in the study of nosofoci as the main structural units of a nosoareal and the paths and regularities of their formation. In the area of the theory of epidemiological nosogeography a comprehensive study of nosofoci should create a firm scientific base for clearing up the structure of a nosoareal. This will make it possible to strengthen and expand the methods of prophylaxis being developed, taking into consideration the concrete peculiarities in the geography of zoonoses within individual territories.



Schematic of the territorial interrelations of a nosofocus with an enzootic focus (particular case, when in a territorial respect these foci do not coincide in connection with the presence of a potential nosofocus and a sector of the nosofocus outside of the limits of the enzootic focus).

1 - enzootic focus; 2 - nosofocus.

a - enzootic focus;

b - nosofocus;

c - sector of exotic morbidity;

d - endemic focus of the zoonosis;

e - area affected;

f - sector where the infection was carried out by animals beyond the limits of the enzootic focus;

g - potential nosofocus;

h - threatened contingents of people.