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EPIDEMIC CHARACTERISTICS OF ERYSIPELAS MANIFESTATION IN CONDITIONS OF NORTHWESTERN BLACK SEA REGION

Проведені дослідження з епідемічного прояву бешихи (1961–2014 рр.), як інфекційної нозоформи, довели її здатність до динамічної зміни сапрозоонозного та зоонозного типів поширення. Значна схожість епідемічних характеристик прояву зоонозної бешихи серед міського і сільського населення на ландшафтно різних ділянках території та в різних соціально-економічних умовах вказує на наявність стабільно активних і універсальних джерел інфекту, прямо або опосередковано пов'язаних із мишоподібними гризунами та продукцією тваринництва. За результатами аналізу показників епідемічної інтенсивності зоонозної бешихи на території регіону виділено 3 зони з різною епідемічною активністю. Встановлено різницю у рівнях епідемічного прояву бешихи серед сільського та міського населення від 12,7 до 14,4 %. До основних груп ризику зі зараження бешихою належать особи віком 35–45 та 60–75 років й старші, серед професійних груп підвищений ризик інфікування виявлено у працівників підприємств переробних, галузі тваринництва та харчування. Абсолютне переважання нашкірних і суглобових уражень в області пальців свідчить про основне значення контактного і травматичного інфікування. Одночасно зберігається й ключова роль провідного фактора передачі інфекту – контамінованого Erysipelothrix rhusiopathiae м'яса й субпродуктів свійських свиней. Визначено чітко виражені піки прояву епідемічної сезонності бешихи – навесні та восени. У ряді випадків прояв бешихи мав ознаки факторної природно-осередкової інфекції з типово зоонозним поширенням, що, як правило, характерно для найбільш зволожених років з високою щільністю польових гризунів.

Ключові слова: *північно-західне Причорномор'я, сапрозооноз, епідемічний прояв, структура захворюваності, сезонність, зоонозна бешиха, факторна інфекція.*

Erysipelas is quite known and well spread infectious pathology of domestic animals and human, it's distributed on great majority of the world, especially in countries situated in the zone of moderate climate [1, 6]. The clinical specificity and clear species predisposition of this infection to domestic pigs allow us to confidently trace historical data of epizootic and epidemic manifestations of this disease for at least during last millennium. Clinical signs of this disease are know from Middle Ages, but for the first time a human form was described only in 1873 by W. Baker [4]. Despite a significant progress in the control of the majority of zoonotic infections, erysipelas is still practically identical for amounts of manifestation to indexes of last century, which show us a permanence of the potential of main sources and reservoirs of the pathogen [23].

Zoonotic erysipelas as individual infectious nosoform of human (code A26 for ICD – 10) has a great variety of synonymic names: cutaneous erysipeloid, erysipelas, Baker's creeping erythema, Rosenbach's erysipeloid, naturalists' rubella, mouse erysipeloid [2, 10, 19, 20].

In veterinary pathology the disease is commonly known as swine and sheep erysipelas, among which enzootic and sporadic outbreaks are often take place. It belongs to the group of typical zoonoses of bacterial nature. Though today erysipelas is one of the most described and successfully prevented animal infection, but in purely epizootic regard, approaches to understand it specificity have a lot of contradict issues [1, 2, 5, 7, 12].

Etiology and nosology independent zoonotic erysipelas was for the first time defined by A. Rosenbach in 1884 during examination of clinically sick people with typical signs of skin and joint lesions. It's proven that infective agent is fixed, Gram-positive, rod bacteria without spores called *Erysipelothrix rhusiopathiae* – representative of the family Corynebacteriaceae. Most reference books reported the existence of two antigenic variants of *E. rhusiopathiae* (*suis ma murisepticum*). In overall, the "swine" variant is circulating among domestic, and "mouse" – among wild animals [3, 9, 11, 15, 17]. The presence of these variants causes ambiguous interpretation of the key epizootic characteristics of this infection pathology. Thus, the perception of the possible existence of pathogens that are able to initiate clinically similar disease in domestic and wild animals can't be explained in environmental terms. Pathogenic agents of infectious diseases seek to cause latent forms in primary reservoir. They are greatly limited by body barriers, and activity of their hotbeds also limited by complex mechanisms of biocenotic self-regulation. In the farm hotbeds septic (in young stock) and local sub-acute (in adult stock) forms of infectious process are prevailed. Of course, representatives of different eco-groups of erysipelas agents should have opposite properties and lead by different initiative factors. However, in practice strains of both variants are able to initiate typically zoonotic and saprozoonotic spreading process, and even, depending on conditions of enzootic hotbed, they can change their circulation character. From this, a logical conclusion that "swine" variant of erysipelas agent is most likely only reverse-selected species-adapted form of wild strain, and it's not an individual ecotype with formed antigenic specificity [12, 13, 21].

Detailed investigation of ecological and epizootological aspects of primary manifestation of eryzipelas whithin natural resorvoir were conducted in the middle of last century by coryphaeuses of soviet theoretical school. Eryzipeloid was investagated in natural hotbeds by T.N. Dunayev, N.G. Olsufyev, O.S. Emelyanova, V.V. Kucheruk. They have formed basic ideas about this infection, as a typical factor of biocenotical self-regulation in conditions of middle lattitudes of Eurasia [18].

Unfortunately, so far there were no researches of erysipelas' hotbed on such level. Thus, main energies of researchers in veterinary medicine were concentrated on creation of effective vaccines, and in human medicine – on developing of diagnostical test-systems and medication. And so the question about existence of clinical forms of infection, as resulting variants of ecological regularity of interaction of macro- and microorganisms in specific conditions remainig out of sight.

Respectively, **the main purpose of this work** is to investigate ecological and epizootic characteristics of eryzipelothrix manifestation in conditions of Northwestern Black Sea region. One of the **main goals** is analytical generalization of data about ecological and epizootological characteristics of cases of illness or isolation of *E. rhusiopathiae* culture from animals and objects of environment during 1961–2014. The object of research work is phenomenon of epidemic manifestation of zoonotic erysipelas, **subject** – investigation of ecological and epizootological characteristics of it.

Materials and methods. Main materials for conducting of analytical generalizations were accumulated during exploration of report materials regarding to cases of diagnostics and epidemic investigations on the territory of Odessa, Mykolaiv, Kherson region during 1961–2014. Since 1961, when erysipelas was for the first time added to list of infectious human diseases, which belong to obligatory registration, was used for comparative investigation [19, 22].

During the given period were investigated zoological, stational, epizootic and landscape-biotopical characteristics of available geographical zones and provinces of Northwestern Black Sea region. Annual reports of veterinarian and sanitary-epidemiological services of taken regions were analyzed, also were analyzed reports

of laboratories and research institutions, which were engaged in control of soils and climatic conditions. One of the key materials was 27 cultures of *E. rhusiopathiae* which were isolated from different sources of the region during 2009–2014.

During processes of laboratory examination of animals were conducted more than 3 thousand of primary expertise, including 708 autopsies, 318 bacteriological, 19 biological and 2011 serological.

There were using entirely standard methods described in NSU, instructions and attitudes regarding to conducting of laboratory-diagnostic investigation in search of *E. rhusiopathiae*. All results were subject to statistical processing and further analytical generalization using power of modern electronic calculating tools and methods of operative landscape mapping based on remote-space probing [8, 16].

Research results and their discussion. Epidemic situation, in sense of reflection of influence on it of indexes of epizootic tension of situation with zoonotic erysipelas, is little informative, but it probably shows general sanitary conditions of the population in different landscape- and socio-economic conditions of the region (Fig. 1).

Generalized information about landscape specificity of values of epidemic intensity of zoonotic erysipelas on the territory of some regions and districts of Northwestern Black Sea region is very interesting and demonstrative for epidemiological analysis of generally-regional situation. Thus, a stable tendency to high infection activity in zones of river valleys (zone 1) directly points on the epidemic value of saprozoonotic and water sources of the pathogen. Their potential is provided by existence within them of powerful natural reservoirs of the pathogen, which are kept by wild (exanthrope) murine rodents. Respectively, especially for landscape and geographical areas, it is possible to specify multicomponent chains of pathogen transmission of sapronotic (reservoir species → water → soil → human) and saprozoonotic (reservoir species → water → soil → nutriment → domestic animals → human) types.

In arid coastal and plain Dnieper regions situated on salt and red soils (zone 2) and don't have any water and near-water biotopes, so they don't provide necessary conditions for surviving of agent in soil. Also there are no important

Fig. 1. Landscape and geographical specificity of epidemic manifestation of zoonotic erysipelas in the region during 1961–2014, on 100 thousands of people:
1 – steadily the highest intensity (9,0–16,7);
2 – steadily the lowest intensity (1,9–2,5);
3 – unstable infection manifestation (5,9–7,0)

conditions for successful functioning of natural reservoirs of the pathogen, which are represented by dense populations of murine rodents. Respectively, amounts of epidemic manifestation of zoonotic erysipelas within these landscape and geographical areas are remaining steadily low, and it is possible that the bulk of infecting is associated with animal products.

The zone 3 covers mainly plain areas of anthropogenically transformed zone of steppe, which are differ by elevation level in conditions of developed chain of arroyo. Latter provide periodical humidifying of fertile black and meadow-black soils with weakly-alkaline pH level, which are optimal for long-term agent preservation. Thus, existence of soil hotbeds constantly assists migration of the pathogen and its circulation in system "soil → plants → rodents → domestic animals → human", while forming mainly zoonotic nature of epidemic spreading of disease. Such a situation is directly depend on climatic and agriculture measures to limit potential of main sources of the pathogen – soil, plant nutriment (with prevalence of root crops), exanthrope and synanthrope rodents. On the background of poly-active sources of the pathogen, epidemic manifestation of zoonotic erysipelas is held on relatively high level, reaching outbreak level in certain years, when conditions for their simultaneous activity combination appear. Such phenomena occur every 3–4 years, causing corresponding tension of epidemiological situation and reaching intensity indexes of level 16,5 and more.

Generalized data concerning total amounts of epidemic intensity of disease manifestation in different groups of population (urban and rural) in Northwestern Black Sea region during period 1961–2014 is shown with graphics on Fig. 2.

Perennial dynamics of indexes of intensity of disease (Fig. 2) in general point on high level of erysipelas spreading in the region and high infecting frequency among humans. On the background of other diseases of this group such as brucellosis, salmonellosis, leptospirosis, the leadership is held by erysipelas. Thus, during 60s the main intensity on the edge of 7,0–15,0 was kept by salmonellosis, zoonotic erysipelas, brucellosis, leptospirosis. Later, in 70s the index of erysipelas manifestation was rapidly falling, but indexes of salmonellosis became to grow, on the background of which levels zoonotic erysipelas and leptospirosis didn't have big amplitudes. From the beginning of 80s were registered only few cases of brucellosis, but indexes salmonella manifestation were growing and reached levels of 24,3–28,5 and even 35,0 in cases per 100 thousand of people, becoming an apparent leader in the group of zoonoses. Leptospirosis and erysipelas during this period didn't acquire any significant changes, but in general were holding relatively high activity [5, 14].

So far zoonotic erysipelas was holding 3–4th place by level of spread in group of zoonoses on the territory, giving way only to salmonellosis, yersiniosis, and listeriosis. There is a notable difference (from 12,7 to 14,4 %) between levels

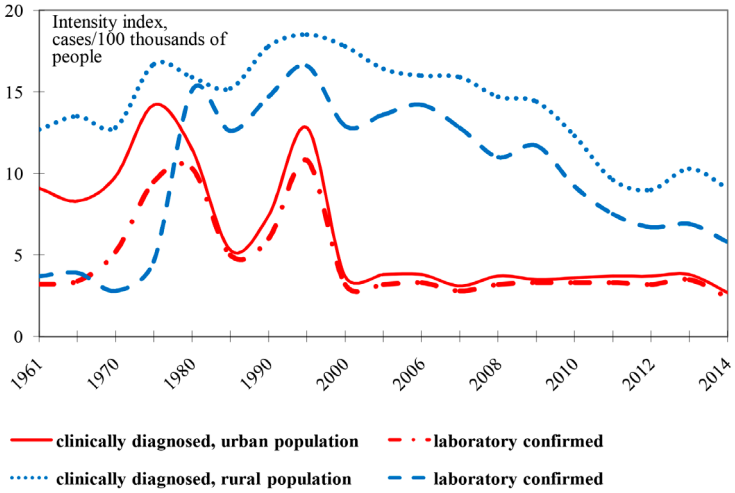

Fig. 2. Epidemical intensity of manifestation of zoonotic erysipelas in the region (1961–2014)

of epidemic manifestation of erysipelas among urban and rural population, which during last years has reduced in size. It is certain that this phenomenon is caused by infecting animals and humans from common sources of the pathogen, so the epizootic and epidemic situation, in this case, is limited by, first of all, activity of these sources and levels of their relationship with certain animal species (directly) and human (directly and indirectly).

Indexes of intensity of erysipelas manifestation during given period are significantly (on 25–130 %) lower in Southern part of Ukraine than analogical in majority of European countries and European part of Russia [2, 5, 23].

The analysis of generalized data of perennial accounting of epidemic manifestation of zoonotic erysipelas shows a great level of diagnostic competence of doctors, which are successfully made primary diagnosis according to clinical and anamnesis data, effectively differentiated disease from clinically similar systemic erythema of streptococcus etiology. Practically identical dynamics of indexes of laboratory approved diagnoses of the erysipelas infection among urban and rural population during 60s of last century show us limitation of conditions for laboratory expertise, when the majority of cases were diagnosed only by clinical signs. In another words, there were no faulty diagnostically process, but a technical underestimation of disease manifestation by laboratory methods.

The analysis of age structure, gender (Fig. 3) and professional dependence (Fig. 4) on erysipelas manifestation is done based on review and statistical generalization of reported data and medical histories. Results of this generalization are based on specifying of fashion index (biostatistics), which most significantly demonstrates amounts of affection of different age groups, which is shown on Fig. 3.

Results of analytical generalization (Fig. 3) show us almost full absence of erysipelas cases in children of age group before 5 years, which practically don't contact with sources of the pathogen. Slightly frequent but also rare the disease was diagnosed in children of age before 10, in teens and generally among young people before 20 (average intensity 0,1/100 thousand). Forth amounts of contamination are rapidly increasing in parallel to age groups and reach their maximum among representatives of age group of 35–45 years, and don't show any significant difference among women and men. Indexes of intensity are decreasing in older age groups and stabilize in group of 56–75 years old.

Thereby for urban and rural population the main groups of risk are adult of working group (35–45 years old) and older working group (56–70 years old and older). In all age groups that are

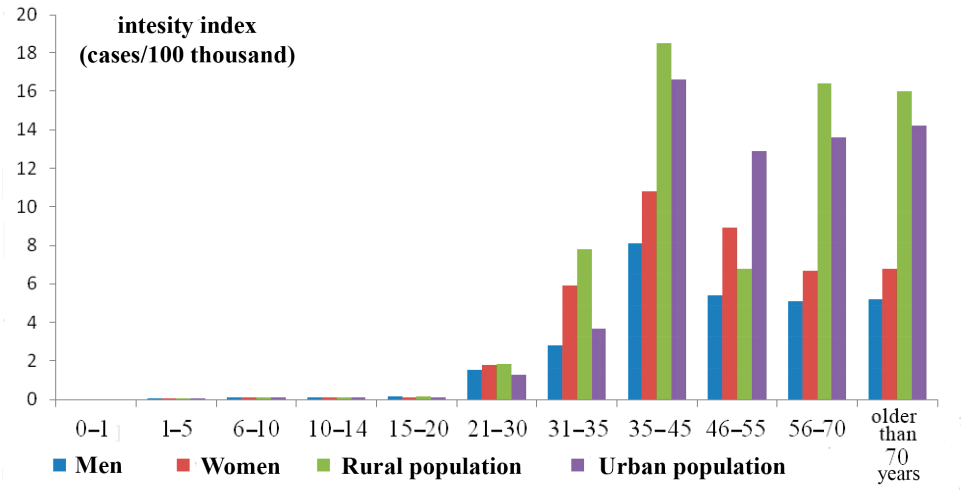

Fig. 3. Age and gender structure of urban and rural population morbidity with erysipelas (1961–2014)

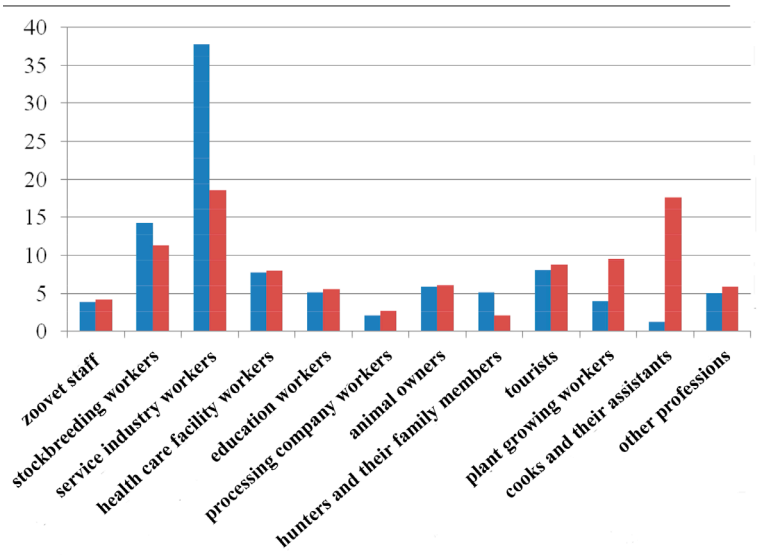

Fig. 4. Professional structure of epidemic manifestation of zoonotic erysipelas, %

older for 20 years, it's well expressed predominance (on 3–11 %) of contamination in women, which indicate on their often infecting during culinary preparation of meat and meat products. As for older age groups, significantly high frequencies of contamination are caused by age and physiological age peculiarities are likely to be caused by immune system defence decrease.

In professional regard (Fig. 4) all indexes of erysipelas contamination during 1961–2014 are also shown via fashion, and constantly leading representatives of three professional groups: processing companies' workers, agriculture workers and housewives.

Percentage, shown on the picture 4, for different professional groups carry only indicative character, due to not so much professional risk level, but to social and sanitary conditions of the region's population. Herewith, there is relatively increased level of infecting exclusively for representatives of professional groups, who are directly or indirectly contact with domestic or wild animals and their products. In group of danger are also housewives and women, who

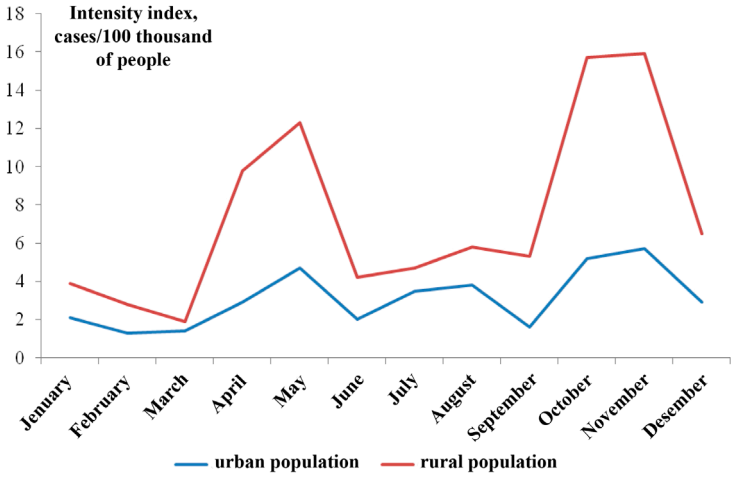

Fig. 5. Epidemic seasonality of erysipelas manifestation on the territory of the region (1961–2014)

work in dining. Of course, that among some of professional groups (stock breeding workers, zoovet staff, animals' owners etc.) prevail rural contingent.

It's credibly that in rural places there are higher infection risks due to not so professional frequency of contacts with animals, but to variety of pathogen sources (wild, domestic and synanthrope animals, soil, water, animal products, food etc.).

As for urban population an almost single cause of infection is meat and meat products, which are vitally and secondary contaminated with *E. rhusiopathiae*.

The seasonality of zoonotic erysipelas cases registration during 1961–2014 in the region is shown on graphics on Fig. 5. Obtained data concerning population changes of reservoir species, the level of contact of human with main sources of the pathogen (rodents, domestic pigs) and transmission factors (meat, by-products, fur and wool products).

Of course, in some seasons, e.g. before New Year holidays and during spring and autumn field work, amount of such contacts also increase, which is reflected in intensity of morbidity among rural and urban population.

Distinct seasonal peaks in May most likely caused by recreation activity of people and optimization of conditions of alimentary infecting while outside, where it is hard to keep elementary hygiene precautions.

Conclusions

1. The researches to specify basic laws of epidemic manifestation of erysipelas in the territory of Northwestern Black Sea region during 1961–2014 allow us to characterize it as an infection nosoform, which is able to dynamically change of saprozoonotic and zoonotic type of spreading.

2. A significant similarity of epidemical characteristics of manifestation of zoonotic form of erysipelas among urban and rural population on different landscapes areas of the territory and in different socio-economic conditions indicate the presence of active and universal sources of pathogen, directly or indirectly related to rodents and livestock products.

3. Stable conservation among sick representatives of age group of 35–45 years old and absolute predominance among them of cutaneous and joint lesions localized in fingers, indicates the main value of contact and traumatic infecting. At the same time also saved a key role of leading factor of pathogen transmission – pork meat and by-products contaminated with Erysipelothrix rhusiopathiae.

4. In a number of cases erysipelas has signs of factorial nature-located infection with typically zoonotic spread, which usually takes place in the most humid years with a high density of field rodents.

***Prospects for further research** are consist in detailed study of etiologic specificity of epidemic manifestation of zoonotic erysipelas in the region, which allows its successful nonspecific (due to avoidance of contact with the main sources of transmission and factors pathogen) and specific (use of vaccines on threatening contingent) prophylaxis.*

References

1. *Ананьина Ю.В.* Природно-очаговые бактериальные зоонозы: современные тенденции эпидемиологического проявления / *Ю.В. Ананьина* // ЖМЭИ. – 2002. – № 6. – С. 86–90.

2. Бактериальные и вирусные зоонозы: Доклад комитета экспертов ВОЗ // Серия технических докладов ВОЗ. – Женева, 2007. – № 682. – 218 с.

3. *Беляев Е.Н.* Концепция санитарно-эпидемиологического надзора и медико-эколого-географическое районирование / *Е.Н. Беляев, В.Д. Беляков* // Региональные проблемы и управление здоровьем населения России. – М., 1996. – С. 16–26.

4. *Беляков В.Д.* Эпидемиология / *В.Д. Беляков, Р.Х. Лфаев*. – М.: Медицина, 1989. – 416 с.

5. *Бобильова О.О.* Сучасна епідеміологічна та соціально-гігієнічна ситуація в Україні / *О.О. Бобильова* [та ін.] // Сучасна інфекція. – 2002. – № 2. – С. 4–7.

6. *Воронин Е.С*. Рожа свиней: профилактика и меры борьбы / *Е.С. Воронин, М.В. Романова*. – М.: Изд-во ВНИИТЭИагропром, 1987. – 115 с.

7. *Голева О.П.* Здоровье сельского населения в условиях активных миграционных процессов / *О.П. Голева, С.В. Вяльцин, Н.Е. Вяльцина* // Проблемы соц. гигиены, здравоохранения и истории медицины. – 2002. – № 4. – С. 12–15.

8. *Далматов В.В.* Применение методов математической статистики при проведении эпидемиологического анализа / *Далматов В.В., Готвальд Р.Н., Стасенко В.Л.* – Омск, 2002. – 68 с.

9. *Дунаева Т.Н*. Изучение эпизоотии эризипелоида среди водяных крыс в природных условиях / *Т.Н. Дунаева, О.С. Емельянова В.В. Кучерук* // Вопросы краевой, общей и экспериментальной паразитологии и мед. зоологии; под ред. И.Г. Галузо. – М.: Изд-во АН СССР, 1953. – Т.8. – С. 175–181.

10. Ежегодник ФАО/ВОЗ/МЭБ по болезням животных за 2011 год. – Париж: WHO, 2011. – 173 с.

11. *Карасева Е.В.* Методы изучения грызунов в полевых условиях / *Е.В. Карасева, А.Ю. Телицына*. – М.: Наука, 1996. – 227 с.

12. *Коренберг Э.И.* Основы современных представлений о природной очаговости болезней / *Э.И. Коренберг* // РЭТ-ИНФО: журнал. – 2000. – № 3. – С. 18–20.

13. *Кучерук В.В.* Структура, типология и районирование природных очагов болезней человека / *В.В. Кучерук* // Итоги развития учения о природной очаговости и дальнейшие задачи их изучения; под ред. А.А. Барояна. – М.: Медицина, 1972. – С. 180–212.

14. Стан захворюваності на інфекційні та паразитарні хвороби в Україні у 2003 році / *О.В. Лапушенко* [та ін.] // Сучасні інфекції: журнал. – 2004. – № 2. – С. 4–8.

15. Эпидемиологические аспекты экологии бактерий / *В.Ю. Литвин* [и др.]. – М.: Фармарус-Принт, 1998. – 256 с.

16. *Лопач С.Н.* Статистические методы в медико-биологических исследованиях с использованием Excel / *Лопач С.Н., Чубенко А.В., Бабич П.Н*. – К.: Морион, 2000. – 320 с.

17. *Овасапян О.В.* Каннибализм как фактор распространения возбудителей эризипелоида, туляремии и чумы среди обыкновенных полевок / *О.В. Овасапян, В.О. Галоян, К.А Аракелян* // Грызуны и их эктопаразиты. – Саратов: "НПО Микроб", 1968. – С. 122–125.

18. *Олсуфьев Н.Г.* Об эпизоотологии рожистой инфекции среди грызунов и насекомоядных / *Н.Г. Олсуфьев, Т.Н. Дунаева* // Вопросы краевой, общественной и экспериментальной паразитологии и мед. зоологии. – 1951. – Т. 7. – С. 244–276.

19. *Павловский Е.Н.* Современное состояние учения о природной очаговости болезней человека / *Е.Н. Павловский* // Природно-очаговые болезни человека. – М.–Л.: Медгиз, 1960. – С. 6–40.

20. *Палтышев И.П.* Общая эпидемиология и основы доказательной медицины: руководство к практическим занятиям / *Палтышев И.П., Филатов Н.Н.*; под ред. *В.И. Покровского, Н.И. Брико*. – М.: ГЭОТАР-Медиа, 2010. – 400 с.

21. *Perotska L.V.* Ekological-epizootic features of sapronose infections (on the example of listeriosi and erysipelas) / *L.V. Perotska, V.V. Nedosekov* // Ветеринарна медицина України. – 2014. – № 5. – С. 15–18.

22. *Терских В.И*. Сапронозы (о болезнях людей и животных, вызываемых микробами, способными размножаться вне организма во внешней среде, являющейся для них местом обитания) // Журнал микробиол., эпидэмиол. и иммунобиол. – 1958. – № 8. – С. 118–122.

23. Сайт ВОЗ в Интернете. [Электронный ресурс]. − Режим доступа: http://www.who.int

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