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EPIDEMIOLOGICAL ASPECTS OF TRAINING ECOLOGISTS IN UKRAINE

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The article substantiates the need to study the issues of ecological epidemiology and epizootiology as the basic components of the formation of professional competencies of future ecologists in the current circumstances. Anthropogenic changes in the environment are subject to comprehensive study, and it is also necessary to apply new innovative approaches in the training of specialists-ecologists. To be successful, specialists-ecologists need to gain knowledge not only from professional disciplines but also the related ones. The article states that the priority in the training of specialists is compliance with industry educational standards. The ecological component in case of outbreaks of emergent diseases among the population, domestic and wild animals is considered. The progress of epidemiological diseases affects the mechanisms of population regulation, as well as the structure, functions, and components of the ecosystem, its connections. Examples of such emergent processes as African swine fever among wild and domestic animals, the affection of coniferous plantations by bark beetles, and the spread of the planetary scale of the zoonotic SARSCoV-2 virus are considered. The results of the analysis of the sectoral standards of higher education in Ukraine, as well as some curricula, working programs are given. Certain aspects of ecological epidemiology can be studied by students while studying such disciplines as “Human Ecology”, “Environmental Safety”, “Plant Ecology”, “Animal Ecology”. The place, structure, and content of the new discipline “Ecological Epidemiology and Epizootiology” in the curriculum for training bachelors of ecology is specified. The educational and methodic set is developed, which includes lecture materials, practical works, tests, and modular tasks. Also, a brief description of the content of the modules of the discipline “Ecological Epidemiology and Epizootiology” is given in the article. *Key words:* ecological epidemiology and epizootiology, professional competencies of ecologists, the health of the population.

Епідеміологічні аспекти підготовки екологів в Україні. Волошина Н.О., Шевченко В.Г., Лазєбна О.М., Волошин О.Г.

У статті обґрунтовано необхідність вивчення питань екологічної епідеміології та епізоотології як базової складової формування професійних компетентностей майбутніх екологів у сучасних умовах. Антропогенні зміни навколишнього середовища підлягають всебічному вивченню і також потрібно застосовувати нові інноваційні підходи у підготовці фахівців з екології. Для успішної діяльності екологам необхідно отримати знання не тільки з фахових дисциплін, але і суміжних. В статті зазначено, що пріоритетним напрямком у підготовці фахівців є відповідність галузевим освітнім стандартам. Розглянуто екологічну складову при виникненні спалахів емерджентних захворювань населення, домашніх і диких тварин. Розвиток епідеміологічних захворювань впливає на механізми регуляції чисельності популяцій, на структуру, функції і компоненти екосистеми, а також на її численні зв'язки. Розглянуті приклади таких емерджентних процесів, як африканська чума диких і свійських свиней, ураження хвойних насаджень жуками-короїдами, розповсюдження планетарного масштабу зоонозного вірусу SARSCoV-2. Наведено результати аналізу галузевих стандартів вищої освіти України, деяких навчальних планів, робочих програм. З окремими аспектами екологічної епідеміології студенти можуть бути ознайомлені під час вивчення навчальних дисциплін «Екологія людини», «Екологічна безпека», «Екологія рослин», «Екологія тварин». В статті визначено місце, структуру та зміст нової дисципліни «Екологічна епідеміологія та епізоотологія» у навчальному плані підготовки бакалаврів екології. Розроблено навчальний та методичний комплекс: лекційний матеріал до курсу, практичні роботи, тестові завдання, завдання для модульних контрольних робіт. У статті подано коротку характеристику змісту модулей дисципліни “Ecological Epidemiology and Epizootiology”. *Ключові слова:* екологічна епідеміологія та епізоотологія, професійні компетенції екологів, здоров'я населення.

Statement of the problem. In the modern world, environmental factors play an increasing role in the formation of public health. The degradation of the environment directly affects human health and life span. It became obvious that the features of the structure and dynamics of human diseases, their occurrence and outcome, are directly related to global transformations of natural ecological systems and phenomena in society.

Anthropogenic factors significantly change the properties of pathogens of infectious and parasitic diseases. Thus, natural disasters, local military conflicts, migration processes, urbanization – all these create conditions for the formation and functioning of new biotopes of pathogens of diseases or the introduction of new pathogens and their vectors that are not inherent to the specific territory, which occur together with an intensification of biological pollution, antibiotic

resistance, etc. In such conditions, the new hotbeds of diseases are formed and spread (AIDS, SARS, COVID-19, avian flu (H1N1), spongiform anemia, the Ebola disease, etc.), and the already known socially dangerous infections return (tuberculosis, cholera, typhoid, etc.), which ultimately lead to real crises and need the operational transformation of focuses in healthcare [4, 6].

Today, biological pollution needs more and more attention. An important aspect of improving health, both an individual and society, is the familiarization of the general population with probable biological risks, their manifestations and consequences, as well as with modern methods of prevention. Also, special attention needs to be paid to the regularities of the development of pathogens of a non-infectious nature and risk factors in the occurrence of oncological, cardiovascular, allergic, and occupational diseases. A significant number of poisonings with heavy metals, pesticides, nitrates, etc. are recorded annually [3].

Most researchers tend to believe in the subsequent unpredictable anthropogenic transformations of the environment and the ‘man-made evolution’ of the epidemiology of diseases. The current situation requires accumulation, scientific analysis, and forecasting of regularities of the epidemiological process in the current circumstances, as well as a rethinking of tactics and approaches in solving specific epidemiological problems.

Relevance of the study. Modern times require changes in approaches to the training of highly qualified specialists-ecologists, the formation of their knowledge and skills for an objective assessment, effective prevention and solving of environmental, in particular, environmental and epidemic problems. The introduction of innovative approaches in the field of well-balanced use of natural resources and environmental protection to the professional training of ecologists is necessitated by the need to update the content and search for the new methods and means of training that improve the professional and practical training of ecologists in higher educational institutions of Ukraine [1, 2, 6].

Highlighting of previously unsolved parts of the main problem to which this article is devoted. The purpose of the research is to determine the feasibility, role, and place of ecological and epidemiological knowledge in the system of training students-ecologists of the specialty ‘Ecology’.

Novelty. The level of knowledge and the range of professional competencies of graduate students-ecologists regarding the issues of environmental epidemiology are determined; systematization, generalization of scientific and methodological information took place to prepare the curriculum on such basis, which includes corresponding disciplines of the selective part of the cycle of professional and practical training.

Methodological or general scientific significance. This review will contribute to the development

and implementation of results of the research in the educational process of training of future ecologists.

Presentation of the main material. In our days, the problems of ensuring the epidemic well-being of the population in all spheres of human life have ceased to be the prerogative of the medical and sanitary-epidemic services. The tension of ecological, epidemiological, and epizootic situations requires intersectoral integration and improvement of training of specialists in higher educational institutions, who can solve applied environmental problems. The directed orientation of the content of the educational process should be focused on environmentally rational use of natural resources in the context of human health as the main criterion for the feasibility and efficiency of all spheres of economic activity of the countries of the world without exception [2].

At the same time, human health problems are rarely mentioned in environmental programs and programs of sustainable development, and often environmental protection measures are in direct conflict with the canons of human health, creating serious environmental problems. Thus, the implementation of individual environmental projects has created favorable conditions for the spread of dangerous human diseases. For example, the formation of urban hotbeds of tick-borne encephalitis is associated with the attraction of chipmunks with their companions – ticks – to city parks and the simultaneous refusal to threaten parks with insecticides. The increase in cases of Lyme disease, caused by microorganisms-borrelia, is related to the increase in the number of deer, which are protected by the law. Mass epidemic outbreaks of cercariasis (cercarial dermatitis) are caused by the reproduction of wild ducks in urban water bodies [2, 6].

From an ecological point of view, the manifestation of emergent diseases is a biotic mechanism for regulation of the size of the population of species and reflects the disturbance of structure, functions of the components of the ecosystem, its resistance, and the disturbance of evolutionarily formed connections.

In Ukraine, an example of such emergent outbreaks is African swine fever among wild and domestic animals. As of 2021, 540 cases of the disease are reported, 117 of which are among wild boars. The high contagiousness of the disease and the rate of the spread lead to a threatening situation in pig farming [3, 7].

Another telling example is related to the ecological catastrophe in Ukrainian forests, namely, the affection of coniferous plantations by the parasitizing of bark beetles (the family *Scolytidae*). The split-second and uncorrelated reproduction of these pests (*Ips acuminatus* (Apical bark beetle) and *Ips typographus* (Engraver beetle)) are associated by the researchers with global climatic changes, i.e., an increase in the sum of effective temperatures, a decrease in snow cover in winter, and an increase in the growing season [5].

At the same time, it is impossible to ignore the pandemic caused by the penetration of the zoonotic

SARSCoV-2 virus from the natural biocenoses from bats to humans. The control of emergent outbreaks is rather limited since the population of new host-pathogens lacks the regulatory and inhibiting mechanisms of the epidemic process [7].

All the abovementioned and other examples are vivid evidence of the fact that to solve urgent practical problems, ecologists need integrated knowledge from related specialties, including a deep understanding of mechanisms of formation and functioning of hotbeds of natural focal infections.

In such a case, the traditional approaches and methods of educational activities in the system of training specialists-ecologists need to be rethought, revised and restructured, since they do not provide the need for acquiring the knowledge necessary to solve vital environmental problems and to implement the program of a balanced development effectively.

The priority direction of training specialists-ecologists is compliance with industry standards, the generalized object of which is the organization of events aimed at ensuring well-balanced use of natural resources and protecting the environment from excessive anthropogenic impact. Bachelors and masters with the qualification "Ecologist" are the specialists trained to provide services in the crop and livestock production, management in the social sphere, in particular, the management of programs aimed at increasing the well-being of people in the fields of health care, environmental protection, education, culture, sports, construction of housing, etc. At the same time, the involvement of ecologists in solving the real problems of environmental management specified above should include a thorough theoretical training and provide for the acquisition of necessary skills and interdisciplinary synthesis of modern ecology, toxicology, chemistry, and epidemiology by the students.

Therefore, a new direction is developing in world and domestic science – ecological epidemiology. This is a science that studies the influence of natural, anthropogenic, technogenic, and social factors of the environment on the health and well-being of the population [4, 6]. The rapid development of this discipline is related to the urgent need to solve the tasks of defining, identifying, and assessing the influence of a whole complex of negative environmental factors, their medical and biological consequences in dynamics, and quantitative indicators.

Most universities in Ukraine that train ecologists do not have special courses, which form competencies related to knowledge and understanding of the conditions for the emergence and spread of ecologically caused diseases among the population and animals. To some extent, the issues of environmental epidemiology are included in training programs for medical workers, and certain aspects related to ecological epizootiology (animal diseases) are studied by the students of veterinary and biological faculties.

The analysis of the sectoral standards of higher education in Ukraine, as well as available curricula and working programs for the training of ecologists (both bachelors and masters), has revealed the absence of disciplines or content modules reflecting the task of epidemic epidemiology. Partially, certain aspects of ecological epidemiology can be covered in the disciplines "Human Ecology", "Environmental Safety", etc., although a decrease in the number of classroom hours does not fully ensure the formation of the necessary competencies.

The Department of Ecology in National Pedagogical Dragomanov University has developed and, starting from 2015, introduced into the educational process the discipline "Ecological Epidemiology and Epizootiology" for the bachelors of the specialty "Ecology". A training manual has been prepared, which contains lecture material and practical work, as well as situational tasks, modular tasks, and examination papers. Also, an online version of the course at the university's service Moodle has been developed to ensure students' distance and individual work. The purpose of the educational discipline "Ecological Epidemiology and Epizootiology" is to help students to learn the basic ideas about the regularities of influence of the complex of natural and socio-economic environmental factors on the health of the population, the emergence and spread of diseases, epidemics, pandemics, as well as to learn about the methodology of a comprehensive medical and environmental assessment of specific territories.

6 ECTS credits are reserved for the study of the discipline, which is 180 hours. This academic discipline consists of 2 modules: "Ecological Epidemiology and Epizootiology of Infectious Diseases" and "Ecological Epidemiology of Non-Infectious Pathologies". The theoretical material included in the first module is divided into six topics and acquaints students with the history of the formation of the scientific discipline "Ecological Epidemiology and Epizootiology", the prerequisites for its emergence, terminological apparatus and basic definitions, scientific theories, concepts, and regularities of development of the epidemic process. Also, the issues of the triad of factors, the formation and functioning of the epidemic process, epidemiological hotbed and its indicators, are considered in detail.

The parasitic systems as the components of biocenosis, their organization, models, types, and properties are considered separately, as well as an ecological component that ensures the stability of the "parasite-host" systems.

The second module includes five topics, which reflect modern trends in the epidemiology of diseases of non-infectious origin, the causes and conditions for the occurrence of vector-borne, emergent diseases, mixed and associated pathologies, the development and spread of which is related to the technical progress and the constantly deteriorating environmental situation. Special attention is paid to the development of epidemics among the population in

the territories affected by natural disasters and environmental disasters, as well as to the ways of control and prevention of environmentally dependent pathologies.

The topic “Ecological Epidemiology of Non-Infectious Diseases” discusses in detail the role of chemical elements and substances in the development of non-infectious pathology, provides real examples of the influence of an anthropogenic factor on the development of such diseases as “multiple chemical sensitivity”, “black heel”, “Itai-Itai”, Minamata and Yusho diseases, asbestos disease, etc.

The large-scale development of nanotechnology in the world, as well as the pace of research, development, and production of nanomaterials (fullerenes, metal nanoparticles, nanotubes, etc.) significantly exceeds the acquisition of knowledge about their toxicological and exposition aspects. The range of manufactured nanotechnology products is quite wide, starting from electronic equipment to personal hygiene products; from disinfectants to the creation of nanomaterial-based filters and membranes for the purification of water, drinks, air; from feed additives and crop protection products to packaging materials and food.

In this regard, when presenting the course, the authors pay special attention to modern, little-studied factors as a potential source of environmental risks in the formation of the epidemiological process. Considering the increasing production volumes of nanomaterials, the authors use in their material the advanced experience of foreign specialists in managing nanotechnological risks in production, limiting the negative impact of nanoparticles on the health of personnel, as well as the emissions in the technological area, and the pollution of the environment.

A separate topic is devoted to the study of epidemiological situations arising in emergency natural (earthquakes, floods, forest fires, etc.) and anthropogenic (military conflicts, acts of terrorism and bioterrorism, industrial accidents, etc.) situations.

During the practical training students: analyze the ecological and epidemic situation in Ukraine on the example of a specific region; determine the cause-and-effect relationships in the occurrence of epidemics and epizootics; determine the mechanisms of transmission

of pathogens and the conditions for the occurrence of emergent, transmissible pathologies, epidemics during technological disasters, environmental disasters, emergencies; analyze the risks to public health caused by the influence of unfavorable environmental factors. The theoretical knowledge gained by the students during the study of the discipline “Ecological Epidemiology and Epizootiology” is aimed at developing the ability to assess various components of the environment, foodstuff, risks related to the influence of unfavorable anthropogenic factors in constantly changing conditions of our time.

The course also provides for independent and individual work of the students based on an in-depth study of the main provisions and partial regularities with the use of additional educational and scientific literature, the information provided on the Internet, the selection and analysis of the information, necessary for writing an essay and preparing a report. Individual situational tasks on environmental and epidemic topics ensure learning, generalization, and systematization of the material, and its practical application in a real situation, which contributes to the formation of students' professional competencies.

Thus, the realities of social, economic, and environmental transformations of social development outline some problems; in particular, the urgent problem of our time is the training of highly qualified personnel in the field of ecology, who are capable of solving specific practical environment and epidemic situations in the context of human health. Bringing the competence of future ecologists in line with the world standards requires improvement, reform, and modernization of education, including the development of new innovative courses.

Main conclusions. The improvement of the professional training of ecologists in the aspect of epidemiological and epizootic problems of our time can be realized by introducing the practice of teaching the discipline “Ecological Epidemiology and Epizootiology” in the training of ecologists. The expediency of teaching the course is grounded, the subject and content of lectures and practical classes in accordance with specified professional competencies are determined.

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