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Traditional and new in the content and technique of ukrainian regional nosogeographic mapping

Anatolii Kornus*

Candidate of Sciences (Geography), Associate Professor of General and Regional Geography Department
e-mail: a_kornus@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Olesia Kornus*

Candidate of Sciences (Geography), Head of General and Regional Geography Department
e-mail: olesyakornus@gmail.com; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Mykyta Konovalov

MSc, Lecturer of the Department of Social Sciences and Economics
e-mail: mykyta.konovalov@gmail.com; ORCID ID: <https://orcid.org/0000-0002-7377-1936>
Polarsirkelen High School, Murbakken 1, Mo i Rana, 8622, Norway

Olena Danylchenko*

Candidate of Sciences (Geography), Senior Lecturer of General and Regional Geography Department
e-mail: olena_danylchenko@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Olena Korol*

Candidate of Sciences (Pedagogy), Senior Lecturer of General and Regional Geography Department
e-mail: korolelena1976@gmail.com; ORCID ID: <https://orcid.org/0000-0003-0175-3824>

*Sumy State Pedagogical University named after A.S. Makarenko, Romenska Street, 87, Sumy, 40002, Ukraine

The aim of the article is to outline the traditional classification of nosogeographic maps and suggest additions to it. These additions are formulated, taking into account the changes that have occurred in the classification of nosologies, the source base and technical capabilities of mapping, as well as in the organization of the system of medical care for the population.

Main material. The authors have analysed peculiarities of the content and specifics of making nosogeographic maps. They have established the fact that computerization of the health care facilities, including primary medicine ones, makes it possible to carry out very detailed types of nosogeographic mapping, taking into account more advanced methods of medical and statistical data processing, which are a source of information in compiling such maps. It becomes possible to draw new nosogeographic maps by using individual address accounting data with flexible selection of territorial units over which averaging is carried out. Thus, we can obtain characteristics not only for administrative units, but also for individual houses, their groups, micro-districts (communities), etc.

Conclusions and further research. The cartographic method has extremely wide possibilities in the implementation of nosogeographic analysis, since each group of diseases has its own chorological and chronological specificity. Its use allows us to predict the existence of specific factors (indicators of the environmental situation, level of medical care, sociodemographic indicators, etc.) that determine the morbidity rate. Cartographic models can be used in strategies for socioeconomic development of regions, special events, aimed at reducing the level of certain types of diseases, rational territorial organization of medical care system for the population. The authors believe that the classification of nosogeographic maps, and, accordingly, the structure of nosogeographic mapping, as well as the topic of cartographic plots, should be supplemented by the following three varieties. Firstly, these are demographic and nosogeographic maps. They convey differences in the morbidity of people according to demographic and sociodemographic indicators of the population. These maps analyze gender, age, nationality, other factors of population susceptibility to certain types of diseases. Secondly, there are physiological-nosogeographic maps, which, in addition to the morbidity of the inhabitants of a country or region, transmit certain indicators of physical development and health of certain population groups. Thirdly, nosogeographic maps should also include maps of road traffic accidents.

Keywords: thematic mapping, nosocartography, nosologies, nosogeographic maps, mapping, classification of maps.

Анатолій Корнус, Олеся Корнус, Микита Коновалов, Олена Данильченко, Олена Король

ТРАДИЦІЙНЕ І НОВЕ У ЗМІСТІ Й МЕТОДИЦІ УКРАЇНСЬКОГО РЕГІОНАЛЬНОГО НОЗОГЕОГРАФІЧНОГО КАРТОГРАФУВАННЯ

Метою статті є викласти традиційну класифікацію нозогеографічних карт і запропонувати доповнення до неї. Зазначені доповнення сформульовані з урахуванням змін, що відбулися в класифікації нозологій, джерельній базі і технічних можливостях картографування, а також в організації системи медичної допомоги населенню.

Основний матеріал. У статті показано місце нозогеографічного картографування в сучасній структурі загально-медико-географічного картографування. Проаналізовано особливості змісту й укладання нозогеографічних карт. Встановлено, що розвиток комп'ютеризації медичних установ, у т. ч. ланки первинної медицини, дозволяє проводити дуже детальні види нозогеографічного картографування з урахуванням більш досконалих методів обробки медико-статистичних даних, які є джерелами інформації при складанні таких карт. З'являється можливість створення нових нозогеографічних карт, у т. ч. з використанням даних індивідуального адресного обліку, з можливістю гнучкого вибору територіальних одиниць, за якими проводиться усереднення. Це дозволяє отримувати характеристики не тільки для адміністративних одиниць, а й для окремих будинків, їх груп, мікрорайонів тощо.

Висновки і подальші дослідження. Картографічний метод має надзвичайно широкі можливості при проведенні нозогеографічного аналізу, оскільки кожна група хвороб має свою хорологічну і хронологічну специфіку. Його використання дозволяє прогнозувати наявність конкретних факторів (показників екологічної ситуації, рівня надання медичної допомоги, соціально-демографічних показників та ін.), що визначають рівень захворюваності. Картографічні моделі можуть бути використані при розробці стратегій соціально-економічного розвитку регіонів, проведення спеціальних заходів, спрямованих на зниження рівня окремих видів захворювань, раціональну територіальну організацію системи надання медичної допомоги населенню. На наш погляд, класифікацію нозогеографічних карт і, відповідно, їх структуру, а також тематику картографічних сюжетів слід доповнити такими трьома різновидами. По-перше, це демографічні та нозогеографічні карти, які відображають відмінності захворюваності людей у зв'язку з демографічними і соціально-демографічними показниками населення. Ці карти призначені для аналізу статевої, вікової, національної та іншої сприйнятливості населення до певних захворювань. По-друге, це фізіолого-нозогеографічні карти, які, крім захворюваності жителів країни або регіону, передають окремі показники фізичного розвитку і здоров'я певних груп населення. І, по-третє, до числа нозогеографічних карт мають входити і карти дорожньо-транспортних пригод.

Ключові слова: тематичне картографування, нозокартографія, нозології, нозогеографічні карти, картографування, класифікація карт.

Анатолій Корнус, Олеся Корнус, Микита Коновалов, Елена Данильченко Елена Король

ТРАДИЦИОННОЕ И НОВОЕ В СОДЕРЖАНИИ И МЕТОДИКЕ УКРАИНСКОГО РЕГИОНАЛЬНОГО НОЗОГЕОГРАФИЧЕСКОГО КАРТОГРАФИРОВАНИЯ

Цель статьи – изложить традиционную классификацию нозогеографических карт и предложить дополнения к ней. Указанные дополнения сформулированы с учётом изменений, произошедших в классификации нозологий, источниковой базе и технических возможностях картографирования, а также в организации системы медицинской помощи населению.

Основной материал. В статье показано место нозогеографического картографирования в современной структуре общего медико-географического картографирования. Проанализированы особенности содержания и составления нозогеографических карт. Установлено, что развитие компьютеризации медицинских учреждений, в том числе звена первичной медицины, позволяет проводить очень детальные виды нозогеографического картографирования с учётом более совершенных методов обработки медико-статистических данных, которые являются источниками информации при составлении таких карт. Появляется возможность создания новых нозогеографических карт, в том числе с использованием данных индивидуального адресного учёта, с возможностью гибкого выбора территориальных единиц, по которым проводится усреднение. Это позволяет получать характеристики не только административных единиц, но и отдельных домов, их групп, микрорайонов и т. д.

Выводы и дальнейшие исследования. Картографический метод имеет чрезвычайно широкие возможности при проведении нозогеографического анализа, так как каждая группа болезней имеет свою хорологическую и хронологическую специфику. Его использование позволяет прогнозировать наличие конкретных факторов (показателей экологической ситуации, уровня оказания медицинской помощи, социально-демографических показателей и др.), определяющих уровень заболеваемости. Картографические модели могут быть использованы при разработке стратегий социально-экономического развития регионов, проведении специальных мероприятий, направленных на снижение уровня отдельных видов заболеваний, рациональную территориальную организацию системы оказания медицинской помощи населению. На наш взгляд, классификацию нозогеографических карт и, соответственно, их структуру, а также тематику картографических сюжетов следует дополнить следующими тремя разновидностями. Во-первых, это демографические и нозогеографические карты, которые отображают различия в заболеваемости людей в связи с демографическими и социально-демографическими показателями населения. Эти карты предназначены для анализа половой, возрастной, национальной и другой восприимчивости населения к определённым типам заболеваний. Во-вторых, это физиолого-нозогеографические карты, которые, помимо заболеваемости жителей страны или региона, передают определённые показатели физического развития и здоровья определённых групп населения. И, в-третьих, в число нозогеографических карт должны входить и карты дорожно-транспортных происшествий.

Ключевые слова: тематическое картографирование, нозокартография, нозологии, нозогеографические карты, картографирование, классификация карт.

Introduction. As it is known, one of the main indicators of life quality is indicators of the health status of the population and development of the health care system. The cartographic method is an extremely successful tool for assessing the geographical regularities of forming these indicators, their territorial differentiation. For example, we have established the dependence of cardiovascular diseases spread on the complex of natural factors, based on the cartographic method [1]. This gave an impetus to the development of nosogeographic mapping – one of the areas of medical-geographical mapping, the task of which is to develop methods and techniques for using cartographic methods in studying and generalizing medical-geographical information in the form of cartographic works.

Deterioration of the population's living standards, increase in primary morbidity and general prevalence of diseases determine the need for further development of nosogeographic mapping, especially regional one. There is also the need to clarify the geographical features of their distribution among residents of various administrative units of Ukraine. The latter draws attention to the peculiarities of nosogeographic maps content (mapping objects, topics of new cartographic plots), taking into account the latest opportunities and the specifics of compiling such maps. This includes studying localization of certain diseases and the factors of their natural and social environment that cause them, compiling interactive maps of various contents, in particular, morbidity forecast design maps, etc.).

All of this, as well as the need to develop of medical-geographical zoning of Ukraine makes the study of regional nosogeographic mapping important and relevant.

The aim of the article is to outline the traditional classification of nosogeographic maps and suggest additions to it. These additions are formulated, taking into account the changes in the classification of nosologies, the source base and technical capabilities of mapping, as well as in the medical care organization for the population.

Ukrainian geographers and cartographers do not often address issues of content and features of the compilation technique of nosogeographic maps, although this section of cartography has a long history. One of the first in this context was the work of S. A. Podolinsky "Life and Health of People in Ukraine", published in 1878 in Geneva [12]. In it, the author emphasized that health depends on the circumstances of life, primarily on the state of the environment. The maps of general and child mortality of the population published in the "Atlas of Ukraine and neighboring lands" by V. Kubyovych [1] became the first examples of Ukrainian medical-geographical mapping. Among the later cartographic works, "Ukrainian SSR. Territories for Recreation and Treatment of the Population" [13], atlas "Malignant Neoplasms in the Ukrainian SSR (Recommendations for Medical-Geographical Analysis)" are worth mentioning [3]. The works of L. Rudenko, A. Parkhomenko, V. Peresad'ko, A. Bochkovskaya, K. Pirozhenko and others,

were devoted to mapping the state of public health in connection with the quality of the environment. A monograph by V. Shevchenko [15] theoretically generalizes the results of these studies.

Among modern scientific papers examining various aspects of the content and techniques of compiling regional nosogeographic maps, we can highlight the work [8], the author of which received nine nosogeographic maps of the Kirovohrad Region. The works by V. Gutsulyak, under whose leadership nosogeographic zoning of the territory of the Chernovtsy Region, as well as by Yu. Kushniruk about Rivne Region, and others, especially by V. Peresad'ko [10] are devoted to issues of regional nosogeographic mapping. S. Tkachenko created nosogeographic maps of the morbidity and spread of coronary heart disease, steno cardia, myocardial infarction among residents of Ukraine, as well as population mortality from these nosologies. A. Kornus et al created numerous nosogeographic maps of Sumy Region [6, 7].

V. Peresad'ko described the elaboration procedure of medical-ecological maps of settlements, using mathematic-cartographic and geographic information modelling methods [11]. New views appear on the object, subject, and tasks of medical geography, its structure, and then the place of nosocartography in it. For example, O. Shabliy (2001) believes that its object is the forms of the geographical organization of the health sector. In particular, it is territorial medical systems – from grassroots to global, and the subject of research is the spatial organization of society aspects that have a direct impact on the health of its representatives, as well as health itself (in other words, the spatial structure of the health sector).

Materials and methods. The material includes previously published medical-geographic works. In particular, these are interdisciplinary theoretical works in the field of thematic cartography, mathematical-cartographic modeling, as well as a number of medical-demographic and nosogeographic maps and atlases developed by the authors and other researchers, created in Ukraine.

Analysis of nosogeographic maps classifications showed the need for their additions taking into account the changes in the nosologies classification, the source base and technical capabilities of mapping, as well as in organization of medical care system for the population.

Analysis of cartographic publications has showed that the sources of background information for the nosogeographic maps vary depending on the territorial level (local, regional, national) and include statistical data predominantly. Statistical sources best meet the requirements for the initial information because they are readily available, comparable, and collected, using standardized methods. They also contain reference for administrative units as well as cover long periods, thus allowing selecting time intervals for analysis with consideration of specific natural and socio-economic changes. In some cases, statistical data represent the only acceptable sources of information for mapping.

Computerization of the health care facilities, including primary medicine, makes it possible to carry out very detailed types of nosogeographic mapping, taking into account more advanced methods of medical and statistical data processing. They are sources of information for compiling such maps. It becomes possible to create new nosogeographic maps by using individual address accounting data, with the possibility of flexible selection of territorial units over which averaging is carried out. Thus, we can obtain characteristics not only for administrative units, but also for individual houses, their groups, microdistricts (communities), etc.

Results and discussion. As the above analysis of publications shows, medium- and small-scale maps of the actual spread of diseases and the primary morbidity of the population – health maps occupy central place in the modern nosogeographic mapping. The information content of such maps is usually low and, to a large extent, they are only a cartographic expression of medical statistics. The content of such maps is compiled according to the information of the territories (sites) of polyclinic service, reports of treatment and prevention facilities and health-care institutions. In other words, such nosogeographic maps are created not according to specific, but averaged data from medical statistics, which can lead to a loss of information content, pseudo-compensation of the morbidity/prevalence indicators of diseases, “erosion” of factors that cause certain diseases. All this complicates the search for the causes of the population morbidity.

Therefore, there is a need to develop large-scale nosogeographic mapping, from the level of administrative regions, medical districts, to more detailed territorial coverage. This determines the goal of our work – to analyse new features of the content and specifics of compiling of nosogeographic maps, taking into account the opportunities that have appeared in recent decades.

Nosogeographic maps convey the territorial differences in the population morbidity, prevalence of diseases, as well as their relationship or conditionality (dependence) on the characteristics of the geographical environment, including its quality in the environmental aspect (nosoecological maps). Using simple software tools of GIS-technologies (for example, MapInfo) or manual mapping, cartograms, or map, diagrams of the population’s morbidity are easily compiled.

These maps are closely related to other groups of medical-geographical maps. Among the latter are environmental maps (influence of the geologi-

cal and geomorphological structure, climate, vegetation, areas of distribution of dangerous animals, including risk of infection with infectious diseases from them), social and living conditions that affect the morbidity level in the population. Another group consists of medical service cards (cards of the organization of the health care system), which provide the population with general and specialized medical care, a network of health-care institutions and their availability (mapping of service areas) as well as the health-care institutions: sanatoriums, resorts, dispensaries recreation centres, etc.

Computerization of health-care facilities, including primary medicine allows to have detailed views of nosogeographic mapping, taking into account more advanced methods of processing medical and statistical data as a source of information in compiling such maps. It becomes possible to create new nosogeographic maps by using individual address accounting data with the possibility of flexible selection of territorial units over which averaging is carried out, how it is done in other countries (for example, [2]) (Fig.1).

Most importantly, a morbidity level according to the contingents of workers of a certain enterprise or occupation, based on the fact that it is the working conditions of people, and the level of workplace safety are an important cause of the emergence and development of many diseases. Fig. 2 shows the main sources of data. It is important that data from different sources are commensurate to provide reliability of

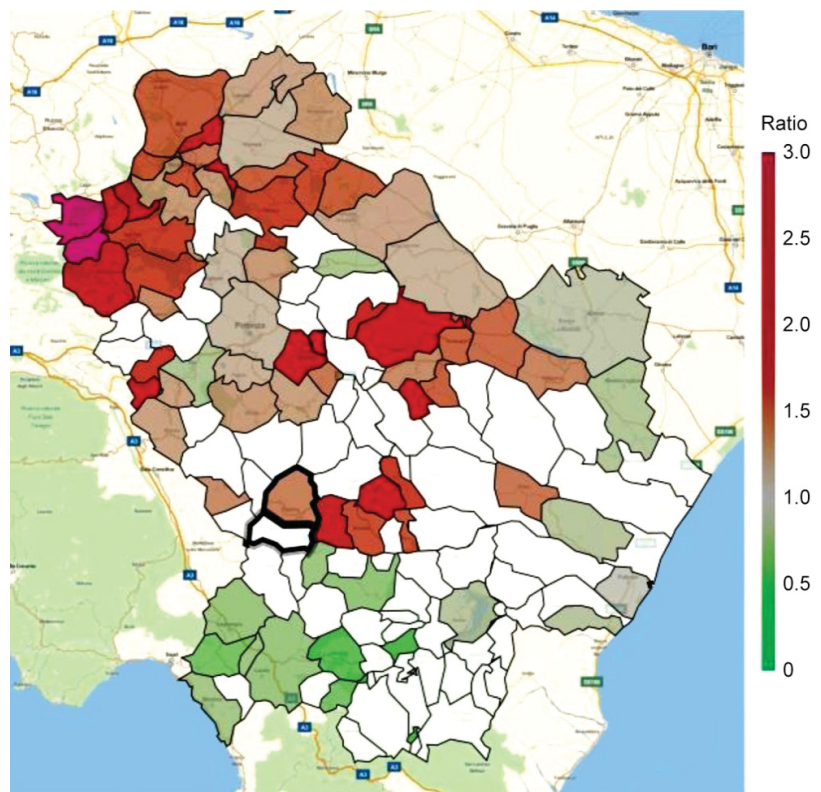


Fig.1. Standardized hospitalization ratio for respiratory diseases in each municipality of Basilicata for the time period 2001–2013 [2]

the mapping, compatibility and comparability across regions/districts. This means that data should be collected in a comparable manner, with the same definitions of individual indicators, etc. Additional sources of information should be consulted as much as possible. The mapping may be done even at the households' level, but personal data about health of someone should be kept confidentially.

This will allow us to move away from the use of unnatural administrative-territorial units in nosogeographic mapping and to avoid cartographic illusions of geographical contrasts of the morbidity of their limits (although it is hardly possible to completely agree with the radical opinion of E. Feldman that a map "compiled on an administrative basis only confuses the researcher" [14]. Unambiguously, this approach is much more informative; it will become possible to identify and map self-organizing territorial heterogeneities, in particular, by gradation of disease prevalence levels.

Another important problem of nosogeographic mapping is the question of a substantive nature, firstly, an explanation of the territorial differences/heterogeneities of the morbidity levels of the population or prevalence of diseases identified by the cartographic method [5]. These problems, on the one hand, are associated with the complexity of a person's relationship with the natural and social environment surrounding him/her. On the other hand, - with the disadvantages of maintaining medical statistics. This is especially true of nosoecological maps – indicators of environmental quality (levels of the atmosphere, soil pollution, the quality of drinking water or food), although they are recognized as an important factor affecting health of the population. They are very weakly correlated with the morbidity rate of residents, and then only for individual nosologies. It is believed that nosogeographic maps convey the state of public health as the most reliable integral criterion for the environmental impact on the human body. However, it often turns out that diseases that, at first glance, should be significantly dependent on the quality of the environment, are not directly related to environmental factors. Moreover, the high correlation coefficients, cited in some works, between the morbidity rates of population by certain nosologies and environmental pollution levels, do not find further confirmation in other regions.

With this in mind, an important element of nosogeographic mapping, its preparatory and justifying stage should be factor analysis, which makes it possible to identify factors that determine the geographical differences in the morbidity. In general, factors of the natural and social environment, both positively and negatively affecting the state of human health, should become the main subject of not only nosogeographic, but also medical-geographical mapping as a whole. Therefore, with nosogeographic mapping, there is a need to analyse the geographical (natural, social, environmental, industrial, socioeconomic) prerequisites for the occurrence of diseases and the prevalence of diseases among residents,

typical of natural and industrial-territorial complexes surrounding people and their combinations.

The same applies to external factors, first of all, road traffic injuries, among which there are three groups: the *human-related factor* – drunk driving, violation of the rules of the road by drivers and passengers; the *vehicle-related factor* – the number and condition of cars, etc.; and the *environment-related factor* (factor characterizing the conditions of the road traffic) – density of roads, their quality, condition of the road surface, etc. [5].

We should distinguish between the following groups among the above maps of nosological factors: maps of geological and biogeochemical endemia; bioclimatic maps, showing the impact of climate on human health. Such maps can indirectly characterize the immigration situation, because the indigenous population is usually more or less "homogeneous", adapted to their native climatic conditions. Maps of soils show a specific medical and geographical specificity (for example, the content of important trace elements and macroelements); maps of the properties of groundwater and surface water and the characteristics of their impact on the human body). Maps of biota and its impact on public health (for example, the circulation of pathogens). Maps of the social environment should consider the living conditions of the population, especially their social environment, the presence of stressful conditions, the prevalence of bad habits among residents, the level of employment and income of the population.

In contrast to maps of nosological factors, nosogeographic maps (maps of the geographical prevalence of diseases) show the territorial differences in the morbidity of the population and the prevalence of diseases, their dynamics in the spatio-temporal aspect. In other words, while maps of nosological factors convey the prerequisites for the emergence and spread of diseases, nosogeographic maps primarily show the territorial differentiation of diseases. Their classification (typology) should be based on international classifications of nosologies, in particular, ICD-10, which also underlies the division of diseases by specialists and medical statistics authorities, – for example, maps of the morbidity of malignant neoplasms, the prevalence of cardiovascular diseases, etc.

It is worth noting that in May 2019, the World Health Organization (WHO) introduced the new international classification of diseases ICD-11 for adoption by Member States at the next session of the World Health Assembly. This classification will come into force on January 1, 2022. Accordingly, the classification of nosogeographic maps will undergo some changes, because the ICD-11 includes new sections, in particular, concerning complementary (traditional) medicine (although millions of people around the world use complementary medicine methods, it has not yet been represented in this classification). Another new section in it is devoted to sexual health – it combines diseases and

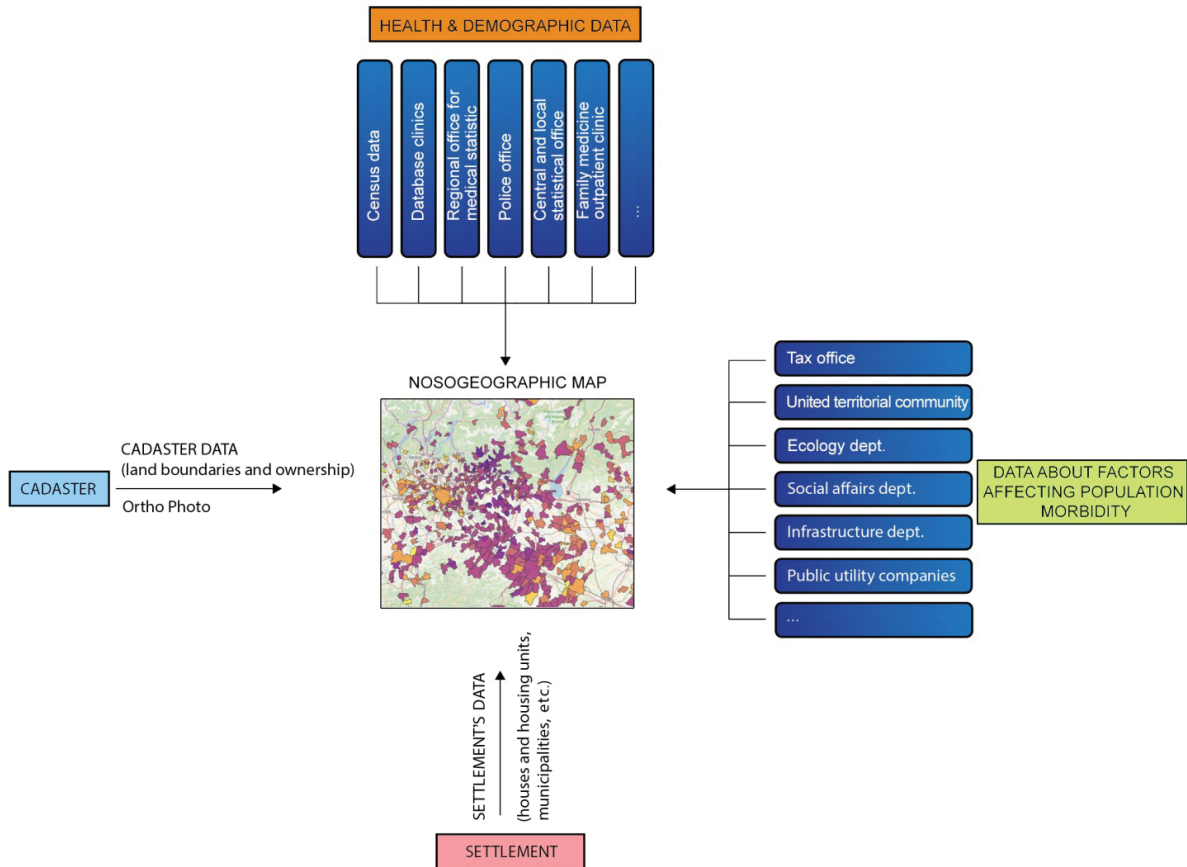


Fig.2. Types of data for mapping from different sources

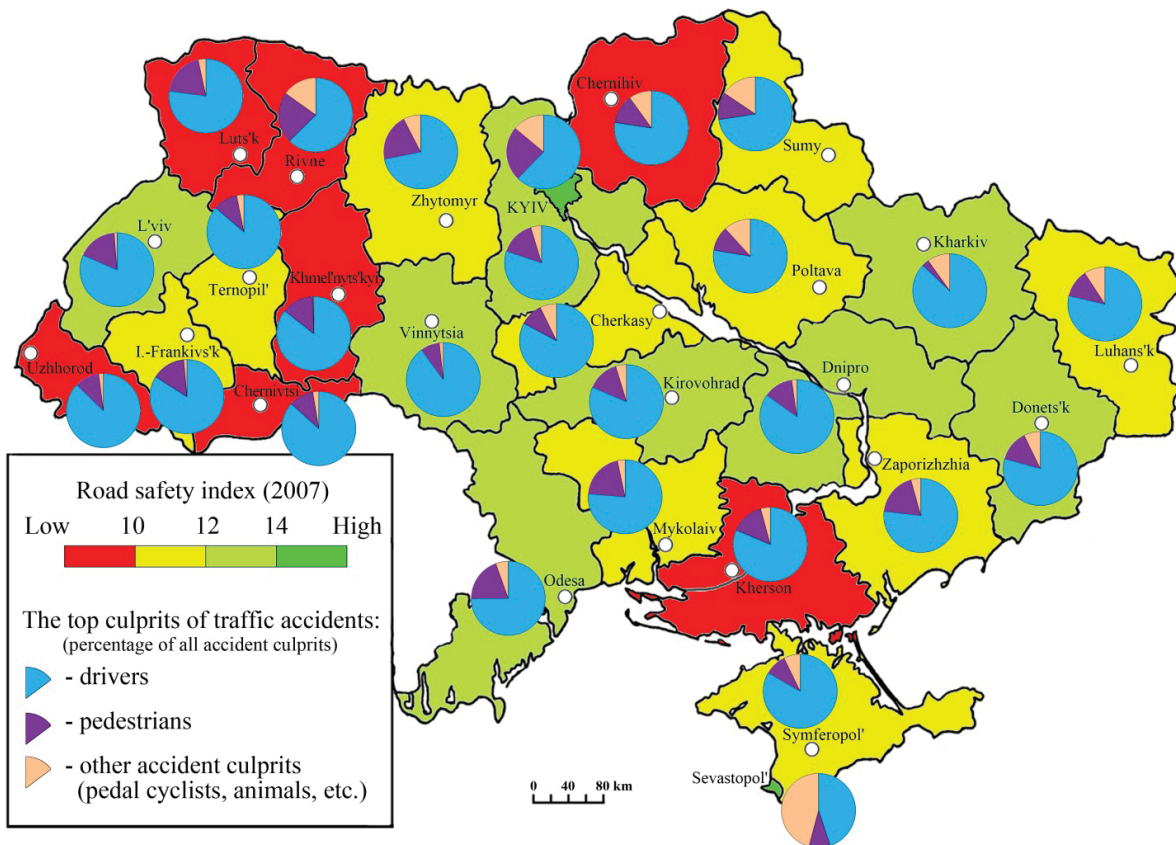


Fig.3. Road safety index of Ukraine regions [5]

disorders that were previously assigned to other categories (for example, gender discrepancy was indicated in the category of mental disorders) or described differently. Game addiction has been added to the substance dependence disorder section, etc. [4].

Increasing level of the data detail on which nosogeographic maps will be compiled will require creation of specialized GIS, the databases with morbidity indicators, data on their territorial and time reference, sources of receipt, etc. These bases are structurally composed of information-accumulating blocks grouped in certain directions, nosologies, or nosological classes. Such data sets make it possible to obtain more complex synthetic maps compiled on the basis of the calculated various composite indices, for example, maps of the roads level (Fig. 3). This opens the way to the development of forecast and recommendation maps that reflect the results of the analysis of primary data by presenting integrated information based on various techniques for assessing and predicting nosological phenomena and processes.

Conclusions. The cartographic method has extremely wide possibilities in the implementation of nosogeographic analysis, since each group of diseases has its own chorological and chronological specificity. Its use allows us to predict the existence of specific factors (indicators of the environmental situation, level of medical care, sociodemographic indicators, etc.) that

determine the morbidity rate. Cartographic models can be used in developing strategies for the socioeconomic development of regions, special events aimed at reducing the level of certain types of diseases, rational territorial organization of the system of medical care for the population.

In our opinion, the classification of nosogeographic maps, and, accordingly, the structure of nosogeographic mapping, as well as the topic of cartographic plots, should be supplemented by the following three varieties. Firstly, these are demographic and nosogeographic maps, showing differences in the morbidity of people in connection with demographic and sociodemographic indicators of the population. The aim of these maps is to analyze the gender, age, national, and other susceptibility of the population to certain types of diseases. Secondly, there are physiological-nosogeographic maps, which, in addition to the morbidity of the inhabitants of a country or region, transmit certain indicators of physical development and health of certain population groups. And thirdly, nosogeographic maps should include maps of road traffic accidents, especially considering the fact that more than 1.2 million people die in road accidents annually and another 20-50 million are injured. Among the cartographic plots of this group, we should mention distribution of traffic accidents by severity, culprits, as well as time of day, days of the week.

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ВІДОМОСТІ ПРО АВТОРІВ / СВЕДЕНИЯ ОБ АВТОРАХ

Корнус Анатолій Олександрович - кандидат географічних наук, доцент кафедри загальної та регіональної географії Сумського державного педагогічного університету імені А.С. Макаренка. e-mail: a.kornus@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Корнус Олеся Григорівна - кандидат географічних наук, доцент, зав. кафедри загальної та регіональної географії Сумського державного педагогічного університету імені А.С. Макаренка. e-mail: olesyakornus@gmail.com; ORCID ID: <https://orcid.org/0000-0001-7469-7291>

Коновалов Микита Георгійович - викладач відділення суспільствознавчих наук та економіки Вищої школи Polarsirkelen (Норвегія). e-mail: mykta.konvalov@gmail.com; ORCID ID: <https://orcid.org/0000-0002-7377-1936>

Данильченко Олена Сергіївна - кандидат географічних наук, старший викладач кафедри загальної та регіональної географії Сумського державного педагогічного університету імені А.С. Макаренка. e-mail: olena_danylchenko@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Король Олена Миколаївна - кандидат педагогічних наук, старший викладач кафедри загальної та регіональної географії Сумського державного педагогічного університету імені А.С. Макаренка. e-mail: korolelena1976@gmail.com; ORCID ID: <https://orcid.org/0000-0003-0175-3824>

Корнус Анатолій Олександрович - кандидат географічних наук, доцент кафедри общей и региональной географии Сумского государственного педагогического университета имени А.С. Макаренко. e-mail: a_kornus@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Корнус Олеся Григорьевна - кандидат географических наук, доцент, зав. кафедры общей и региональной географии Сумского государственного педагогического университета имени А.С. Макаренко. e-mail: olesyakornus@gmail.com; ORCID ID: <https://orcid.org/0000-0001-7469-7291>

Коновалов Никита Георгиевич - преподаватель отделения обществоведческих наук и экономики Высшей школы Polarsirkelen (Норвегия). e-mail: mykta.konvalov@gmail.com; ORCID ID: <https://orcid.org/0000-0002-7377-1936>

Данильченко Елена Сергеевна - кандидат географических наук, старший преподаватель кафедры общей и региональной географии Сумского государственного педагогического университета имени А.С. Макаренко. e-mail: olena_danylchenko@ukr.net; ORCID ID: <https://orcid.org/0000-0002-5924-7812>

Король Елена Николаевна - кандидат педагогических наук, старший преподаватель кафедры общей и региональной географии Сумского государственного педагогического университета имени А.С. Макаренко. e-mail: korolelena1976@gmail.com; ORCID ID: <https://orcid.org/0000-0003-0175-3824>