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Public health service, exerting effects (whose external aspect appears to be “diagnoses”) attempts to “extinguish” them itself handing them over into a “governing impact” of its own activity: it is incapable (acting alone!) to achieve a desired result on such a basis. Hence it should revise its lines of activity, the internal set-up and leading functions in conformity with the systemic character of the concept “the population health”, the sources and principles of its preservation presented in the law of survival at the life cycle of each generation, taking into account an infinite majority of its status characteristics, “selections” of standards and the motivation of behavior aimed at preserving one’s own health.

Conclusions.

1. In the ideology of measuring the health of the population, the Strehler-Mildvan theory of aging, adapted to address the issues of public health management, was used.

2. To calculate the age-gender parameters of survival and to build a “longevity scale” we used materials that are common for calculating mortality tables, they

were used for the first time in scientific practice to assess “health resources of the population” and the rate of their loss (losses) over the years of life in the system “inverse countdown” from mortality – “through the looking-glass”, from the moment of birth.

3. The presented ideology allows passing (on the basis of the aforementioned) to the search for and selection of patterns in the dynamics of public health throughout the entire life cycle.

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METHODICAL APPROACHES TO DETERMINING THE POPULATION SYSTEM AND THEIR HEALTH, TO THEIR MEASUREMENT AND ASSESSMENT

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Abstract

The paper presents system characteristic of the environment of human existence (and population), its basic components, the system logic of the definition of generic and aspectual concepts of health (individual, family, population), system schemes for their measurement and assessment.

Keywords: *system analysis, management, environment, health, population.*

One of the main tasks of the higher medical school is to develop the understanding of the “population system” and the development of people's health in the dynamics (throughout the life cycle) related to its quality. This knowledge forms the professional thinking of the doctor and the choice of the right solutions for patient care.

It is generally recognized that the environment in general, includes physical and social components. But proclaiming the so-called “anthropogenic” effects on the environment the “population” itself as an object (as an element of “morphology” and environment), as well as “population” as a leading “function” in this environment realizing a certain “lifestyle” in it should be included in the environment. Besides, the submitted list of the components of the environment should include one more component – “state of health” of the population. (Table 1.5 presents all of the above components of the system environment of the population in medical and social aspects).

The morphological characteristics of the object “population” traditionally, primarily, are represented

by the structure (distribution) of people by gender, age, education, occupation, etc. These characteristics in the system medical and social analysis of the population are basic in the “morphology” of forming its health.

Similar (morphological) characteristics for the “lifestyle” of the population are represented by a spectrum of specific knowledge, defining public awareness of its own health conservation (by means of education, training, information communications, etc.).

Morphological characteristics of the object “social environment” (social surrounding) are reflected in the laws of life created by the people themselves, in the historically accumulated and existing traditions, in the social infrastructure of people’s settlements, including the development and accessibility of health care, etc.

The morphology of “physical environment” is determined by its fragments in a spatially confined place of residence (where labor and household life activity of the population passes), namely water availability and debit, soils structure, air quality, climate and other fragments that define the life and health of people.

Table 1

System environment from the point of view of reflecting integral states (statuses) of population health					
Aspects of system environment	Environment components				
	Population	Lifestyle	Social environment	Physical environment	States (statuses) of population health
Morphological	Structure according to sex, age, education, occupation, etc.	Knowledge of preservation of human health and life	The laws of life and the traditions associated with preservation of health and life of the population	The structure of the physical characteristics of place of residence: water, soil, air, climate conditions of life, etc.	Status of the population by biomedical and medical and social characteristics of its structure
Functional	Lifestyle (observance of written and not written laws on preservation of health and life in the settlements)	Behavior (decision, actions, events, traditions on preservation of health and life of the population)	Action-execution of laws, traditions observance, etc.	Interference of human and physical environmental factors	Status of the population by on the sign-markers of its behavior
Genetic	Qualitative distribution of socio-environmental statuses of residents of settlements with regard to their health parameters	Quality of life (in terms of population health and quality of living environment from the standpoint of preserving the health and life)	Quality of the social environment from the standpoint of preserving the health and life of the population	Quality of the physical environment of territory of residence of the population from the standpoint of preserving health and life	Population status by medical and social signs of its life quality

Leading functional characteristic of the object “population” is “lifestyle” of the latter oriented at specific behavior in a particular situation and leading to the preservation of human life and health.

Functional parameters of the object “social environment” are derived from the executable laws adopted in the community, its commitment to the traditions, limiting action of the factors negatively affecting the life and health of people, etc.

Functional characteristics of the object “physical environment” are displayed by laws of relationship and mutual influence of anthropic dependable and physical factors that change each other at long mutual existence (in this case the nature of the interaction is determined by “preserving of the life and health of people”).

Genetic traits of environment components as integrity diversity of the object “population” are qualitative characteristics of the latter depending on the composition-structural distribution of people by their status: “young” and “old” generation (by age), its distribution by life expectancy etc.

Genetic characteristic manifestation “lifestyle” of the population supports the quality of its collective behavior from the standpoint of preserving the health and life in the community.

“Social environment” quality manifested in the form of the living conditions of people from the standpoint of supporting their health and life, with a choice of these areas with the best conditions of health parameters as “norms” and “standards” corresponds to the same aspect of the object sign “social environment”. The same applies to genetic parameters of the object

“physical environment” (“physical surrounding”), where urban places of residence, the nature of the safety of industrial activity, recreation, etc. are included.

Thus, all the characteristics of the components of living conditions of the population composition are associated with its health: morphological aspect of “health” is presented by social status based on biomedical and medical-social characteristics of its structure; functional – by status, representing the behavioral characteristics of the population from the standpoint of preserving health and life; genetic aspect – by status, reflecting the qualitative result (information product) of systemic coherence and indivisibility (inalienability) of the first two aspects in medical-social area.

It should be noted that the qualitative characteristics of the system environment of the population are summarized in Table 1. This is a frame, which must be filled in at the planning stage of recreational activities during the in-depth analysis of the health of a particular “population” in a particular environment at a particular time. At the same time, each researcher introduces in the concept of the studying environment only certain characteristics determined by him for his study, rejecting others not studied by him, so that in such studies there is a tendency to exclude the possibility of the correct determination of the studied object relations - only the so-called “not live markers” of the latter are studied. However, taking into account the structural unity of the object, the obtained results still partly reflect a holistic knowledge of the object - you only need to correctly identify their place in the studied system environment. This is a fundamental requirement and peculiarity of

the use of the system analysis ideology, which give an opportunity to significantly limit the scope of research, if the connection of the whole and its components is accurately determined. At the same time, having knowledge about the invariants of the state of any of the objects of the system environment it is possible to deductively evaluate other objects in this environment taking into account its indivisible integrity.

The above approach captures and emphasizes the composite connection of all components of the system environment. When using it, a measurement of correlation of one component with the other is not necessary

to gain knowledge about the state of the object under study and, as will be shown below, does not make much sense, eliminates the need for such calculations.

Submitted knowledge of the system environment of the population in medico-social terms contribute to the solution of many problems in the study of health in the living environment, enabling you to see all the links of the objects environment and reasonably use some approaches to measuring their condition, including the study of public health with using the logic of the universe of bonds (Figure 2) on the “longevity scale” of the population (Figure 1).

Figure 2
Triads of consistency (similarity) of aspect analysis of the human and population, their health based on the basic properties of the system

Basic properties of the system		Aspect analysis of system objects, fragments							
		Man (object)		Population (object)		Health (fragment)			
Internal	External	Internal	External	Internal	External	Internal	External	Internal	External
Dependability	Resistance	Biological	Organism	Social	Group of people	Processes composition	Processes structure	Processes composition	Processes structure
Ability of modifying	Manageability	Psyche of functioning	Activity (individual behavior)	Psyche of functioning	Way of life (collective behavior)	Functioning (process flow)	Functions, made by processes	Functioning (process flow)	Functions, made by processes
Comprehensibility	Observability	Bio-social	Individuality	Social organization	Social-medical status	Organization	Registered state	Organization	Registered state
		Morphological							
		Functional							
		Genetic							

The methodology of analysis of the concept “health” and the subsequent development of methodological aspects of its measurement and evaluation using the latter for making management solutions for the population health and health care will require a more systematic consideration of the concepts “risk factors”, “lifestyle”, their links with the “health” including use of systematic approach for the measurement.

Today, there are infinitely many studies on measuring the effects of various factors (risks) on human health, but there are no methodological and / or technological grounding of schemes of performing related analysis - with access to constructive methodology of classification of these factors and calculations of their significance. Therefore, let us initially define specific areas of system analysis of human health and public health.

To consider the state of the population (person) can only be based on the living environment and, as a rule, in three main areas:

1. as an object on which the environment impacts;
2. as an object that implements the function to rebuild living area (materialized action);
3. as (dynamic) object that implements its own laws of life, as an active system, which (as an integral system) sends the totality of its properties to the own selected specific condition.

Of course, given structuring deepens possibility of health **observability** and enhances the possibilities of its assessment when using system properties of the object and phenomena derived from it in the analysis.

Logical development of this analysis (from the standpoint of the clinic) was the need to provide a link of **set of observed changes in the population (person) health condition** with **exposure activities** for them: prevention, treatment. The goal is to make these changes **manageable**.

It is known that medical characteristics of the observed states of objects (people, person) led to the concepts of “symptom”, “syndrome”, and finally “name” (diagnosis). The latter ensured the possibility of **classifying the states** of the body and, at the same time, made it possible to analyze the links of observed **situations** (state of object health) with the **response** (actions) of medical services and institutions.

But, both the population’s and the person’s changes of states are associated not with one, but with all the properties of a group of people or an organism. Moreover, these conditions represent the entire spectrum of changes in the whole system (person, population): in the morphological composition, in the nature and functioning of the organization (genetic characteristics).

Relationship of the population with living environment can be represented as follows.

1. Population is *an object exposed to the environment* (socially – it is characteristic of settlements and the laws by which people live, work and relax, the number and composition of the latter, their image, standards and way of life; physically – it is a landscape, geochemical composition of soil, air, water sources, wind rose and other microclimatic conditions).

2. Population is *an object that itself affects its living environment*:

- on its physical characteristics (pollution, land reclamation, creation of artificial lakes, embankments, landscaping etc.);
- on its social characteristics (laws, forms of work, work organization, trade, transport, family life, including health care etc.);

3. Population is *an object that is as a totality (active social object) implements its own rights and duties in its own system forming its state (lifestyle and its corresponding mentality behavior)*:

- in ownership issues (implementation of economic laws);
- in medical-social services (implementation of relevant laws, regulations, traditions);
- in the reproduction (implementation of aspects of demographic behavior);
- in public interaction (implementation of the right to work, organization of domestic collective existence favorable for health and life, information security, i.e., as an implementation of the laws of social communication);
- in faith – as in the psychology of implementing your own “soul”.

In this case, you should consider the historical aspect of these laws - their relationship with the history, traditions and ethnic composition of the population (in the region), etc.

Informally, they are reduced to the implementation of the aggregate morphological properties in the group (population) - sex-age composition as one of the leading community coexistence parameters - as a marker of survival of the species in the psychosocial environment.

Functionally, they are supported by written and not written traditions, officially adopted “statutes of collective existence” (Constitution, legal laws, regulations, holy scripture, etc.).

Genetically they are implemented by settlements improvement (in its social characteristics), environmental pollution (in its physical characteristics), qualitative aspects of the population behavior (in the mode of life in the settlement), which together - along with indicators of “population (settlement!) health” form the concept of “settlement health” (where “population health” is only one component of the latter).

In such description of settlement life “population health” is defined as an invariant reflecting the result of the manifestation of the combination of observed properties of the collective behavior (in the above broad, three aspects sense). The consequence of this property (observability) is the possibility of measurement (measurability) and control (manageability) of genetic parameters of “settlements” (of controlled area).

Hence “population health” as one of the qualitative characteristics of “settlement health” in the form of indicators of morbidity, disability and mortality (survival) of the people is not only population health, in fact, but also an indicator of one of the many qualities of “settlement health”, in which an individual or population is only one of the components (objects, frag-

ments) of settlement system environment. And this object, as outlined above, not only impacts the environment, but also becomes the object of the impact of this environment.

It should be noted that, historically, the development of medical practice and health care (individual services and facilities network) has long focused on serving the individual and, consequently, in general the entire health care system was vertically (by stages of giving help) built. It linked a set of observed changes in the population state (morbidity, mortality, etc.) with the characteristics of the individuals' status, taking their sum, excluding changes in the quality of this new system object - the "population" (!!!), and, consequently, has developed activities to influence it (prevention, treatment).

This was aimed at ensuring controllability of changes of observed state of population. However, due to such actions management led to establishing a department - health care sector with quite narrow possibilities to influence the parameters of the collective (public) health (!). Population health, as shown above, has absolutely different qualitative - mainly socially derived- characteristics and parameters unlike the individual's ones and, therefore, **requires other** (by system content and structure) **measures of the impact in social, communal and territorial system of rehabilitation, care and restoration of human health**.

In addition, it should also be emphasized that changes in health state at the individual level (which gave rise to the concept of symptom, syndrome and diagnosis), at the population level have contributed to the emergence of a large and complex "International Classification of Diseases", followed by adjustment thereto health sector (cardiac, pulmonary, oncology and other centers) with separate form of reporting (documents, indicators) and ascension of individual state indicators to "average" indicators of the individual state, but, for some reason, giving the latter name of "public health indicators". The levels of reporting and assessment of information importance of parameters of "public health" were adjusted to these indicators, and, respectively, according to the latter - the impact activities on them, which should be assessed at this time as the methodological and information inadequate and certainly not adequate realities of practice.

Absence of direct integral health indicators, i.e. long-term lack of possibility to measure its actual state (as opposed to traditional measurements of its individual manifestations of fertility, morbidity, mortality, etc.) and, accordingly, the uncertainty in the assessment of a real connection of population health with the quality of their territories (settlements) of living - their morphological composition, characteristics of functioning and organization architecture - led to errors in determining the reasons for the prevalence of major diseases and primarily chronic ones, leading to death, as well as in kinds of effect on these pathologies spreading day by day.

The above justifies the content of this monograph - targeting health care and those responsible for the health of the nation and people of certain territories at the use of new system technologies in its organizational

activities leaving the best of the established models of health.

Let us consider the number of methodological and methodic techniques to assess the health of the population and the factors affecting it (positively or negatively).

Mathematically, if all factors affecting health were considered in terms of causal relations (relationships) when evaluating the states of population (human) (which is denoted by Z , the morphological characteristics of the object - by the symbol x and their performance characteristics - by the symbol f) we would obtain the formula: $Z = f(x)$. It formally indicates that the state of the object (Z) which we get at the output is always a genetic derivative of the biosocial composition (structure) in the object (x) and a consequence of its interaction (f) with the living environment. In other words, **the state of the object** is always a *regular derivative* of the specific (by morphological characteristics) activity of an object - *it is a law*.

This formula has been successfully included in the assessment of human health by J.-F.Nys, although meaningful components of this author's model are completely different, not adequate to the methodology presented above.

The formula research shows that similar patterns can be found everywhere, even in any of the health care subsystems: for example, in the work of clinic, where Z is a derivative of its structure (x) and qualitative characteristics of its components (f) activities (operation). Or, in other words, the production capacity (product, clinic services at the "output") always derive from its composition, units structure, staffing, employees' qualifications, material and technical provision of execution of the intended mission and the qualitative characteristics of all departments functioning: quality of services, their availability, reliability of produced technology and others in total unity.

Adapting the above formula to the system ideology of health and social research provided in this monograph we can deduce that any genetic characteristic of the object (Z) directly dependent on its morphological components (conditions of object operation) - x , and the immediate implementation of the intended functions (activities of morphological structures) - f .

Factor dependence of public (human)health requires systemic treatment of such concepts as "factor", "risk factor", "anti-risk factor", "lifestyle" taking into consideration their subsequent use in the below methodological developments in the study of "population health".

The term "factor" in the dictionary of S.I.Ozhegov is designated as "a moment, important circumstance in any process, phenomenon". On this basis, the systemic definition of "factor" may be as follows:

"Factor - invariant qualitative characteristics of the processes defined in the object of specific system environment, reflecting coherent integrity of its morphological, functional and genetic aspects of this object and determining the quality characteristics of its interaction direction (and, accordingly, its existence conditions) together with other objects of the environment and the environment itself".

Represented definition shows the relationship of factor with a particular object causing it as well as with specific objects of interaction in a fixed system environment. It shows that its characteristics are determined by the composition and structure of the object itself, where the qualitative characteristics of its interaction with other objects of the environment (as indivisible integrity) determine the conditions for the existence of the latter and condition of the environment itself.

S.I.Ozhegov designates the term "risk" as "a possible danger". On this basis, the systemic definition of "risk factor" may be as follows:

"Risk factor - invariant qualitative characteristics of the processes in the object of certain system environment reflecting its morphological, functional and genetic aspects as coherent integrity with the possibility of negative orientation of its functioning (while interaction) and the corresponding change in the state of the environment objects, it faces, and the environment itself".

Then the opposite notion – "anti-risk factor" based on the above definition should be considered as "another invariant of the state of the object that implements the ability to support the desired (reference or standard) characteristics of the processes in other objects that interact in the environment and the environment itself".

In the presented definitions factor morphology (its composition and structure) are reflected in the rules of the object functioning, functional aspect – in the parameters of their fluctuations (processes modifications), and genetic - ideally, that is in defined and desired, its scientific or historical "regulations" (numeric markers of "norm") of the processes in a specific object while its being (existence and interaction) in a particular environment³⁾.

These definitions are of generic nature. Only function of the object and the environment gives them quality certainty. For example, access to health care as a risk factor for the health of people living in a rural area distant from the regional center, often determines its higher morbidity of chronic diseases, disability and mortality reflecting the flow direction of pathological processes not only in the "health" of people, but also in the "health" of a particular system environment, etc.

Understanding of health depending on those or other risk factors of population (person's) living environment and determining their lifestyle by the latter requires the presentation of the system concept "lifestyle":

"Lifestyle of the population (populations) – an invariant of life traditions of certain group of people, which was formed in their living environment and represents a qualitative result of coherent unity of morphological, functional and genetic aspects of this life."

In this definition the term "invariant" should be understood as an established or formed (in a particular environment at a particular time) the only option in the spectrum of their many modifications. The notion of "tradition" is treated as a prevailing or stable order in people's behavior aimed at preserving and support or breaking their abilities to improve health (duration of

the biological and working life, the function of reproduction, etc.). Its morphological aspect is represented by certain norms of behavior, functional – by schemes of their changes (modification of the norms) and genetic – historically established (and generated by the first two aspects) ideals, including the quality or "comfort" of living environment, a leading indicator for assessing potential for conservation of health and life.

Then from socio-medical point of view the wording of "lifestyle" should be as follows:

"Lifestyle of the population (populations) is an invariant of behavioral traditions of certain group of people, which has evolved historically in a particular environment of its residence, which is a quality result of a coherent unity of its standards, change of their patterns and ideals of life generated by them in terms of their focus on the preservation and support (or breaking) of certain modifications of actions to strengthen their health and improve the quality of the living environment (habitat)".

At the same time, in the first case, the result is a "healthy way of life", in the other - its opposite – "unhealthy", in which the flow of the object functioning deviates from the ideal, and in the case of achieving deviations peak leads to the formation of a new invariant of object state – "indisposition" (illness, disability, death), which contributes to wasting of "vital resource" by the object (population, generation, a person) reducing its life expectancy - both biological and labor and / or viable.

The presented definition reveals that life activity (lifestyle) regulates the traditions, and the latter, in their turn, based on the "feedback" in the cybernetic object, lifestyle. Proceeding from this, it is obvious that the real impact on the people's health should be directed to the "education" of certain behavior, preservation and support of the traditions of "healthy lifestyle", on the effectiveness of social influence on the formation of healthy norms of behavior in relation to the physical and social environment and own health that includes the corresponding training of collective behavior and their own systems.

The latter actually defines the main tasks of health system management in general, as well as public and medical prevention in particular.

Let us consider one of the approaches to measuring parameters of certain "health" states used in the monograph. The above method of measuring the state of the object - $[Z = f(x)]$ reflects a cause-and-effect relations of system environment fragments, but this model does not always correspond to the model of objects relations in it taking into account their full and coordinated interdependence.

It is already noted that the interactions of any object to be viewed from three sides: from the point of view of its impact on the surrounding objects and the environment in general, from the point of view of the influence of other objects on it, as well as the point of view of the impact of an object as an element of the environment on itself.

Population as an environment object



Fig. 1. Population as a function in the system environment

Imagine that the environment in the state A_1 (Figure 1) under the influence of the activities of the population - L, which changes its state, also changes itself, goes into state A_2 . The difference between these states ($A_1 - A_2$), with their measurability, provides an opportunity to make the calculations of parameters change of environment A in units and measurement scale of the

object "population" - L, determine the direction of these changes, their speed and the consequences for the environment as a whole. At the same time, to measure the subsequent impact of modified environment (A_2) on the population (L) a similar scheme (Figure 2) should be used.



Fig. 2. Environment, as a function, in the interaction with the population

In this case ($A_2 - A_1$) is equal to ($L_2 - L_1$). But A is measured in scale units of environment measurement and L - in the scale units of the population measurement, which leads to the conclusion that there is a necessity to find common parameters for measurement both the environment and the population. Determination of such technique would allow assessing the health of the population and the "health" of its living environment, to predict the direction, scope and possible correction of their states, to determine appropriate resources for the implementation of control actions in single scale parameters, as well as to monitor the effectiveness of their implementation (realization).

At the same time, interacting both objects can influence not only its own (and others) final state, but also on the quality of the operation itself and, ultimately, on the morphological structure of each other. That is, having a measurement of one object you can always measure changes occurring in the objects interacting with it (in units and the scale of measurement of the first!).

The represented diagrams fix the fact: the population (in the first case) and the environment (in the second case) are, for any changes, risk factors of changing state ("health") of each other.

Taking this into account and meaningfully (in systematic analysis) combining two approaches to measuring objects - modified approach of J.F.Nys (Figure 3) and the foregoing are proposed for general use in research and practice in the measurement of systemic linkages of the model of the universe of knowledge on the objects state of the system environment, it itself, as well as events taking place in it and its objects (Figure 4).

State	Integral set of genetic signs-markers Z	Laws of population functioning in the system environment F	List of processes (fragments) of population on which environment influences $X_1, X_2, \dots X_n$
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Fig. 3. Contents of constituent elements in the formula of J.F.Nys

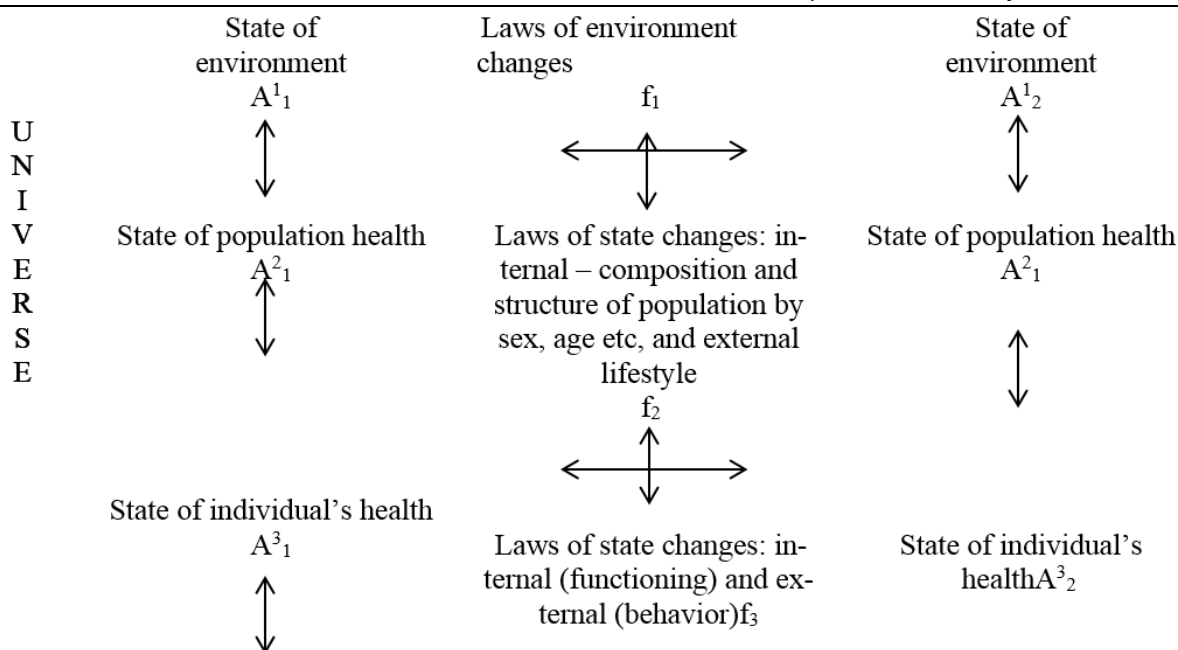


Figure 4. The universe of knowledge on the state of the system environment and it itself, where “<>” presents system indivisibility of the considered object (phenomenon) and knowledge about it, a + and \leftrightarrow - a compositional unity of the considered environment and knowledge about it.

Such scheme to measure and analyze the state of the system environment and its objects takes into account the basic properties and aspects of the study of the classical system. It allows fully and deeply analyzing the main factors and relations of formation of public (individual) health and their system environment. The scheme establishes a harmonious relationship in the system “population (person) – place of its habitat (life activity)” in all aspects (ecological balance, lifestyle in a particular socio-ecological environment, morbidity, mortality, survival, etc.).

Presented theoretical analysis always allows identifying a unique determining of “health” for the observed object. For example, for the “population health” (of one or another group) in the n-th, a clearly defined system environment: in the village, district or regional center, in the region etc., taking into account certain (in a particular settlement) laws of its functioning, as well as the diversity of life style forms of a group of people under study.

In addition, the precise fixing of the object functions and its environment allows taking into account the above analysis to enter the classification of the states of the object functions and, ultimately, its habitat areas.

Finally, the presented scheme of the analysis of the relationships of the system environment objects allows making direct and indirect measurement of their states and the environment in different aspects of relationships in general.

The foregoing technological schemes of disclosure and analysis of the relationships of public health with leading (presented above) concepts of theoretical and practical medicine, as well as in social ecology were used in this monograph while the development of

medical and social techniques for studying the incidence, mortality, survival, resilience and life expectancy, working out strategy of development of public health care, health care management, dealing with the related resource and economic problems.

Conclusions.

1. In a systematic analysis of the population system and health, three basic aspects of the analysis were identified: morphological, functional, and genetic.

2. The component analysis of the environment includes the population, its lifestyle (meaning maintaining health), the social and physical environment (from the same positions), and the status structuring of the population according to their health conditions.

3. In the methodology of integral measurement and assessment of public health, systemic triads and their mutual influence should be used.

4. The results obtained in the study formed the basis for the transition to a system-integrated measurement and assessment of the public health in the dynamics.

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