Medicon Microbiology
Volume 2 Issue 2 November 2023
Article Type: Short Communication
ISSN: 3008-248X

Diagnosis and Monitoring of Adaptive Norm in Physiology of Living Things: Informational - Geometric Approach

Ruben Kazaryan*

Dr of Technical Sciences, Professor Ruben Kazaryan

***Corresponding Author:** Ruben Kazaryan, Dr of Technical Sciences, Professor Ruben Kazaryan.

Received: October 31, 2023; **Published:** November 08, 2023

Numerous researchers (Dines A., Cribb A., 1993; Downie R.S., Tannahill C., Tannahill A., 1996; Ewles L., Simnett I., 1999; Marmot M., Wilkinson R.G., eds, 1999; Adams L., Amos M., Munro J., 2002; Aslanov D.I., 2011; eds) interpret the definition of «human health» and «norm», treating them as an arbitrary or as conditions, «though epistemologically conceivable, but expressing nothing definite in real life» (Tsaregorodtsev G.I., 1998).

There are at least five common approaches to the norm understanding: medical; behavioral; educational; focused on the client (patient); social - ecological.

The World Health Organization defines health as «a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity». Despite the many criticisms of this definition, the medicine has not yet developed a clear view of health.

Medical approach considers health as the absence of disease or physio- logical conditions that lead to the development of a disease. Despite the competition between approaches, medical approach remains dominant. More information on health determinants, their classification and relative contribution of each approach to the formation of health of an individual can be found in the review (Marmot M., Wilkinson R., 1999).

Interpretation of the term «norm» is quite diverse and heterogeneous, although the norm has been studied in different aspects for centuries.

A growing number of professionals face the problem of biological inadequacy of statistical approach to classify norm and abnormal states, and interpretation of norm as averaged populational characteristic.

Modern medicine, which development is based on information-wave representations, is not any more content with the average statistical definition of the norm, which leads to serious methodological inconsistencies and difficult- ties in solving clinical diagnostic problems.

For example, the norm in patients with hypo- or hypertensive blood arterial pressure is different from the average norm. Norms from the standard form of laboratory analysis is considered only as an indicative norm, but not for that particular patient. The rise of temperature in a number of infectious diseases are considered as norm (*dynamic norm*) (Volozhin A.I., Subbotin K.J., 1998).

It is known the functional understanding of the norm, as a process whose system-wide measure is unchanged. The general mathematical theory of action, having a developed apparatus of quantitative analysis is most likely to be used in this domain. This example of mathematics application in medicine allows expecting correct and adequate results, not contrived arguments and conclusions.

There are also functional and biological and socio-biological approaches to the notion of the norm, the homeostatic (assuming a dynamic balance of bodily functions and environmental factors) and evaluative (ensuring satisfaction of human material and immaterial, spiritual needs) approaches.

Attempts to use the concept of individual norm as the best of the human condition, not excluding the quantitative and qualitative proximity of its main parameters in a given population, is also not sufficiently substantiated (Kartashov Yu. I., 2005).

In several papers and manuals of russian researchers (Bayevsky R.M., 1979, Tsvetkov N.A., 2002, etc.), the adaptive approach as the body's ability to adapt to constantly changing conditions of existence in the environment has gained popularity for human health characterisation.

Classification of options for «prenosological» health condition diagnosis (Bayevsky R.M., 1989) is quite popular and useful in applied studies, but it lacks quantitative expression and is significantly uncertain:

- Adequate adaptation (regulatory systems maintain homeostasis via minimum voltage);
- Condition of adaptation mechanisms tension (regulatory systems maintain homeostasis vith increased activity, tension);
- Unsatisfactory adaptation (reduction of the body's functionality, homeostasis is maintained by the inclusion of compensatory mechanisms);
- Failure of adaptation mechanisms (homeostasis is disrupted, an organism is stressed).

There is no consensus on what should be considered the indication of the adaptation onset, the body's adaptation to the environment. The majority of researchers emphasize the dialectics of this phenomenon: useful in its basis for the human body, it may at some point become disadaptational with the development of pathology (Kofler W., 1993; Bayevsky R.M., 1995). For example, the increase in reactivity, or even a change of adapted organs, the use of neurotransmitters and hormones (Hadberg J. et al., 1983; Baraboy V.A., Brekhman I.I., 1992; Meerson F.Z., 1993, etc.).

Different aspects of human adaptation are studied in many fundamental research works (Miller T.W., 1993; Sudakov K.V., 1986-1998, etc.).

A rigorous mathematical modeling of adaptive norm, identifying new classes of problems and models of their solutions within the information technology environment - is the area of application of professional mathematicians diligence. Here we present the basic concepts and definitions that characterize the information-geometric field of adaptive norm and our gained approach to define it. This has required a long-term development of quantitative criteria of assessing the level of the body's adaptive functions, i.e. further development of the concept on "norm" and "normal homeostatic reactions" (Glazachev O.S., Dmitrieva N.V., 2000-2010].

The leading element in the non-specific adaptational mechanisms, as it is known, is the general adaptation syndrome (GAS) - the concept introduced and developed by Selye H. (Selye H., 1973; Selye H., 1987; Sudakov K.V., 1981, 1996; Furduy F.I., 1986; Levi L., 1979; Everly D., Rosenfeld R., 1985; Theorell T. et al., 1988; Herd J.A., 1991; Girdano D., Everly G., 1979).

To determine functional state of the person is necessary and sufficient to identify the level of adaptation processes in accordance with the stages of their development (Selye H. 1960; Kaznacheev V.I., 1980; Sudakov K.V., 1993; Lafaille R., Fulder S., 1995; Grigoryev A.I., Bayevsky R.M., 2001), and to diagnose the nature (and the stage) of the individual adaptation syndrome (Dmitrieva N.V., Glazachev O.S., 2000).

There appear serious methodological difficulties and problems. First of all, lack of a clear understanding of the body's health status. We have repeatedly spoken about this, so we briefly formulate these notions for future discussions.

General adaptation syndrome - a systemic response of the body, which is typically recovered due to physiological and behavioral adaptive response. If the response is not quite adaptive, pathological changes in the body inevitably arise in a while.

The system analysis allows to obtain formal descriptions (including - mathematical models) of processes and procedures of operation of various systems based on understanding of the role of information processes (technology) and methods of system analysis in them (Proceedings of the Institute for Systems Analysis, Russian Academy of Sciences, «Information Technologies and Systems

Analysis», 2004).

However, a formal systematic approach to the study of living systems turned out to be of little effect to human physiology and functional or prenosological diagnostics. Classical cybernetics with the transfer of its concepts of managing technical systems into systems that have arisen through evolution in nature, did not justified itself in physiology (Belotserkovsky O.M., 2005). Experience in the use of mathematical modeling in the field of living systems has also shown the impossibility to predict the body's final state via solving systems of equations based on the body's initial state (Computer models and the progress of medicine, 2001).

We need new main ideas that have cemented the extensive clinical and experimental facts in physiology.

Yet Vernadsky V.I. believed that the space of living matter has a special geometry that is different from Euclidean. It is believed, that «there appears such a symmetry geometry, which in the future will contain as particulars known for each geometry groups of automorphisms and their invariants» (Urmantsev Yu.A., 1971).

One of the basic topological principles of the human body structure is the principle of self-similarity or fractality. Vascular, nervous system, the bronchial tree, alveolar and muscle tissue, the kidney nephronal system, intestinal mucosa, the hierarchical organization of the body's functional systems, etc have fractal organization.

The destruction of fractality often acts as a key link in pathogenesis of several noninfectious diseases (aplasia, dysplasia, dystrophy, atrophy, recovery disorders, etc.). Reversibility of dystrophic changes directly depends on the preservation of the structure topology in its pathological changes.

The general theory of symmetry has become one of the major methodological principles of scientific theory (Vernadsky V.I., 1975), it covers all appearing areas of science. The current understanding of the principle of symmetry is due to its geometric foundation, ideas of conservation, invariantce, theoretic-group methods. The key point in understanding the symmetry notion is the preservation of objects: the more stable and thus more successfully the object maintains its existence in time, the more balanced and aligned its constituent parts are (geometry). The notion of invariant is associated with geometry and is a relationship of the system elements.

This means that not absolute or relative values are the system parameters, but the nature of the relationship between them. The numerical characteristics of the system on the basis of the symmetry approach is defined as the degree of its perfection, conformity to «perfect proportions» (Symmetry, 1988). A quantitative measure of symmetry breaking may be the degree of deviation from the ideal form, as the model of comparison. Of the symmetry properties, as a condition of systemic organization, the possibilities of the system organization correctness assessing and notion of the norm appear. The developed methods based on these principles of cognitive graphics (Zenkin A., 1991) in combination with artificial intelligence means (Pospelov D.A., 1995) are powerful tools for the systemic analysis in multiple theoretical and applied fields.

Physiology (human physiology medical sciencies) is still a poorly formalized science, the relationship between physiological functions is not transferred to the strict «language» similar to the language (definitions, measures, principles) of theoretical physics or chemistry. Much of this is due to the particular complexity of the biological systems organization, as well as to the state of physiological experiment, which does not allow to directly observing a class of such phenomena as symmetrical or information links of physiological functions.

The main feature of mathematical methods of modeling living systems is that they have little or have no effect at all on the development of physiology.

However, the physiology continued to influence the development of systems analysis in the direction of research in the field of mathematical modeling based on neural networks (Neural networks, 2000; Neural informatics - 2005). Models of neural networks were capable of processing noisy and incomplete information, of self-tuning and learning. Currently, this area is defined as simulation of multi-agent environment.

Fundamental basis of modeling biological systems biology was (Wiener N., Rosenblum A, Bigelow J., 1948) the idea that the success of the living systems vital activity determines the consistency and stability of frequent and phase relationships between the functional changes of its parts, and that all or nearly all regulation processes in biological systems are built as oscillators.

This problem presupposes considering the integral biological process as a system in which processes are the result of partial or complete harmonization of many elementary vibrations. Search for new opportunities for more indepth analysis of vibrational relationship requires adequate methodological approach. Currently there are several fundamentally new approaches: the principle of «order out of chaos» (Prigozhin I., 1986), methods of using Petri nets and cognitive graphics (Zenkin A.A., 1991), fractal geometry (Mandelbrot, 2002) and others. All these developments are carried out outside the physiology (Computer models and the progress of medicine, 2001). It is obvious that an adequate model can be built only with an interdisciplinary approach (Belotserkovsky O.M., 2005).

At present, the greatest opportunities provide intelligent systems and methods of cognitive graphics (Zenkin A.A., 1991, Pospelov G.S., Pospelov D.A., 1998). Using the methods of cognitive graphics, many fundamentally new results were received, not only in abstract branches of science, but also in cardiography and electroencephalography.

Cybernetic Approach (Smolyaninov V.V., 1987) is based on algebraic treatment of symmetry, making it difficult for physiologists to use this appro- ach when analyzing living systems. There should be a set of criteria (Hargitai M., Hargitai I., 1989), by which to decide what is symmetric and to what extent. There are two types of equality (compatible and mirror), which are subtypes of the metric equality concept, meaning harmony of proportions (Weyl, 1968).

The study of genetic self-organization symmetry promotes the development of the symmetry theory in self-organization of nature.

Original research of structural relations of ensembles of genetic code symmetry (Petukhov S.V., 2008) has allowed obtaining in matrices a beautiful and mathematically meaningful expression, allowed showing the relation- ship of such matrices with the Pythagorean musical system, the golden section, Hadamard matrices, and other well-known mathematical structures.

Biological evolution is considered as a process of expanding and replicating forms of symmetry arrangement (Zarenkov N.A., 2008; Petukhov S.V., 2010, etc.). These forms are passed from generation to generation using a genetic code, which in its turn, is endowed with the symmetrical order.

The principles of symmetry are recognized as one of the foundations of such scientific field as mathematical science. It is difficult to overestimate the value of the system symmetry invariant when analyzing oscillatory physio- logical processes, where it is associated with geometry and presents a bond of system elements (Dmitrieva N.V., 2008).

In recent years, the idea of the geometry of living things as a factor that provides the effect of multiple information accumulation in the body has been proposed (Loshchilov V.I., 1998). This has opened a way for the use of geo- metric approach to the analysis of living systems and problems of the knowledge creation. Currently, geometric approach, allowing to transform the problem of the knowledge creation into the language of geometric relation- ships between objects, is considered to be promising (Mandelbrot B., 2002). In projective geometry, the relation between provisions acts as definition of the action (Klein, 1989).

For electrophysiological processes considered in analog form, a special interest is the fractal geometry (Mandelbrot B., 2002). Fractal behavior of complex nonlinear systems are now considering as their inherent property and offer (Gergey T., 2004) fractal-like functional architecture in which each function is mobilizing all the structure components. Using data of given do- main to identify new information requires the presence of the knowledge as subject area, as well as adequate rules of processing.

A long-term experience of polyparametric modeling of intelligent sys- tems, conducted by us on the basis of fractal geometry and cognitive graphics to research «system behavior» and functional order of activity of electrically excitable structures of the whole organism, has shown the possibility and benefits of such cognitive modeling for understanding adaptive human norms (Dmitrieva N.V., 1989-2008, Dmitrieva N.V., Glazachev O.S., 2000- 2010).

Generalization of lessons learned on the work of poly-cognitive models of different physiological processes (electrical activity of the heart, brain, cardiovascular system, individual neurons and cardiomyocytes when polygraphically recording the complex of electrophysiological processes) and the development of diagnostic methods based on these models (9 of them patented in Russia) has allowed to come with the above stated position to the definition of adaptive human norm. In this case, diagnosis and monitoring of individual adaption syndrome were carried out in accordance with general principles of clinical medicine (Dmitrieva N.V., Glazachev O.S., 2000).

Volume 2 Issue 2 November 2023