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# Optical monitoring of systemic pathologies of the nation's health as a legal platform for a decent human life

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## ABSTRACT

The article is aimed at developing of a new multiparameter (statistical, correlation and fractal) laser polarimetric approach to the analysis of spatial (layered) distributions of the optical anisotropy parameters of multiple scattering biological fluids, finding of new methods of differential Mueller matrix mapping using algorithms of layered polarization-phase tomography based on differentiation of partial completely polarized and completely depolarized component of Mueller matrix to reconstruct the distributions of birefringence magnitude and linear and circular dichroism coefficients of polycrystalline networks of biological layers (polycrystalline films of plasma of donors and patients with diabetes).

**Keywords:** Optical monitoring, pathology, nation's health, human life.

## 1. INTRODUCTION

There are several main centers in the world where priority groups of scientists are concentrated, whose results form the basis of a new optical direction of biomedical diagnostics - layer-by-layer reproduction of distributions of parameters of optically anisotropic structures of biological tissues and fluids. In particular, the scientists of Y.A. Izat's group (USA) developed and practically tested optical coherence tomography (OCT) methods for obtaining a series of layer-by-layer images of the vitreous tissue of the human eye at a depth of up to 2 mm<sup>1</sup>.

The research laboratory led by Y. Yasuno (Japan) improved methods of laser reproduction of biological tissue structure by polarization Mueller matrix analysis of coherent images, which allowed obtaining information on coordinate distributions of birefringence of layer-by-layer sections of biological tissues<sup>2</sup>.

The polarization tomography technique can be improved by differentiating the information on the fully polarized and fully depolarized components of the Mueller matrix of a multiply scattering biological object, as planned in the project. For the first time, this approach was implemented by the method of digital holography by scientists of T. Kobata's group (Japan)<sup>3</sup>.

In recent years, Ukraine has developed a diagnostic area that is original for tomography - laser polarimetry of optically anisotropic media. Within this area, scientists led by O. Angelsky (Yuriy Fedkovych Chernivtsi National University) have developed and substantiated a new Mueller matrix model of biological layers with phase and amplitude anisotropy<sup>4</sup>.

The functionality of this Mueller matrix approach was extended by a set of new methods of polarization and phase mapping of biological tissues developed by scientists of Yuriy Fedkovych Chernivtsi National University under the supervision of Doctor of Physics and Mathematics Yuriy Ushenko<sup>5</sup>.

## 2. FUNDAMENTALS OF THE LEGAL PLATFORM FOR OPTICAL MONITORING

The transformation of modern society is taking place in the direction of human centrism, reassessment of basic values, the place and role of each individual, maximum focus on the individual as such, improvement of the quality of life and formation of new conceptual and legal approaches to the interpretation of the content of the "right to life" and "right to a decent life".

The right to life is the foundation of the constitutional and legal status of every person in every country that has proclaimed itself to be a country governed by the rule of law and democracy. By virtue of the right to life, a person enjoys all other rights provided for and guaranteed by constitutions and international documents<sup>6-19</sup>. Today, the right to life should not be interpreted only as "the right to be born", "to exist in any way" or simply "to stay alive". In a modern society governed by the rule of law, the right to life should be viewed in a broader sense - the right to a decent life and decent living conditions, i.e., the qualitative aspect, the so-called quality of life, should be taken into account. It is necessary to

take into account the quality of life indicators in all its spheres: work, social security, healthcare, education, private life, etc.

It is worth noting that there are no clear, unchanging, legally defined or socially formed criteria for a decent life. The latter are constantly changing as society, technology and human capabilities evolve. That is, there is a peculiar pattern: the higher the requirements of society, the more opportunities there are to meet them, the broader the content aspect of the right to a decent life in the theoretical and legal plane.

We cannot talk about decent living conditions when a person is unable to satisfy his or her needs for healthcare, food, education, housing, or to realize intellectual and creative abilities; in other words, decent living conditions mean satisfying material and non-material needs at a sufficient level.

Since the right to life is the starting point in the system of rights at the national and international levels, and all other rights (to healthcare, education, work, recreation, social security, etc.) are derivative, it follows that their realization is impossible without the right to life. In turn, guaranteeing and ensuring the right to a decent life will be possible only if conditions and mechanisms are created for the realization of the whole range of other inalienable rights.

One of these is a group of rights in the field of health care: the right to health, to health protection, to medical care, to information about one's health status, to favorable environmental conditions, to optimal working conditions that do not cause harm to health, and others. This category of rights, as well as the healthcare system as a whole, have a great impact on the existence of a person as a social being, because if the right to life is the basis for all other rights, then health is a common good, the basis for a decent life for everyone. The internationally recognized human right to health imposes an obligation on the state to take all possible measures to ensure access to healthcare<sup>7</sup>, continuous development, and the establishment of the principle of equality in relation to every citizen, regardless of their social status, based on the economic resources of the nation and legal regulation.

Diseases and the discomfort, pain, and limitations caused by them impede our "normal existence" and social development, affecting the quality of life and, consequently, the exercise of the right to a decent life. In contrast, health monitoring, identifying the source of pain, and reducing it, contribute to improving the psycho-physiological state of a person, and thus to improving the quality of life.

Being in poor health, a person cannot fully participate in the social life of the community, is unable to guarantee their own economic, political and social rights<sup>8</sup>. Health is a factor that allows a person to be an active member of society, to assume responsibilities and exercise rights<sup>9</sup>.

The transformation of society, rethinking the content of the right to life and the criteria for a decent life - all this is happening in parallel with the development of technology, including in the field of medicine. The development of humanity reflects the efforts of doctors and scientists aimed at maintaining and improving health, implementing social measures and preventing diseases. New diagnostic methods are constantly being developed and existing ones improved for periodic and long-term health monitoring. Early accurate diagnosis is the key to maintaining a high quality of life<sup>10,11</sup>.

Modern healthcare is constantly facing an increasing demand for medical services. This demand is driven by the growing amount of patient data, the dynamic development of technological capabilities, and the need for fast and efficient healthcare processes and systems<sup>12</sup>. Today, every individual seeks to exercise their constitutional right to health in full, in the most comfortable, affordable, and most importantly, fast way possible, and to receive reliable information about their health status and appropriate quality treatment.

Monitoring of processes in the human body allows for early and rapid diagnosis and, at the same time, prevention of diseases, helps people to monitor their condition, physiological parameters of the body and track the impact of the disease on the functioning of a particular organ, preventing deterioration of health. In addition, further development of the monitoring system and optical health monitoring will allow reducing healthcare costs in the future<sup>13</sup>. That is why the improvement and development of new technologies for tracking and monitoring the state of human health is currently one of the main priorities in the modern healthcare system.

The latest technologies of optical health monitoring contribute to the improvement of treatment and perform a preventive function, as they are primarily aimed at preventing the occurrence of diseases, controlling them and stabilizing their condition. At the same time, the ageing of the nation, and hence the increase in the number of people with chronic diseases, is also a prerequisite for continuous monitoring and the use of the data obtained for their further analysis and prevention of the development of pathological processes that may occur in the event of disease progression or untimely diagnosis.

Chronic diseases are among the most important health problems<sup>13</sup>. The World Health Organization (WHO), in order to address rising healthcare costs and the increasing number of elderly people, recommends continuous health monitoring as a cost-effective tool for use in many areas of healthcare - from preliminary examination, preliminary diagnosis and

preliminary treatment<sup>11</sup> to remote monitoring, thereby enabling people to live longer, and most importantly, safely<sup>12</sup> and maintain their independence.

Personal health has gained particular importance and value during the COVID-19 pandemic. In addition to sending a clear message to the world about the need to build a resilient and sustainable healthcare system<sup>12</sup>, the pandemic has left long-term consequences for human health in the form of disruption of the cardiovascular, nervous, digestive, respiratory systems, etc. and, therefore, there is/will be a need for constant, periodic control and monitoring of health for its comprehensive, integrated assessment and subsequent treatment.

The use of an optical monitoring system will allow for an informative diagnosis of the health status, and the results of timely optical monitoring can be used to draw up a treatment plan and rehabilitate the patient. In turn, untimely diagnosis of a disease, in addition to severe, acute, chronic forms of the disease, pathological changes, systemic pathologies, can also lead to significant costs for medical treatment or surgery, or even death.

Information about the patient's health status obtained as a result of optical monitoring will allow to better understand the etiology and pathogenesis of certain types of diseases, as well as to trace the body's reaction to the existing disease, the factors that cause the progression of the disease, and identify complications caused by the disease.

Optical monitoring is especially important for detecting and tracking the development of systemic pathologies, clinical aspects of the disease that manifest themselves in a particular organ system: digestive, respiratory, circulatory, immunological, neurological, etc. Since systemic health disorders can change or even be hidden and manifest themselves only in the form of periodic symptoms, this can be misleading and thus delay a comprehensive health examination.

Optical monitoring is also important for continuous health screening of patients with cancer, as the latter tend to have a rapid course, rapid damage to related organs, recurrence; diabetes mellitus, cardiovascular diseases. Continuous screening of the human body with systemic pathologies will allow us to determine how effective the selected treatment is and to select new treatment regimens in a timely manner if the previous ones are ineffective.

A decent life cannot be ensured without decent work and decent working conditions, the latter, in turn, imply an appropriate level of safety at the workplace and consideration of the employee's health condition, which would fully allow him or her to perform his or her work duties in accordance with the terms of the employment agreement or contract. It should be emphasized that health is important for both the employee and the employer in the process of job search, employment and performance of specific work duties.

According to the International Labour Organization, decent work is "productive work for women and men in conditions of freedom, equality, security and human dignity"<sup>13</sup>, but it is impossible to work productively if an employee has certain health problems or if the work is unsuitable or contraindicated for health reasons. The latter situation may arise due to the employee's concealment of full information about his or her health status, or ignorance of certain health restrictions of both the employee and the employer (if they had any, they should not have been hired for the position, of course, subject to the requirements of the law prohibiting the disclosure of medical secrets).

Optical health monitoring is also important for employees working in underground, mining, coal, chemical, metallurgical, nuclear power and industrial sectors and exposed to constant or periodic exposure to harmful, hazardous substances that can cause poisoning, burns, occupational diseases (respiratory, cardiovascular, oncological, nervous system, musculoskeletal, etc.) or even systemic organ pathologies. Monitoring the health status of employees not only helps to prevent health deterioration and mortality, but also to evaluate the control and protection measures in place at the enterprise for their effectiveness.

The development of optical monitoring and the use of health information collected with its help are also important for insurance law and insurance activities. After all, reliably collected information will allow an insurance company to assess all possible insurance risks, correctly calculate the insurance amount and insurance premiums, and the insured to receive full information about his or her health and enter into an insurance contract that would best meet his or her interests. This is especially important in the case of employer life and health insurance for employees, where the employer acts as the insured and the employee as the insured.

Complete information about the state of health (based on the results of optical monitoring) is equally important for the social welfare sector, namely the provision of quality social services. Nowadays, social services should be as person-centered as possible, helping to meet their vital needs, especially when it comes to social services for people who have lost their independence due to health problems or have a disability. In particular, this applies to permanent or long-term care services, rehabilitation services, supplementary nutrition services based on a diet prescribed by a doctor, etc.

## CONCLUSIONS

Optical monitoring of physical and biological parameters (state of health) of a person is aimed at detecting, diagnosing diseases and monitoring the status of existing pathological changes in order to prevent their further development and deterioration of the person's health. The information obtained from the monitoring results will allow to start timely treatment, preventing the disease from becoming chronic or acute, or to stabilise the patient's condition in case of diagnosis of chronic forms of the disease or pathological changes in the activity of a particular organ, thereby preventing the development of serious conditions, and thus contribute to an increase in life expectancy and a decrease in mortality.

Correctly selected and, most importantly, timely treatment, first of all, indicates the presence of all the necessary determinants for the proper exercise of the individual's right to health; it helps to improve the physical and mental well-being of the person, and thus activates him/her as a full-fledged, full-fledged member of society who wants and is able to exercise his/her rights. The exercise of a set of rights by an individual (at a level sufficient for him/her) leads to an improvement in the quality of life, the latter being interdependent with decent living conditions and a decent life; in turn, the right to a decent life in every independent, democratic, social, and legal state should be its de jure and de facto basis, attribute or goal of development.

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