In bioimpedance analysis, the active and reactive resistances of the human body and/or its segments at different frequencies are measured. Based on these measurements, the body composition characteristics such as fat, cellular and skeletal muscle mass, body water volume and distribution are calculated. To conduct bioimpedanceometry, a device called a bioimpedance meter is used, sensor include two pairs of electrodes in the chain "arm– torso–leg" with the use of probing sinusoidal current of constant frequency and low power (no more than 500 - 800 μA).

The main parameters evaluated by this method are the amount of fluid in the body, body mass index, basic metabolic rate, bone and fat mass, level of physical development and others, as well as their reference values depending on sex and age.

Bioimpedance analysis is used in the medical practice by doctors of different specialties: nutritionists, endocrinologists, doctors of other directions. The technique provides the doctor with a large amount of valuable information, indicates the need for laboratory and functional studies, and helps in determining treatment tactics [13].

There are several ways of measuring bioimpedance, one of them involves performing the following operations:

- the doctor enters data such as age, sex, weight and height, waist circumference, hip circumference, and wrist circumference into a computer program;
- the person is laid down, special sensors — electrodes are connected to his wrists and ankles, through which a weak alternating current of low power is applied;
- results are analyzed by a computer program and given in the form of convenient screen forms with comments.

Measurements are carried out within less than one minute.

C. Preliminary Diagnosis Based on the Assessment of Basic Parameters of the Functional State

The main parameters evaluated by this method are: electrocardiogram (ECG), arterial blood pressure, heart rate (pulse, HR), temperature distribution in the local area of the skin, volume of carbon dioxide in exhaled air CO_2, arterial blood oxygen saturation SpO_2.

Electrocardiography (ECG) is a ubiquitous method of studying heart function based on a graphic representation of the heart's electrical impulses. The intensity of heart muscle contractions is measured and converted into a graphic image (on a tape in the form of teeth). The results determine the absence or presence of abnormalities in heart function. Curve records the heart biocurrents.

Arterial blood pressure is the pressure of blood on the wall of the artery. The value of blood pressure is denoted by two numerical values. The figures 120/80 millimeters of mercury column for the brachial artery are taken as the norm. Systolic (upper) blood pressure — the level of blood pressure on the arterial wall at the moment of maximum heart contraction (the norm is 100-140 mm Hg). Diastolic (lower) blood pressure — the level of blood pressure on the arterial wall at the moment of maximum relaxation of the heart (normal — 60–90 mmHg). Values of normal BP depend on inheritance and age.

Heart rate (pulse rate, HR) is a physical quantity obtained by measuring the number of cardiac systoles per unit of time, the norm is 60-90 beats per minute. Deviations from the normal regular sinus rhythm are considered a heart rhythm disorder. HR depends on age, sex and external factors.

Temperature distribution in the local area of the skin is a comprehensive indicator of the thermal state of the human body. The body temperature of a person during the day varies within small limits, remaining in the range of approximately 35.5°C to 37.2°C. Changes in body temperature may indicate the presence of an inflammatory process in the body. The patterns of change in skin temperature often provide important diagnostic information about a person's condition.

Volume of carbon dioxide in exhaled air CO_2 , is a physiological stimulant of respiration: affects the cerebral cortex and stimulates the respiratory center. The norm is up to 4

Arterial blood oxygen saturation SpO_2 is the percentage of oxygenated hemoglobin in the blood (the amount of oxygen in the blood). This is an important indicator of the state of the human respiratory system. The norm is 95-100 percent.

Respiratory rate (RR) is the number of respiratory movements (inhalation-exhalation cycles) per unit of time (usually a minute). The normal respiratory rate (RR) is 16–20 per minute. Respiratory rate depends on the position of the body, physical activity.

These physiological parameters of a person can be measured using various devices, including the "Patient Monitor" (Fig. 1) [2].

Analysis of the measured parameters will allow the doctor to objectively assess the physiological state of the patient [2], [16].

In non-invasive measurements of basic human physiological parameters, the output signals of sensors have different physical nature and, accordingly, the types of data representation are heterogeneous, which, in turn, demonstrates the necessitates the use of ontological approach.

D. Detection of Organ Pathology by Zakhar'ina-Geda Zones

Zakhar'ina-Geda zones are certain skin areas in which reflected pains, as well as pain and temperature hyperesthesia often appear when internal organs are diseased.

In order to assess the condition of the patient's organs and identify diseased organs, we propose to use Zakharyin-Ged zones.

Initial data is the digitized thermal image of the patient taken in the infrared spectrum (using a thermal camera or heat sensors). It is necessary to compare the obtained image with reference maps of pathologic thermal zones allocation.

The method of detecting diseased organs of a patient involves performing the following operations:

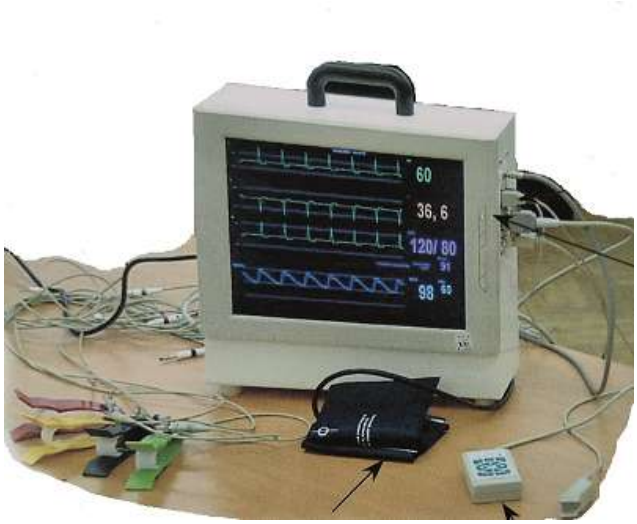

Figure 1: External view of the "Patient Monitor" device

- taking an image of the patient in the infrared radiation range using a thermal camera (obtaining a thermal portrait);
- digitizing the image by comparison and functional transformations;
- comparing the digitized thermal portrait with reference maps of Zakharyin-Ged, which are stored in the computer memory;
- allocation of pathological thermal zones based on comparison of the thermal portrait with reference maps;
- identification of the diseased organ by pathologic zones and output of information on the monitor to the doctor.

Measurements made on Zakhar'ina-Ged zones will allow to give a preliminary assessment of diseases of internal organs [17]. These measurements can be carried out with the help of the device "Patient Monitor".

The use of Zakharyin-Ged zones has been technologically developed in dynamic segmental diagnostics (including Nakatani method diagnostics).

E. Nakatani method diagnostics (riodoraku diagnostics)

Diagnosis using the Nakatani method consists of the studying the segmental cutaneous sympathetic reflex activity and is performed by measuring electrical conductivity values at representative points.

Japanese physician I. Nakatani (Nakatani) developed a method of electropuncture diagnostics of the functional state of meridians based on the measurement of electrocutaneous resistance (ECS) in representative (representative) acupuncture points. By measuring the ECS with an electrical detector in patients with inflammatory kidney disease, Nakatani found points with increased electrical conductivity and called them the electropermeable points.

The lines drawn through the electrically permeable zones are called "riodoraku" (from Japanese: line of good electrical conductivity, where "rio" — good, "de" — (electro) conductivity, "raku" — line). The main purpose of testing cutaneous sympathetic reflexes is to assess the activity of classical Chinese meridians for the subsequent prescription of acupuncture. Nakatani justified the use of galvanic current of 12 V and current strength of 200 μA (with closed electrodes) for diagnostic purposes. In Nakatani's method, current is applied to a point on a 1 cm^2 area of skin.

According to the method, the analysis is focused mainly on the ratio of these indices among themselves rather than using absolute values of current intensity (or ECS). For convenientt use of the method, a "standard riodaraku map" has been developed, where the ratios of the ratio of the current strength indices on skin projections of different "riodaraku", characteristic of healthy people, are graphically laid down. A scale is also used to interpret the indices of cutaneous sympathetic reflex activity in the area of representative zones of each riodoraku [20].

Electropuncture reflexodiagnostics according to Nakatani belongs to the methods of functional research. Through the assessment of the state of acupuncture meridians obtained by measuring the electrical conductivity of a set of representative points, it is possible to determine the functional state of individual internal organs and body systems. According to the Nakatani method, any changes in internal organs are reflected in the electrical characteristics of the skin. Therefore, the parameters of electropuncture measurements can be sensitive indicators, signaling systemic and nosological risks or the development of a pathological process.

The basic principle of this method can be formulated as "treat the person, not the individual disease". Nakatani method testing is widespread in many countries and is even considered mandatory during medical examination in Japan [18].

Electropuncture diagnosis is an integral part of clinical reflexology. The general order of investigations includes several main stages:

- gathering information about the patient;
- examination (measurements) (sensor-electrode);
- analysis and evaluation of measurement results;
- drawing up a conclusion.

The Nakatani method is widely used by reflexologists, mainly to assess the state of the meridian system and subsequent planning of acupuncture [18], [20].

F. Frequency-Resonance Diagnostics (Bioresonance)

The generation of wave diagnostics was created in 1978 by H. Schimmel and was called frequency resonance diagnostics (bioresonance).

Bioresonance diagnostics is one of the methods of body research, which allows to carry out a complete examination of internal organs and systems in real time, to detect functional disorders at an early preclinical stage, to identify a weak or affected organ, and to determine the pathological process.

The core principle of the method can be formulated as "like cure by like".

Any organism emits electromagnetic vibrations. Cells and organs vibrate with a certain frequency. If we get sick, the vibrations of the affected organ change.

The frequency resonance method of diagnosis is based on the principle of frequency resonance.

This diagnosis involves the following operations:

1) electrodes are "attached" to the patient, which will read the measurements of electrical potentials at the points of skin projection of organs or systems of the body. Diagnostics is carried out on the points: head, hands and feet;
2) measurements of skin resistance by alternating current at various frequencies are started under the action of a very weak electromagnetic current;
3) the doctor, examining biologically active points, sends to each different frequency requests in expectation of resonance. Depending whatever the signal has been , received or not, the doctor finds out if a certain organ or system of the tested patient has a specific set of frequencies characterizing a specifically defined disease;
4) a diagnostic conclusion is formed.

Frequency resonance diagnostics is carried out within 2-2.5 hours.

VII. Non-Invasive Methods of Diagnostics and Periods of Diseases

Several periods (stages) are distinguished in the development of the disease. The most effective, in our opinion, non-invasive methods of diagnostics are proposed for a particular stage of the disease (Table I). It should be noted that diagnosis according to the Nakatani method is not in the periods of the disease, but in the plane of the state of the organism.

Let us emphasize the following periods of the disease:

- prenosologic period (risks) is — the period from the onset of gynesis risk (moment of gestation) to the onset of pathogenesis;
- latent period is the period from the onset of pathogenesis to the appearance of the first clinical signs
- prodromal period is — a period of time from the first signs of the disease to the full manifestation of its symptoms (manifestation);
- manifest period (period of pronounced manifestations) has- specific symptoms of the disease are pronounced.

Design and implementation of a diagnostic decision support system is a labor-intensive and time-consuming process. It is expedient to formulate priorities and decompose the tasks.

Analyzing the data shown in the table, FSD diagnostics allows to identify the risks of diseases and has maximum informativeness and therefore it can form the first stage of the system implementation.

Let us determine the ontologies of the subject level (by diseases) within the framework of this problem.

VIII. Conclusion

Ancient Chinese wisdom says: "If there are no errors in diagnosis, there can be no errors in treatment". The use of intelligent non-invasive diagnostics will improve the quality of preventive medical care for the population.

In the paper, the justification and overall proposed architecture of intellectual non-invasive diagnostics system is discussed in great details.

Table I: Disease stages and non-invasive diagnostic methods

Periods of disease	Non-invasive diagnostic methods				
	FSD	Bio-impedance	key parameters	Zakharyin-Ged zones	Frequency resonance
Prenosologic period (risks)	+				+
Latent period	+			+	+
Prodromal period	+		+	+	+
Manifest period (period of pronounced manifestations)	+	+	+	+	+

Several directions (variants) of non-invasive diagnostics are considered: Functional-spectral diagnostics (FSD-diagnostics); preliminary diagnostics based on the assessment of basic parameters of the functional state (such as ECG, arterial blood pressure, HR, temperature distribution in the local area of the skin cover, volume of carbon dioxide in exhaled air CO_2, arterial blood oxygen saturation SpO_2); bioimpedance analysis; Zakharyin-Ged zone diagnostics; Nakatani method diagnostics; frequency-resonance diagnostics.