Structure and Functionality of Mobile Telemedicine Screening Complex (MTSC)

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***Abstract* – The article is dedicated to research in telemedicine field, including statements required for e-medicine and based on preliminary development results of computerized screening complex with wireless transmission of measurements to the analysis centre, computerized decision-making realization with certified expert conformation and feedback of conclusion to a user.**

System hardware part of Mobile Telemedicine Screening Complex (MTSC) is based on a set of specially designed measurement modules. Overall MTSC modules can acquire more than 60 parameter values – numeric, nonnumeric, number strings or curves, measurement values and calculated values.

Computer included in MTSC provides more additional features, result visualization and data flow management. Measuring modules in the unit include the management of separate measuring operations and the recalculation of raw parameter values. Information transmission unit sends the results of digitization and preprocessed data to the analysis centre. Its task is to check the information received, provide a detailed analysis, including computerized and expert evaluation of individual tests, confirmed by a certified specialist and storage of tests and results in the database. Consequently, the link to the analysis centre is duplex, the indication is provided on both ends of the system.

***Keywords* – Consulting, diagnostics, e-health, emergency, mobile, screening, telemedicine,, wireless transmission.**

I. Introduction

It has been proved that not early diagnostics of diseases and early patient medical or surgical treatment and rehabilitation cost for person itself, his employer and, generally for a country, significantly more than prevention, reduce of risk factors, and early diagnosis [1]. It is based on the necessity to check population with an aim to determine the so-called risk groups for regular screening to find out individuals with health abnormalities before they need serious and costly medical treatment. If the screening procedure founds abnormality it guides potential patients for further diagnosis to certain specialists – cardiologists, oncologists and others. The authors offer their solution to screening by creating a new portable telemedicine screening complex (MTSC) and analysis methods used. It consists of a set of up to14 physiological parameter measuring modules, computerized interactive questionnaire (CIQ) of subjective symptoms on 12 body subsystems, portable computer with a monitor, wireless data transmission means to the remote analysis and consultancy centre with a database [2].

One of basic statements is that CIQ should be done before real measurements to reduce or extend their number according to results of CIQ, in most cases it may significantly lower costs of necessary investigations and analysis performed. MTSC has a number of functions. Measuring function unit includes separate measurement functions, their management and data preprocessing. Transmission of information includes the results of digitization and preprocessing, and wireless transmission to the analysis centre. Decision-making is based on questionnaire data, objective measurement and test results. Data display function provides access to information in measuring people familiar decimal system or verbal form, including those, received as feedback from the analysis centre.

II. Target Functions of Screening

Decision-making functionality of MTSC provides target screening functions formulated as follows:

- to discover abnormal deviations of a patient health status before feeling discomfort or problems;
- to provide recommendations to a patient for necessary actions, stating the professionals to whom to resort to more accurately identify a possible problem;
- to identify potential risk factors;
- to -provide recommendations for risk reduction;
- to create a patient database to compare data dynamics in the following exams.

Information sources of the system are as follows:

- the patient's history and complaints acquired from interactive questionnaire;
- the objective measurement data provided from the existing 14 measurement modules of MTSC;
- the complex of medical service personnel evaluations of individual measurements;
- the primary results of formal data processing and analysis of measurements;
- analysis centre specialist assessments and adjustments of the primary data.

Based on this information screening results are established and followed by recommendations for further action.

III. Technology of Measurements

MTSC includes a portable computer (PC) with a touch screen monitor and at least rear WEB camera (for anthropometric measurements using photogrammetry) [3] and separate modules for physiological parameter measurement connected to PC using wireless (WLAN or Bluetooth) or USB connection. Modules provide more than 60 physiological parameters measured, each of the modules can perform a number of functions; for example, ECG module provides 12 standard Leads, Blood pressure module measures 3 values, Urine test strips give 11 values, Hearing test measures 14 parameters and so on. The system is designed using a distributed resource principle [4], meaning that each module processes the acquired data to an appropriate level and format stated by specially developed Transmission Protocol. The measuring side, partially in modules, additionally in PC, calculates also valuable additional parameters (see Table I).

TABLE I

MEASURED AND CALCULATED PARAMETERS

No.	Module	Number of Measured Parameters	Parameter Description	Calculated Parameters
1.	ECG device	8	At least 500Hz sampled potentials at RA; LA; C1-C6, 10 second segment	12 Lead ECG, others depend on the Analysis Software if used
2.	Blood pressure (NiBP)	3	P_{SYS}, P_{DIA}, Pulse Rate (PR)	Mean Arterial Pressure (P_{MAP})
3.	Pulse Oximeter (SpO_2)	3	Plethysmographic curve, SpO_2 level in % (H_6O_2 level), Pulse Rate (PR)	Compared to normal
4.	Digital Phonendoscope	3	Sound in 3 frequency ranges (Bell, Diaphragm, Extended)	Depend on PC Software for sound interpretation
5.	Cholesterol Strip Test	1	Cholesterol level in blood	Compared to normal
6.	Spirometer	1	Flow velocity in time	FVC, FEV_1, Tifno index (FEV_1/FVC in %), relative to calculated normal
7.	Digital Thermometer.	1	Body temperature in ˚C	
8.	Urine Strip Test	11	Standard parameters of urine analysis	Compared to normal
9.	Dermascope	Individual number	Photos of suspicious formations in visible and infrared light	
10.	Anthropometric measurement module	6	Distance (in relative units) between predetermined anatomical points on the human body; Determined constitutional type,	Body length (A), waist circumference (V), hip circumference (G), Scoliosis index, Kyphosis index, Relationship V/G
11.	Weight and fat/muscle ratio meter	2	Weight, fat/muscle ratio	Body mass index (BMI)
12.	Glucose Strip Test	1	Glucose level in the blood	Compared to normal
13.	Computer based Visual Acuity Meter	4	Visual acuity in each eye, colour vision in each eye	Acuity index for each eye
14.	Audiometer	14	Hearing threshold for each ear at 7 frequency values	Graphic hearing level presentation in db relative to the hearing threshold (0db)

Measurement module technical capabilities are higher. Table I summarizes the parameters used only for screening diagnostics.

The information obtained from measurement modules can be in several forms:

1. Measurements when a human physiological parameter can be expressed as a single number, such as height, weight, temperature, pulse rate, etc. Parameter value in digital form is for wireless data transmission to remote data analysis centres. Parameter value in decimal form is used in on-site measurement at a local indication side. This form is used in 10 modules and partially in the computerized interactive questionnaire (CIQ) as a special number.

2. Measurements, formed as a series of numerical values, are usually presented and analysed as curves, functional relationships, such as an ECG, audiogram, etc. Only digital values are transmitted that are obtained by fixing parameters at certain time intervals. In case of ECG digitization frequency is 500Hz with 12 bit resolution for each channel. Obtained values are presented as curves at the measurement side on the monitor.

3. Presentation of information in nonnumeric form, such as sound from phonendoscope evaluating noise found (or not found) in certain locales: the heart, lungs, and major blood vessels. The results are transmitted in coded form to the analysis centre and may be indicated at the measurement side. Sound file record, transmission and analysis are not used in screening.

Something similar occurs with ECG evaluation at the measurement side, when medical personnel visually analyses and states only 3 situations – normal, some abnormalities, probably dangerous situation. Detailed measurements and deeper evaluation are performed in the analysis centre by a certified cardiologist.

Interactive questionnaire responses are in verbal form (yes, no, cannot answer), and are entered in the system in encrypted form. This group includes also the person's constitutional type found in anthropometric data (Weakness, normastenic or hyperstenic type).

4. The measurements are transmitted to the analysis centre without a local evaluation. This is one module – dermascope that takes photos of the abnormal area of skin, and images are assessed and evaluated by an expert in the analysis centre.

5. Information is obtained by the calculation of the individual parameter measurements, like mean blood pressure; body mass index, etc. (see Table I). The calculation process is organized at the measurement side of the complex by software in a portable computer. The results are indicated on site and sent to the analysis centre. Every measurement module is characterized by several values, for illustration a short description of measurement modules M1, M3, M5, M6, M13, and M14 is given. Measurement module M2 is described in [5, 7].

M1. Electrocardiography (ECG)

Parameters Measured by a Module

Standard simultaneous 12-lead ECG of patient in digital form, 10-second segment.

Measurement Principles

10 electrodes are located on the patient body at predetermined anatomical points, see Fig. 1.

4 electrodes for arms and legs;

6 chest electrodes.

Measurements are organized to obtain 12-lead ECG record, including:

- 3 Einthoven's leads I, II. III;
- 3 Goldberg's leads aVR, aVL, aVF;
- 6 chest leads V1÷V6.

Results are obtained in digital form with sampling frequency of at least 500Hz and 12-bit resolution. Instantaneous values of leads are calculated from potentials at anatomical points, see Fig.1, using the following formulas:

I=LA-RA II=-LR III=-KR
aVR=RA-LA/2 aVL=LA-RA/2 aVF=-(RA+LA)/2
V1=C1-(LA+RA)/3 V2=C2-(LA+RA)/3
V3=C3-(LA+RA)/3 V4=C4-(LA+RA)/3
V5=C5-(LA+RA)/3 V6=C6-(LA+RA)/3

Potentials from legs RL and LL are not measured and are used for technical purposes.

Comparison with Normal Values and Symptomatology

As family doctors or paramedics usually are not certified ECG evaluators, the detailed analysis at the measurement side is not provided. A simplified conclusion about the recorded ECG is suggested by a doctor:

- no essential deviations from normal values;
- deviations exist, meaning that cardiologist consultancy is required;
- critical situation, immediate emergency assistance is required.

For decision making in screening two symptoms are used:

M1=0 – normal ECG

M1=1 –deviations from normal values.

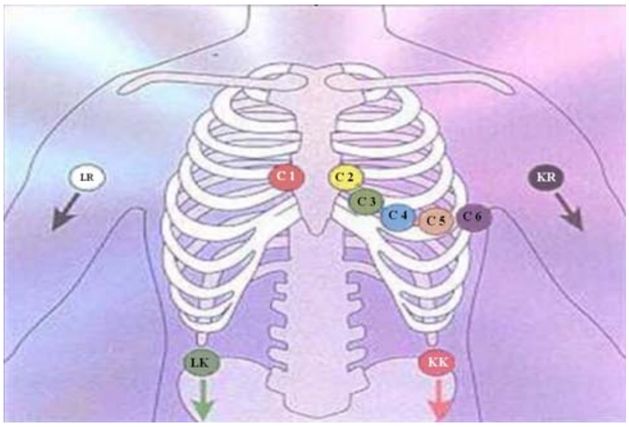

Fig. 1. Location of electrodes for ECG recording.

Technical Requirements for a Module

1. Potential registration to obtain simultaneously required data acquisition with resolution of at least 0.01mV for standard 12-lead ECG.
2. Frequency range not less than 0.03–100Hz.
3. Sampling frequency not less than 500Hz.
4. Resolution not less than 12bits.
5. Sampling time for all registered channels not more than 10% from the sampling period.
6. Compensation of DC offset not less than 300mV.
7. ECG file format for data transmission to the analysis centre is at least SCP (standard) and/or specific, like MDW analogue compatible with ECG evaluation software at the analysis centre.
8. Transmission speed (from a module to a PC) not less than 115.2 Kbit/sec.

Measurement Use in Screening Diagnostics

ECG is a very informative indicator, which may base the necessity of cardiologist consultancy or urgent emergency assistance.

M3. Pulse Oximetry

Parameters Measured by a Module

Pulse oximetry is the photometric method to determine oxihemoglobine HbO_2 level in % in the blood, which characterizes the body's supply with oxygen.

During measurement additional parameters are calculated:

- pulse rate;
- quality number (if available), giving some evaluation of artefacts, which may influence a result.

Measurement Principles

Oximetry is based on the possibility of oxihemoglobine HbO_2 and reduced hemoglobin to absorb different determined light wavelengths (620 - 640 nm), which change during a pulse cycle.

Format of Results

Three numbers that are measured, calculated and transmitted in digital form and presented in decimal form are:

- relative content (%) of oxihemoglobine HbO_2 in the blood, decimal format 00;
- pulse rate (bpm), decimal format 000;
- quality number (if available); decimal format 0÷10

Symptomatology

Three arterial Hypoxemia (low oxygen content) grades are distinguished:

- mild arterial hypoxemia with HbO_2 level from 90% to 93%;
- expressed arterial hypoxemia with HbO_2 level from 80% to 90%;
- severe arterial hypoxemia with HbO_2 level below 80%

Technical Requirements for a Module

Measurement range of relative content (%) of oxihemoglobine HbO_2 in the blood should be at least from 80% up to 100% with an error not greater than ±2%. Pulse rate ranges at least from 20 to 250 bpm. Transmission speed (from a module to a PC) is not less than 9.6Kbit/sec.

Measurement Use in Screening Diagnostics

Oximetry enables the identification of arterial hypoxemia, which is the most common cause of lung ventilation problem or discrepancy between pulmonary ventilation and blood circulation. Results can be used in conjunction with spirometry results and ICQ data assessing the patient's condition at the dynamics of lung and heart diseases. It can be used to monitor the patient state of anesthesia, respiratory arrest during sleep of (apnea) patients, infants in intensive care units, when there are possible rapid changes in HbO_2 level due to respiratory or circulatory problems.

Screening decision makes use of two symptoms:

M3=0 – normal, no deviations;

M3=1 – there is hypoxemia.

M5. Cholesterol Test Strips

Parameters Measured by a Module

Test strips determine a total cholesterol level in the capillary blood sample in millimoles per litre (mmol/l)

Measurement Principles

Commercially available test strips are used. The method is based on cholesterol reaction with chemicals in a polymer strip and its colour change (absorption) at a specific spectral range. Reader device (analyser) is specific for series of strips and is recommended by a manufacturer. Total cholesterol level is less affected when a person has eaten, and may be analysed at any time.

Format of Results

Results are presented in format 00.00 mmol/l.

Normal Values, symptomatology

Total Cholesterol level ranges:

- for persons without risk factors <6.6 mmol/l
- for persons with risk factors <5.0 mmol/l
- for persons with coronary disease <4.5 mmol/l
- for screening needs normal 5.18 mmol/l

Measurement Use in Screening Diagnostics

Atherosclerosis reasons are multifactorial, but the major cardiovascular disease factor is hypercholesterolemia. Cholesterol is a lipid that is important cell outer casing (membrane) component, which allows a cell membrane to be resistant in a wide range of temperature. At the same time, cholesterol is used in the synthesis of bile acid, vitamin D and various hormones, like cortisol, cortisone, aldosterone, testosterone, progesterone, etc.

Most cholesterol (~ 80%) is produced in organism (liver, intestine, adrenal gland, gonads, etc) but ~20% is taken up with food and drink, such as fatty meat, butter, high-fat dairy products, egg yolk and others. Herbal products do not contain cholesterol.

Since lipids are insoluble in blood, in order to enter cells, some kind of "transporter" is required. In this case lipoproteins are transporters. There are two kinds of lipoproteins – high density (HDL) and low density (LDL). The sum of both is total cholesterol (TC).

LDL is the main cholesterol transporter in the blood, sometimes called "bad" cholesterol as it is deposited on artery walls making formation known as plaques, as a result narrowing or even clogging lumen of coronary arteries, known as arteriosclerosis.

HDL also carries cholesterol and is known as "good", as it helps to remove excess cholesterol.

Since TH represents HDL and LDL amount, it may be used as an indicator of hypercholesterolemia.

High TH levels together with risk factors, such as hypertension, diabetes, obesity, smoking, sedentary life style, may lead to high risk of development of coronary diseases, myocardial infarction, stroke, etc.

The resulting TH level is used together with ICQ data to determine a risk level and necessity for cardiologist consultancy. Decision making uses two symptoms:

M5=0 – normal

M5=1 – increased total cholesterol (TC) level.

M6. Spirometry

Parameters Measured by a Module

Air flow rate is measured during inspiration and expiration cycles in litres per second (l/sec).

Measurement Principles

For air flow measurement, a turbine type transducer (sensor) is used. Rotation speed of turbine is proportional to flow velocity. The device is calibrated for constant air volume, as calculated results are dependent on the volume. During spirometry a patient makes several forced inspirations and expirations trough a sensor device attached to electronics to determine the direction and rotational speed of turbine and to transmit data to a PC. Volume/flow measurements are represented as an expiration/inspiration chart, see Fig. 2.

Some explanations:

PEF – Peak Expiration Flow, l/sec;

FEF – Forced Expiration Flow, l/sec (at moments of 25%, 50%, 75% from volume);

FIF – Forced Inspiration Flow (at moments of 25%, 50%, 75% from volume);

FEV – Forced Expiratory Value, in litres, (at time 0,5, 1, 3 sec from beginning of expiration);

FVC – Forced Vital Capacity, in litres.

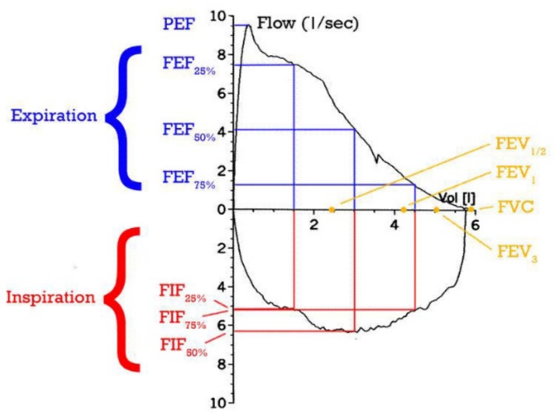

Fig. 2. Typical Flow/Volume chart [6].

Acquired data are processed according to the international recommendations for spirometry.

Measurement Results and Format

During screening, it is most important to calculate 3 parameters that are indicated at the measurement side and transmitted to the analysis centre:

1. Forced Vital Capacity (FVC) in litres, format 00.00;
2. Forced Expiration Volume (FEV_1) at 1-st second, format 00.00;
3. Tifno Index in %, format 00, calculated as:

$$T_f = \frac{FEV_1}{FVC} \times 100\ (\%)$$

Normal Values

"Normal" values for the above-mentioned parameters are not determined; they are calculated as individually predicted values in each case separately, depending on a gender, age, height. For example, predicted value FEV_1 for a 50-year-old man, with height of 1.80m will be:

$FEV_1pred = (4,301\times1,8)-(0,029\times50)-2,492 = 3.8$ litres [6]

The patient's gender, age, height is obtained from Patient Data interface and anthropometric measurements.

Symptomatology

Real calculated measurements are compared to individually predicted measurements. If they (flow velocities, volumes) are less than that predicted, possibly there are problems with the respiratory system.

Technical Requirements for a Module

Spirometry module must provide a flow velocity measurement at least up to 10.0 l/sec, with an error not greater than ±0,1 l/sec. It must have a calibration possibility using a constant volume air pump.

Measurement Use in Screening Diagnostics

Any deviations from the predicted normal (downwards) measurements need pulmonologist's advice. Decision making uses 4 symptoms:

M6=0 – individual normal;
M6.1=1 – reduced FVS;
M6.2=1 – reduced FEV_1;
M6.3=1 – reduced Tifno index (Tf).

M13. Vision Test

Parameters Measured by a Module

During the vision test, individual acuity for each eye and colour vision capability is determined.

Measurement Principles

Visual acuity is determined using Helmholc rings or E letters. On a computer monitor located at a certain distance from a patient, Helmholc rings with different size and cut location are displayed. Patient, using 4-button wireless control unit, shows cut direction, he/she sees. Test ends at the smallest adequately visible ring.

Format of Results

Visual acuity is determined by the corresponding ring size number in format 0.0. Table contains 10 different sizes representing different acuity. 1-st size corresponds to acuity 0.1, 2-nd to 0.2, etc. 10-th size corresponds to acuity 1.0 considered to be normal. The smallest size ring correctly identified by a person is his/her acuity number.

Colour vision test is the second part of test.

Equipment and Method for Colour Vision Test

On a PC monitor, 6 different ring form patterns are displayed. Each pattern is built using smaller ring type "dots" in 3 basic colours – red, green, blue with different intensity, see Fig. 3. If a colour monitor confirms to at least minimal standard requirements, a possible error due to colour spectral presentation is considered to be minimal.

Description of method

The test task is to identify a number or symbol presented in colour ring, looking with one eye. If necessary, glasses may be used. Individual must say to a researcher what he/she sees in the pattern.

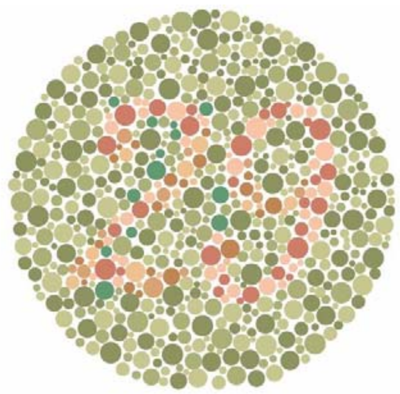

Fig. 3. Vision test pattern representing number 29.

If all answers are correct, it is considered that a person does not have colour vision problems. If at least one answer is not correct, it is considered that there is a colour vision problem and it is fixed as a symptom, and a person should be sent to an optometrist for a more detailed investigation.

Result Use in Screening

4 symptoms for visual acuity and colour vision are used:

- M13.1=0 – normal vision;
- M13.1=1 – reduced vision acuity;
- M13.2=0 – normal colour vision;
- M13.2=1 – colour vision problem.

M14. Audiometry

Parameters Measured by a Module

Hearing threshold in decibels (db) is measured for each ear at 7 frequencies normally audible to humans, together 14 determined values.

Measurement Principles

The test should be carried out at a relatively silent environment (suggested surround sound level not more than 30 dB), using "over the ear" type earphones with good sound isolation (not less than – 20 dB). In the predefined time intervals (5 seconds or others), sound with different frequencies and levels, beginning with lowest, is produced in the left or right earphone. The examined person should press any button on a 4-button wireless remote control unit (the same as used in the Vision test), when he/she hears sound. If a button is not pressed, it is suggested that he/she does not hear this sound and its level should be increased next time. Frequencies used are 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz. Sound level change step is 5 db.

Format of Results

Final result of the test is 14 numbers, 7 for each ear, presenting the hearing level graph of a person, and is presented at the measurement site and sent to the analysis centre in decimal format as 00 (dB).

Normal Values

According to surdology practice it is considered to present all 14 numbers in graph, and visually determine if they fit the so-called "grey area" for normal hearing, see Fig. 4. Results are evaluated locally, if a graph is inside a grey area, hearing is suggested as normal, if outside, the results are sent to the analysis centre and possibly, together with ICQ results surdologist consultancy will be required.

Fig.4. Hearing graph, suggested problem with the left ear.

Symptomatology

Human hearing mostly is capable to accept and analyse sounds in the frequency range not less than 50-10000 Hz, sometimes even more – 16-20000 Hz, at levels up to 140 dB. Due to this, the hearing threshold level range in dB is divided into 6 gradations, if the heard sound level is not greater than:

0÷25dB – normal hearing;
25÷40dB – slight hearing loss;
40÷55dB – medium hearing loss;
55÷70dB – medium hard hearing loss;
70÷90dB – hard hearing loss;
90÷140dB – absolute hearing loss.

Technical Requirements for a Module

Additionally, the surrounding sound level must be measured (this feature is included in a measurement module). If it exceeds a determined value, capable to reduce with earphone sound isolation, the test must be cancelled, as results may be unreliable.

Result Use in Screening

Negative test results serve as the basis to send a person for surdologist's consultancy, for a detailed analysis, if there is a problem.

M14=0 – normal hearing;
M14=1 – reduced hearing (more than 25-30 dB) level.

IV. Acquired Information Transmission and Presentation

MTSC has two information flows:

1. from sensors and measurement modules to a portable computer;
2. from a computer to the final establishment called the analysis centre.

The following legal entities or private persons may act as the analysis centre:

- university clinics;
- existing medical centres, having necessary experts;
- specialized analysis centres formed within the framework of this project;
- family doctors and other general practitioners in private practice.

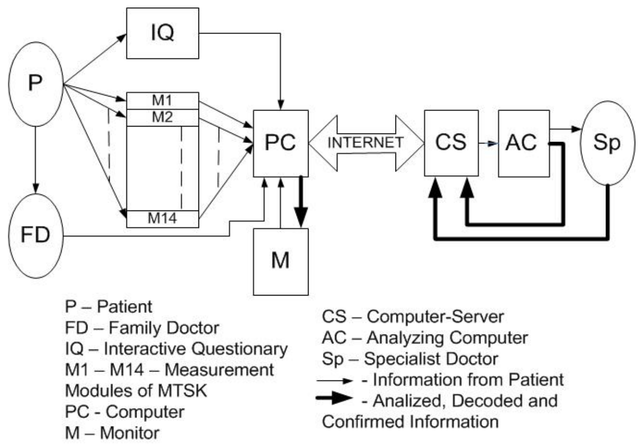

Fig.5. Information flow in MTSC and analysis centre.

The first information flow is implemented on standard wired connections (RS232 or USB) with a computer or using wireless network tools (WLAN, Bluetooth) for separate modules. The second flow is implemented from a computer to the analysis centre (including also the server and database) using wireless Internet connection.

Transmission to the analysis centre includes the encoded initial patient data, digital values of measurements, calculated results, medical staff comments, interactive computerized questionnaire (ICQ) data, images. The aim of transmission is:

- to provide necessary information processing by means of advanced and powerful analysis software that is not available on site, like for multi-profile ECG evaluation;
- to obtain high qualification specialist conclusions, when formalized processing is not possible on site, like dermoscopy image analysis.

Information flows are presented in Fig. 5. Computer included in a set of MTSC provides a decision only about total screening results and recommendations for future actions.

Decisions are based on decision making theory and are implemented by means of production laws described in [8].

V. Conclusions

Nevertheless MTSC is targeted at screening needs, its functionality may be increased by additional modules and software. This may find additional applications of complex as a full featured diagnostic tool in family doctor's practice and as a more rugged version for emergency, rescue and army use.

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Juris Lauznis, Zigurds Markovičs, Ieva Markoviča. Mobila telemedicīnas skrīninga kompleksa (MTSK) uzbūve un darbība
Darbs izstrādāts telemedicīnas, ieskaitot lietojumu E-medicīnas, jomā un atspoguļo datorizētu skrīninga diagnostiku, fizioloģisko parametru mērīšanu ar mobila mērmoduļu kompleksa palīdzību, mērījumu un to rezultātu bezvadu pārraidi analīzes centram, lēmumu pieņemšanas datorizētu realizāciju un sertificētu speciālistu apstiprinātu slēdzienu indikāciju.
Sistēmas aparāta daļu nodrošina mobils telemedicīnas skrīninga komplekss MTSK. Kopumā ar MTSK 14 mērmoduļiem var iegūt vairāk par 60 parametru vērtībām – skaitliskām, neskaitliskām, skaitļu virknēm jeb līknēm, aprēķinu vērtībām u.c.
Īpaša nozīme kompleksā ir interaktīvas datorizētas izmeklējamās personas aptaujas anketas izmantošana, kas ļauj jau sākotnēji samazināt vai palielināt nepieciešamo mērījumu apjomu lēmuma pieņemšanai.
Kompleksā MTSK ietilpstošajam datoram uzticētas vairākas funkcijas – informācijas ieguve, tās priekšapstrāde, un, ja iespējams, to attēlošana un sākotnējā interpretācija. Mērīšanas funkciju blokā ietilpst atsevišķu mērīšanas operāciju vadība un aprēķinu lielumu ieguve, izmantojot tajos esošās iegultās programmatūras resursus. Tāpat tiek aprakstītas iegūto parametru vērtības, formāts, izmantošana skrīningā un to nozīme lēmuma pieņemšanā.
Informācijas pārraides funkciju blokā ietilpst divvirzienu datu un rezultātu bezvadu pārraide analīzes centram un atbildes saņemšana no tā.

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Работа выполнена в области телемедицины, в том числе в отношении возможности применения в е-медицине, и отражает компьютеризированный диагностический скрининг, измерение физиологических параметров с помощью мобильного комплекса измерительных модулей, передачу измерений и результатов в центр анализа с помощью беспроводного способа передачи и принятие компьютеризированного решения, подтвержденного сертифицированными специалистами, включая индикации заключений.

Часть системы и аппаратной поддержки комплекса (МДСК) обеспечена 14-ью измерительными модулями. В целом, МДСК может получить более 60 параметров - числа, строки или кривые, и другие значения или закономерности.

Особое значение в комплексе имеет интерактивная компьютеризированная анкета, позволяющая уменьшить или увеличить количество измерений, необходимых для принятия решения.

Компьютерная система в составе МДСК должна обеспечить ряд функции - сбор информации, ее предварительную обработку, и если возможно, графическое отображение и первоначальную интерпретацию. Функция измерения модулей включает в себя отдельные измерительные операции и предварительную обработку данных, возложенных на встроенную программатуру модулей. Также выявлены необходимые значения для определения рубежных параметров, их формата и назначения, используемого в скрининге, и их роль для принятия решений.

Функциональный блок передачи информации включает в себя двустороннюю беспроводную передачу данных и результатов анализа и получение ответов от него.