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Abstract book

001 MHEALTH ADOPTION FACTORS FOR PATIENTS IN THE DEVELOPING WORLD. AN INSTRUMENT DEVELOPMENT

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There are many instruments for measuring patient's adoptability of mHealth in the developed world, but none of these instruments provide a comprehensive scale for measuring critical issues affecting patient's adoption of mHealth in the developing world. The aims of this paper is to construct a reliable and valid assessment instrument for measuring patients' adoption of mHealth adoption in the developing world.

A Patients mHealth Technology Adoption Scale (PmTAS) was developed with data from 585 mothers who had previously been on Mobile Technology for Community Health (MoTeCH) system deployed in the Ewutu Senya east and west districts of the Central region of Ghana. A simplified cluster sampling technique was used to randomly select mothers who had used MoTeCH from 9 clusters of 64 mothers each, between June-October, 2017. The instrument is made up of 39 items, grouped under 8 constructs namely: system usefulness; available infrastructure; collaboration and funding; user characteristics, cost and ownership, stewardship; intention to adopt; training, language and literacy. The results of the study presents a reliable and valid scale based on strong evidence for future patients adoption research.

002 ON THE EVALUATION OF THE COURSE OF THE CARDIOVASCULAR SYSTEM'S DISEASES USING NEURAL NETWORKS

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Aims. To apply nonlinear classification systems, namely neural networks, on evaluation of the course of cardiac ischemia and to extract the most valuable features using FRiS.

Materials and methods. We used results of clinical observation of 297 patients as material to the observation. All data have been classified on chosen criteria with calculation of integral features. We used only data of patients who have been diagnosed at least twice during 3 years of observation held. The main features that were used in model construction are the length of QRS interval, the level of AST, ALT, age, sex, Duke's index, PTP, left ventricular ejection fraction, weight, the level of uric acid, diagnostic coefficient. According to followed observations all patients were divided on to groups: with favorable and non-favorable outcomes. Primarily we used software NeuroSolutions 7 to train models on 80% of data randomly selected from the dataset. The software made by Alisher Ikramov used Zagoruyko method to extract the most valuable features representing the data. Zagoruyko method uses optimization methods to get coefficients of 'valuability' of each of the feature in the subspace. It uses FRiS-function to solve the problem. Next, a subset of the training dataset is chosen to represent nearest neighbors properly (to maximize similarity function).

Results and discussion. The lack of the number of patients with unfavorable outcome (death) resulted in unstable model with statistically biased characteristics. As it was mentioned above the dataset was randomly divided on two sets (train and test) with 80% in train set and 20% in test set. Software NeuroSolutions 7 built a neural network that was trained on train set. Next we performed a testing phase on test set. We obtained following results: false positive errors of 14%; 12% — false negative errors. The most representative entries were selected by Zagoruyko method (n-195) on train set. Then we applied testing on test set by the nearest neighbor algorithm (as nearest to one of the representatives) and found 14% of false positive errors; 10% of false negative errors. The diagnostic coefficient demonstrated false positive error of 40% (36/89); and false negative error of 60% (125/208). The new diagnostic coefficient constructed on the features obtained from Zagoruyko method gave false positive errors of 34% (30/89) and false negative errors of 16% (33/208). Overall inaccuracy is 21% (63/297).

Conclusion. Nonlinear methods of classification demonstrate a way lower level of errors in comparison with linear methods. Thus, the following investigation would be aimed to construct nonlinear diagnostic coefficient to reflect the results of the experiment held. Constructed neural networks are more effective and could be retrained to show better performance after longer observation of the patients. And also can be used to construct models to estimate life expectancy. Following step is to use deep neural networks to solve this problem.

003 SNOMED CT–BASED STRUCTURING OF CLINICAL TEXTS IN CARDIOLOGY

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A lot of research papers are known to address problems of health information encoding. As SNOMED CT or SNOMED Clinical Terms is considered to be the most comprehensive, multilingual clinical healthcare terminology in the world, many clinical practice concepts from various medical fields are either presented inadequately or missed. Of note, the "blanks" in SNOMED CT result from ambiguity of the target concepts. Practically, one of four terms modeled in SNOMED CT fails to illustrate the whole meaning of a compound term.

Taken as a whole, SNOMED CT for sure is the terminology of choice to encode diagnoses, clinical conditions, laboratory reports, etc. Currently, for the totality of advantages, SNOMED CT is the best possible tool for clinical text structuring.

Indeed, the standard medical histories analyzed, presentation can be seen made up of short complete sentences without excessive speech patterns. Medical text semantics is peculiar due to the fact that, in contrast to usual words, medical terms stand for very special concepts. Put it differently, medical text is formal to be as much as succinct, but for physicians only.

For example, there is no explicit concept for a "constricting pain in the left precordium", an expression popular with cardiologists. However, using the compositional syntax it can be represented as the postcoordinated one as follows:

22253000 |pain| : {363698007 |localization| = (46707002 |precordium| : 272741003 |laterality| = 7771000 |left|), 272144002 | sense quality | *= 410719006 |constricting|}.*

Respective SNOMED CT compositional grammar parser is used to check up if a postcoordinated expression is recognized. The postcoordinated expression above is recognized correctly.

Inquiring into practical implementation of SNOMED CT at the Republican specialized scientific-practical medical center of Cardiology, Uzbekistan Public Health Ministry, demonstrated its high efficiency in health information encoding. Still, the large-scale implementation of SNOMED CT in Uzbekistan remains at the level of true believers' ambitions. Both internal and external factors, absence of SNOMED CT localization in Russian or in Uzbek, in particular, make the contribution.

Summing up, SNOMED CT localization in Uzbekistan is an extremely inviting experience. Although it is a complex methodological challenge requiring interoperation of many professionals, it should be met in coming years, as SNOMED CT is a quintessential means to overcome incompatibility of healthcare information system at the semantics level and increase their interoperability.

004 THE USING A LONG-TERM ELECTROCARDIOGRAPHIC TELEMONITORING IN A YOUNG ATHLETE WITH VENTRICULAR ARRHYTHMIAS

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Athletes with cardiovascular pathology are 2.8 times more at risk of sudden cardiac death (SCD) than non-athletes. One of the most frequent mechanism for the development of SCD is ventricular arrhythmias (VAs). Despite VAs in athlete generally occur in the setting of different cardiovascular pathology, asymptomatic arrhythmia not associated with structural pathology of the heart is an often finding in young athletes.

We report a case of a young athlete with a long history of VAs, and the possibility of using a long-term ECG telemonitoring (TM).

The aim of this study was to analyze using ECG TM in a young athlete with VAs during the screening program for competitive sports.

A 16-year-old male athlete engaged in handball for 6 years. He has been medical examination including ECG, echocardiogram, Holter ECG monitoring two times every year. It is known the first time asymptomatic VAs was registered in 2014 in the number of 100 premature ventricular contractions (PVCs) per day, PVCs were monomorphic. He denied presyncope, syncope, chest pain, palpitations, a family history of sudden cardiac or unexplained death. Echocardiographic results were normal. PVCs were totally absent during exercise test. Since 2014, the number of VAs has not changed significantly. Echocardiographic and exercise test results have not changed. The athlete was allowed to continue participation in professional sport. From 2017 to 2018 years the number of PVCs ranged from 1245 to 5240 per day. There were also detected single PVCs of other morphology, monomorphic ventricular couplets and nonsustained ventricular tachycardia (3 beats) with rate of 103 beats/min. Echocardiographic and exercise test results have not changed. The athlete was allowed to continue participation in the training programs under the control of the ECG TM. TM showed a mean number of asymptomatic PVCs of 9.875 per day. The number of PVCs ranged from 0 to 79 per day (during 8 days). PVCs were single and monomorphic. The risk of SCD in the athlete was low. The athlete was allowed to continue participation in professional sport.

Conclusions. This clinical report illustrates that the unstable number of VAs can not be the main criterion in the decision to admit to sport. The ECG TM allows to evaluate the number of the VAs and the risk of SCD and take decision in participation in sport. It enables a patient to get specialized medical advice 24 hours a day independent of his location.

005 THE POSSIBILITIES OF USING TELEMEDICINE IN THE SYSTEM OF THREE LEVELS OF HEALTH CARE IN RUSSIA

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Introduction. In the Russian Federation, over the long period of development and becoming of health care, a three-level system of health care was created. This structure was created primarily because of the geographical features of Russia — the large size of the country, northern territories, many small settlements.

The first level includes district physician and family doctors, general practitioners, paramedics from medical and obstetric point. etc. This level provides primary care to patients, preventive care and routing patients to medicals specialists (cardiologist, urologist, proctologist, etc.). This level is as close as possible to the population residing on the territory.

The second level unites inter-district (intermunicipal) centers, where are medicals specialists. These centers are created depending on the characteristics of the local territory: population density, remoteness from the centers, etc. These centers have specialized diagnostic equipment, medicals specialists work, outpatient and inpatient care is provided. Interterritorial specialized centers are created to collect medical resources for their more rational use.

The third level is the level of high-tech medical care. These centers are established in large cities of the regions of the Russian Federation. They provide assistance, which requires large financial costs.

The development of modern information technologies and telemedicine allows us to effectively combine all levels and organize telemedicine between them. The development of technologies aimed at the prevention of diseases is extremely important in the healthcare system. Information technology in this can also help.

Purpose. The purpose of our work was the use of modern information technologies, including telemedicine technologies, in the organization of three-level health care for patients with urological diseases, and an assessment of the possibilities of using this technology in other medical specialties.

Methods. On the territory of the Voronezh Region (2.270.000 people live), from 2010 to 2015, a program "Urology" was implemented. The program was supported at the Government of the Voronezh region and personally by the governor of the region. The specialists of all levels of health care from district doctors and urologists to specialists of the Institute of Urology took part in the implementation of the program. Specialists of the Research Institute of Urology provided methodological assistance, took part in training specialists of all levels, provided consultative and high-tech health care. Telemedicine technologies were used at all levels.

Results. The program had special funding. During the program implementation period, 7 inter-district (intermunicipal) urological centers were established, necessary equipment was purchased, general practitioners, urologists were trained, a survey of 307,542 male population aged 45 years (be used IPSS — the International Prostate Symptom Score), a survey of men with deviations from the norm. Needy patients received the necessary health care, including high-tech medical care based on the Institute of Urology (Moscow). To attract patients' to the program, the mass media (newspapers, TV, radio, the Internet) were involved, so-called "Schools of Health" were held.

During the implementation of the Urology program, telemedicine and information technologies were used at all three levels of health care.

For the organization and monitoring of the implementation, regular (once a week) were conducted video telemedicine consultations between specialists of the Urology Research Institute and specialists on the Voronezh Region.

The team of the Research Institute of Urology created distance educational programs for primary care physicians and urologists. 40 general practitioners and 120 urologists have successfully completed distance education.

During the Health Schools, patients and simply healthy people gathered in the conference hall and the doctors of the Voronezh Region were giving lectures on prostate gland diseases. Doctors from the Urology Institute were connected via video telemedicine channels to this school, and also from Moscow they read lectures to patients, answered their questions. Simultaneously, such schools were held online — patients watched the online broadcast of the house on the computer, and doctors from Voronezh and Moscow lectured and answered the patients' questions in the chat.

Some patients (about 10%) filled in the IPSS questionnaire on a special website. If the IPSS values exceeded 7 units, the system automatically suggested that users visit the urologist at the clinic for examination. To do this, the site offered a list of nearby hospitals,

where the urologist is taking a reception, as well as a convenient time to write to the urologist.

If the patient did not decide to visit the urologist at the hospital, the patient could ask the urologist on the site and discuss the IPSS results with him remotely. This allowed the user to make a positive decision about a full-time visit to the urologist. In total, about 2000 such telemedicine consultations were conducted.

The general practitioners and urologists had the opportunity to conduct a telemedicine consultation between themselves or send an electronic medical history to doctors from the Urology Research Institute. A total of 543 such consulates were held.

Some patients were given a special urinary analyzer, which can do a general urine test at home and transfer the results to a smartphone and then go to the doctor's. The doctor could see the results of the tests online and make a decision, advise the patient, adjust the treatment. These were patients who needed to monitor general urinalysis, for example, after surgery or with conservative treatment of urolithiasis. There were 109 cases of using this analyzer.

As a result of the program, the dispensary group of patients with BPH (benign prostatic hyperplasia, prostate adenoma) increased more than 3 times (from 9,659 to 30,054 patients). Changed the structure of the incidence of BPH — increased 1 and 2 stages (in 2009: 1 st. — 51.18%, 2 st. — 38.34%, 3 st. — 10.48%, in 2013: 1 st. — 68.05, 2 st. — 29.22%, 3 st. — 2.73%). The amount of acute urinary retention on the background of BPH decreased by 82%. The frequency of complications of surgical treatment of patients with BPH decreased from 13.2% to 5.6%. By reducing the number of stages of the disease and complications, the cost of treating one patient decreased by 20%.

Similar positive changes were noted in prostate cancer.

After receiving positive results of the Urology program, cardiologists from the Voronezh region used a similar approach for screening and monitoring patients with arterial hypertension.

Conclusions. Telemedicine technologies can be used in organizing and conducting screening. And also for preventive measures in order to increase people's attention to their health.

Distance learning allows you to quickly and effectively conduct training a large number of doctors on the job and at a minimum financial cost.

Telemedicine consultations the availability of medical care for patients, improve the continuity of medical care and the logistics of patients in a three-tier health care system in the Russian Federation.

006 TOWARDS AUTOMATED TAVI DEVICE SIZE SELECTION USING ARTIFICIAL INTELLIGENCE

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Introduction. Transcatheter aortic valve implantation (TAVI) has become the preferred treatment for patients with aortic stenosis at high risk for surgical valve replacement and more recently, also an alternative for surgical treatment of intermediate risk patients. Multi-detector computed tomography (MDCT) is the gold standard imaging modality used during pre-operative planning of TAVI. Based on the dimensions of the aortic annulus (AA), amount of calcium, and other measurements, a prosthesis size is selected. Correct sizing is of paramount importance for optimal procedural outcome but depends on image quality and operator experience. Given that the amount of TAVI procedures is increasing rapidly each year, an automated method that can detect the AA size directly from MDCT images within acceptable accuracy could reduce operator variability and speed-up pre-operative planning.

Purpose. In this work, we present and validate a method that can quantify the AA perimeter automatically using deep learning.

Methods. The MDCT images of a cohort of 455 patients from multiple centers was used during this study. All images were used during the pre-operative phase of a TAVI procedure. During this phase, an expert (observer 1) used the AA plane (AAP) to annotate the AA, from which the perimeter was derived to identify the appropriate prosthesis size. A second expert (observer 2) blindly re-annotated the AA from the AAP of 100 patients. These 100 patients were also used to evaluate the proposed method. The data of observer 1 is considered the ground truth and the data of observer 2 is used to evaluate inter-operator variability.

The AAP and the ground truth AA annotations were used to create the training dataset. The Hounsfield units of the AAPs were used together with binary masks, which were created from the AA annotations (Figure 1).

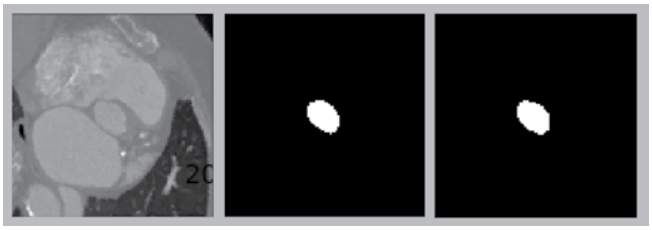

Figure 1: Examples of the data used during training and prediction: the AAP (left) and the associated binary mask (middle) and the predicted sample (right).

Three models were trained with a convolutional neural network (CNN) architecture based on U-Net. During training, the images of 355 patients were used. The three models predicted the remaining 100 patients and during the post-processing step, the perimeter of the predicted area was extracted from the predictions. As a final step, the perimeter was used to determine the correct TAVI size.

Results. The perimeters of all 100 patients were detected. The difference between observer 1 and the predicted measurements was 0.01 [-0.81 — 1.08] (mm) (p = 0.7). The difference between observer 1 and observer 2 was 0.20 [-0.50 — 0.94] (mm) (p = 0.3). There were 89 patients with equal Medtronic Evolut sizes between the observer 1 and the predictions. From the 11 other patients, the predictions of 3 patients were in agreement with observer 2 whereas the predictions of 8 patients differed by 1 size (4 over- and 4 undersized). Total detection time per patient from AAP to Medtronic Evolute size was 1.1 [0.9 — 1.4] (sec).

Conclusion. The proposed method detects the aortic annular perimeter in seconds, while the inter-operator study confirmed that our method is within acceptable accuracy. This clearly shows the potential of using artificial intelligence (deep learning) for pre-operative planning of cardiovascular intervention.

007 CRITICAL SUCCESS FACTORS FOR IMPLEMENTATION OF TELEMONITORING AND EVALUATION OF A HOME-MONITORING PROGRAM FROM CLINICAL PRACTICE

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Background. Telemonitoring can improve survival and quality of life and reduce hospitalization rate and healthcare costs. Unfortunately, many telemonitoring initiatives remain in the pilot phase. Only few programs are successfully adopted in daily routine and can serve as a source for success factors.

Purpose. To reduce the failure rate of telemonitoring, we identified critical success factors using data from literature and from the implementation of a new home-monitoring program: HartWacht.

Methods. The study consists of 3 phases. First, a literature review was performed to identify critical success factors for telemonitoring programs. Success was defined as achieving routine delivery of the telemonitoring program and improving access to healthcare without increasing total healthcare costs or decreasing patients' quality of life. Second, these data were used for the design and implementation of HartWacht. Third, HartWacht was evaluated according to the previously defined factors for success.

Results. The literature review revealed five success factors; 1) inclusion of an appropriate patient group, 2) certified, user friendly medical devices integrated in an electronic health record (EHR), 3) reimbursement, 4) a dedicated team of professionals to review telemonitoring data, 5) adequate feedback to patients.

These factors are used in the design and implementation of HartWacht. 1) Patients are included for therapy-resistant hypertension, atrial fibrillation and chronic heart failure. 2) Devices are certified and validated and connected with a smartphone/tablet application, which is integrated with the EHR. 3) An agreement was made with insurance companies, including a bundled payment per patient for all service related to the condition, instead of pay-per-visit to the clinic. 4) Home measurements are interpreted by a dedicated team with permanent supervision of a cardiologist with a 24/7 availability. The team is supported by algorithms that distinguish measurements between 'normal' and 'abnormal'. 5) If the measurements are abnormal the team can instantly contact the patient for instructions according to the HartWacht protocol.

Evaluation of HartWacht data (from August 2016 to August 2018) shows a successful adoption of the program in routine practice. In the first two years of HartWacht 830 patients were included, resulting in over 60.000 home measurements. Preliminary data show a decrease in total healthcare costs and increase in patients' quality of life.

Conclusion. Analysis of literature provides success factors for the implementation of telemonitoring. Using these factors for the design of a new concept (HartWacht) results in a successful telemonitoring program, which is incorporated in existing healthcare infrastructure, characterized by a high number of included patients, validated hardware and software and integration in an EHR. These factors can be used for future initiatives and will lead to a more effective implementation of telemonitoring.

008 INTELLIGENT DECISION SUPPORT SYSTEMS IN CARDIOLOGY

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Introduction. Modern computer technologies provide unique opportunities for analyzing a large amount of digital data (data science, data mining). One of the perspective areas of data analysis technologies application is the ECG signal decoding. Improving the accuracy of the diagnosis, reducing the time for ECG signal processing through the different algorithms and automation and clinical decision support are a far from complete list of improvements that data science can bring to cardiology.

For data mining in ECG signals, two most urgent problems can be identified: the first is the automatic classification of certain disorders of a heart work and the second is aimed at the development of intelligent decision support systems (IDSS).

Major issues in ECG classification are: lack of standardization of ECG features, variability of the ECG patterns due to personality trait, absence of optimal classification rules for ECG classification.

The task of IDSS development is a continuation of the classification task, and when the second is performed with an acceptable level of accuracy, it is nothing more than the formation of an automatic medical conclusion with the diagnosis.

According to the results of the literature review of ECG classification algorithms from 2017 in the google scholar system were found 14,900 publications. Such a huge amount of publications is explained by the fact that the authors used both different ECG databases, as well as various approaches to feature extraction and further classification (classical machine learning algorithm, neural networks). For that matter, a comparison of the results obtained by different scientific groups is complicated. In turn, 15,400 publications were found in the field of IDSS development for cardiological tasks, which also differ in approaches to the formation of decision algorithms.

Goal. In connection with the lack of the possibility of a correct comparison of the ECG classification results presented in the literature, it was decided to make our own study to determine the most effective classifier. The purpose of this paper is to compare the results of various classification algorithms with the further definition of the most effective classifier in terms of maximizing sensitivity and specificity and minimizing computer time.

Methods. We considered two approaches to the formation of a classifier: with the preprocessing of the ECG signal and without preprocessing. The approach without preprocessing assumes the use of artificial neural networks (convolutional (CNN), recurrent (RNN), long short-term memory (LSTM)) with ECG signal points as an input.

The preprocessing approach is divided into two stages. The first stage is the model-building on the basis of the selected ECG features through various machine learning algorithms and their combinations (SVM, K-nn, Decision tree). The second stage is the system training based on the model built.

For the study were used the MIT-BIH and AHA ECG databases recommended by GOST R IEC 60601-2-47-2015.

Results. At the moment, we estimate the accuracy of classification of disorders of a heart work using various algorithms.

Conclusion. Based on the study results, it is planned to determine the most informative ECG signal features and on their basis to select the optimal classifier. Such an approach will allow to increase the accuracy of detecting disorders of a heart work and to shorten the time spent for processing (ideally, it should be spent only to form a medical conclusion). The next stage will be the IDSS development, which makes it possible to partially automate the process of forming a medical conclusion.

009 D2D: DOCTOR TO DOCTOR, PLATFORM FOR REMOTE ECG/EKG INTERPRETATION BETWEEN GENERAL PRACTITIONERS AND CARDIOLOGISTS

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Background/ Introduction. Cardiovascular disease is the leading cause of early disability and premature death worldwide and its incidence increases with age. The management of patients with cardiovascular disease is a frequent activity and shared between primary care physicians (GPs) and specialist doctors (cardiologists). The electrocardiograph (ECG) is the most used diagnostic tool in Diagnosis.

On the other hand, the use of this tool by general practitioners remains very limited. The difficulty of interpreting ecg/ekg is one of the reasons most often mentioned.

Remote transmission has an important place in the habits of general practitioners. It is used until now via unsecured networks such as fax and social networks (Viber, What's app, Facebook, e-mails ...).

D2D is a secure, easy-to-use platform that provides remote diagnostic assistance (interpretation of the ECG) dedicated to healthcare professionals using ICTs. (Information and communications technology) **Purpose.** The goal is to optimize the management of patients with cardiovascular disease by facilitating the access of the consulting doctors to a network of cardiologists and emergency physicians. Hence the improvement of the immediate decision and the facilitation of the referral of patients to the appropriate institutions.

Methods. The tool is realized in the form of a dynamic responsive WEB application. It consists of a set of dynamic pages to meet all supports and will be used on computer, tablet or smart phones:

1 — Front-end models.

2 — Back office which is a management area for administrators.

We integrate gradually other modules for more features:

• Artificial intelligence that will serve as a diagnostic aid for generalists and young cardiologists.

• Videoconferencing module to allow users to talk to each other via their camera, microphone to better meet. Also it will allow experts to discuss around a clinical case that poses diagnostic problem (in-App Staff).

Results. The emerging market on which D2D is positioned can be defined by:

• A need of health prescribers, assistance for the interpretation of the ECG.

• A need for correspondents (Medical specialists) to reduce the number of useless consultations, embarrassing congestion in public hospitals and promote the R & D axis (research and development) through the data collected via this platform.

• A need for efficiency and effectiveness of the actors intervening to optimize the care of patients.

The Added values of the proposed innovation are:

• Bring innovative solutions to the Millennium Development Goals.

• Sustainable health through the use of digital.

• The dematerialization and the diversification of the supports (Reading of the ECG).

• Pushing the health professional to become an active follower (Training).

• Better quality and optimization of the care path.

• Reduced overall cost of care (especially the Silver Economy).

• Data collection and analysis (Prevention, Prediction, Research).

• Political, economic, social and environmental impacts.

Data security is also our concern but Patient data will be confidential, encrypted with secure exchange protocols. (Also we will try to have the consent of the patient who is tacit in the medical practice). Finally, the database will be put in a server to the standard of the high authority of health.

Conclusion. D2D vision is to offer access, equity, quality, cost effectiveness health care services with benefits for rural and underserved communities in developing countries which suffer from lack of access to health care.

010 REMOTE MONITORING IN CARDIAC SURGERY

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Introduction. Survivability, mortality, complications structure and quality of life are the main factors in evaluating cardiac surgeries. These data allow improving the quality of medical service and providing an individual approach to each patient.

Purpose. Development, organization, and implementation of a program that makes it possible to automatically receive the patient's data with digital surveys.

Methods. The analysis of the current standardized surveys; the development of in-house surveys; the development of a module of the hospital information system for filling and processing data; forming the team to be in charge: a doctor and/or a call-center operator — a patient — the 'Survey' data module. The doctor asks to fill out the survey before the hospital admission and after discharging the patient. The surveys and the planned schedule of filling them are attached to the patient's chart. The data system sends automatic notifications to the patient's email. The patient clicks on the link in the email and completes the survey on a personal computer or a mobile device. The system automatically saves all the replies in the database. Each survey has an 'alarming reply' function in accordance with the main condition. If the survey involves calculation of certain parameters, then the degree of the 'alarm' is calculated on the basis of the reference data. If there are no 'alarming replies', then the patient receives a letter with the evaluation of their health condition. If the system finds 'alarming replies', it automatically notifies the person in charge, after which the survey is analyzed manually. If it is necessary, the doctor might personally contact the patient and/or their relatives to plan further actions.

Results. On 01.03.2018, the Hospital Data Analytics department was organized as a part of the medical institution. The module of 'remote monitoring' has been created in the hospital information system. SF-36 and other clinic-based forms are used for surveying adult patients after the cardiac surgery, children under 18 (the surveys are completed by parents), and the patients who had gone through a carotid artery surgery. The system of remote monitoring has included all patients admitted to the Cardiovascular Surgery Clinic after their voluntary consent. Also, the program included the patients who had surgeries from 2009 to 2018. The program involves 2356 patients, of whom 1878 are active respondents (the feedback rate is 79,7%). 364 surveys with 'alarming replies' have been analyzed. Individual measures have been taken to improve the health condition of each patient in this group. The indicators of long-term mortality for 2018 are the following: 3-month mortality — 1 patient (a child had pneumonia), 6-month mortality — 2 patients (myocardial infarction, the progression of heart failure).

Conclusion. The information obtained by the remote monitoring program allows increasing the quality of medical care for the patients after cardiac surgery.

011 OPPORTUNITIES OF INCREASING MEDICAL LITERACY OF THE RUSSIAN FEDERATION POPULATION THROUGH THE INSTAGRAM SOCIAL NETWORK

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Instagram is one of the largest social networks in the world. According to a number of researchers, the audience of this service in Russia consists of more than 40 million people. By using modern technologies and huge impact of social networks on various aspects of people's lives in general, Instagram represents a new platform with an opportunity for medical personnel to communicate among themselves, as well as to cooperate with patients.

The object of the research is to demonstrate the possibilities of the Instagram social network in the field of improving medical literacy of the population of the Russian Federation.

Materials and methods. the analysis is based on the 2017 results of two medical blogs in Instagram — @ vrachi.insta and @ doc_4_you — with the total number of subscribers of 155 thousand people.

Results of the study. According to the research, most of subscribers of @ vrachi.insta and @ doc_4_you is located in Moscow and St. Petersburg: 20% and 5% respectively. Female audience is a lot bigger and represents 79% of total subscribers. At the same time 63% of the readers are people between 18 and 34 years of age. The most popular topics have proved to be he following: prevention and treatment of chronic non-infectious diseases (obesity, type 2 diabetes mellitus (DM 2), thyroid pathology, hormonal health issues, cardiovascular diseases (CVD)), maintaining a healthy lifestyle (nutrition, mode of the day, fundamentals of sports medicine). The average level of engagement in 2017 for both accounts composed 40.5 thousand views (with maximum index of 66.5 thousand, and minimum index of 22.3 thousand).

Conclusions. The main audience of the two medical blogs based in the social network of Instagram is women from 18 to 34 years of age. The most popular topics have been proved to be about prevention and treatment of chronic non-infectious diseases (obesity, diabetes 2, thyroid pathology, hormonal health issues, CVD), and maintenance of a healthy lifestyle. The average level of engagement in 2017 for both accounts drew up to 40.5 thousand views. Thus, social media, including Instagram, can be a source of medical information in order to improve medical literacy of the population, which can potentially facilitate for the citizens the process of well-timed seeking for medical assistance in real life.

012 MULTIFUNCTIONAL REGISTER OF PATIENTS WITH ISCHEMIC HEART DISEASE AFTER CORONARY BYPASS SURGERY IN CLINICAL PRACTICE

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Clinical databases allow you to detail clinical information, methodologically correctly compare the treatment methods used, identify the extent and risk factors of interventions, and make informed clinical decisions.

On the basis of Chelyabinsk Regional Clinical Hospital, a registry of patients with coronary artery disease after coronary artery bypass was created. The certificate of the state registration of the database "Register of information on patients with coronary artery disease after coronary artery bypass was created" was obtained. The database of the was formed on the basis of the data of a retrospective and prospective analysis, based on this they developed a computer program "Patient monitoring model of coronary heart disease after coronary artery bypass grafting, on the basis of this, they developed the computer program "Patient monitoring model after coronary artery disease" (certificate of registration №20103614215).

When creating a multifunctional register, we were guided by the fact that such system should constitute a territorial population register that will allow registration, recording and monitoring during the entire outpatient monitoring of patients undergoing coronary bypass surgery living in the service region. This will enable health professionals and organizers of health-care to obtain reliable information on the status of care for this category of patients in the territory: prevention, diagnosis, treatment, including compliance with medical and rehabilitation standards in various medical institutions.

The register allows to make recording and monitoring of the status of patients with coronary bypass surgery who live in the service region. The development of the register was carried out on the basis of existing state regulations. The issue of compatibility of information systems between medical organizations is not completely solved because of imperfect legislation and software compatibility problems. There is a number of unsolved issues: the application of a unified classification system for the evaluation and registration of symptoms, diagnoses, medications, treatment results. Standardization is necessary to ensure the exchange of information between different organizations through software. At the same time, today there are problems of comparability of clinical classifications (classifications used in scientific and clinical practice) with the International Classification of Diseases and the International Classification of Functioning, Disability and Health.

Providing the possibility of electronic access for different specialists from different medical institutions to medical information of the patient will allow to choose the best individual tactics of patient management. It will also provide the opportunity for conducting clinical and economic analysis and for planning financial and resourcing support for the system of providing cardio surgical and rehabilitation assistance to the population of the region.

013 PLACE OF ELECTRONIC QUESTIONNAIRE IN THE YOUTH PREVENTION SYSTEM

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Introduction. Due to the development of atherosclerotic diseases several decades before their clinical manifestation, it is necessary to introduce a system of youth preventive measures. This is the most effective approach to the fight against high cardiovascular mortality in Russia, although designed for the long term. The system of youth prevention should be built on the principles of modern electronic technologies. Purpose: to study the possibilities of electronic screening of students' health resources as the first stage of mass preventive examination of young people on the basis of the University Health Center (HC). **Methods.** On the basis of the platform for the creation of various surveys *CMS Lime Survey* it was formed an online questionnaire, including questions to students for self–verification of some risk factors (RF) (1st stage of examination). The factors to be identified in this format include the profiles of nutrition and motor activity, smoking, stress, burdened heredity and past diseases. This questionnaire of students precedes their objective screening (2nd stage of examination), during which an interdisciplinary team carried out the direct determination of biological RF such as high blood pressure, obesity (body structure with bioimpendancemetria), dyslipidemia and hyperglycemia (using strip diagnosis on blood drop) and estimation of vascular age with use of hardware-diagnostic complex Vasera-1500 (Densia Fucuda, Japan). In the process of the 2nd stage, primary preventive intervention is carried out also. This publication presents the results of statistical processing of 100 people from the electronic database of the HC, including 56 girls and 44 boys aged 18 to 22 years from different faculties. Statistical processing was carried out using Excel software package. **Results:** according to the data of the electronic survey, students were diagnosed with the following RF: irrational nutrition (insufficient consumption of cereals, vegetables, dairy products, while the apparent excess in the diet of sweet and meat) — in 47%, hypodynamia in 51%, smoking in 16%, stress in 36%, burdened heredity in 39% and the presence of infectious-inflammatory and allergic diseases in 24%. As a result of second stage, it was possible to further identify biological RF in 14% of students, with almost half of them identified these factors in isolated form. It was turned out students without RF were significantly more at the medical faculty — 34% — compared to other faculties — 16% ($P<0.05$). **Summary.** Electronic diagnostic screening on the basis of specialized platform *CMS Lime Survey*, which provides a convenient opportunity to independently assess the resources of their own health, allowed to abandon the laborious screening in paper format and greatly rationalized the work of the University HC in the conduct of mass preventive measures among students.

014 INTEGRATION OF INSTRUMENTAL DIAGNOSTIC METHODS INTO MEDICAL INFORMATION AND ANALYTICAL SYSTEMS AT THE LEVEL OF THE END USER — THE PATIENT

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Prerequisites. Personalized medicine is a perspective direction of the development strategy of the Russian Federation until 2035, signed by the President of the Russian Federation V. V. Putin in 2016.

Currently, telemedicine care is available in a limited capacity without the possibility of remote follow-up. The development and implementation of innovative methods of remote control of the main indicators of the cardiovascular system (CVS) and biochemical markers of the state of health (BM) is actual.

Purpose: creation and integration of remote monitoring devices for objective indicators of CVS and BM in medical registers (BM) and medical information analytical systems (MIAS).

Methods. Developed and tested new technology of registration, storage and telemedicine data transmission (Audio-Video signal, ECG, NIBP, SpO_2, Glucose, HbA_{1c}, Chol, Trig, HDL, LDL, Urea) was used — hardware and software complexes (HSC): *"Doctor's Bag" and "Bag of the Patient"*.

The basic component of this information support system is the devices for collecting, processing and telemedicine data transmission ("Doctor's Bag" and "*Bag of the Patient*") to the MIAS registers and from specialists (doctors, nurses, administrators, etc.) to the patient. The basis for objectifying the information obtained about the patient's current health status and the exact stratification of risks is the interaction with Big data sets. These data include general information (risk factors, results of standard laboratory, instrumental studies and etc.), information on all acute cases and chronic diseases, evaluation of the effectiveness of treatment and prophylactic measures based on the analysis of outcomes (recovery, rehabilitation, disability, death).

The volume of the study is 120368 users (see Table 1).

Table 1.

Categories	User Quantity
All users	120 368
Hypertension	75 682
Diabetes	27 012
Hypertension & Diabetes	12 026
Seniors (over 65 years old)	152014
Doctor Visits for Hypertension	1 200 168
Doctor Visits for Diabetes	49 2301
Health Check	123 289
Family Doctor Contracted	305,000

Results.

1) Universality of the use of the HSC "Doctor's Bag" and "*Bag of the Patient*" is proved.

2) Increased adherence to drug therapy.

3) Increased number of telemedicine consultations.

4) There was a decrease in the number of repeated calls for main disease.

5) Significantly reduced the burden on the emergency medical and the functional diagnostics departments.

6) Increased number of newly diagnosed diseases at the preclinical stage.

Conclusions.

1) The concept of integration of instrumental diagnostic methods into medical information analytical systems at the end-user level is a promising direction aimed at solving medical and organizational tasks, including the management of the quality of diagnosis and treatment.

2) Using objective control data of CVS and BM indicators in the field of personalization of medicine provides for an increase in the effectiveness of telemedicine health monitoring by unifying methods for collecting personal data on health status, storage, systematization and analysis of Big data blocks.

3) The opportunity to improve the quality of medical care with the help of the "Doctor's Bag" and "Bag of the Patient" at all stages of medical support of the patient is proved.

Doctor's Bag

Bag of the Patient

015 PAVING THE WAY FOR E-LABORATORY MEDICINE

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The increased pace of digital adoption is an ally in addressing the healthcare challenges in the networked age and the provision of high quality services is a critical component of patient care, involving diagnosis, monitoring and screening services. There is little doubt that an increasing number of laboratory and healthcare tasks performed by trained professionals today will be replaced by technology. Technology tools are increasingly automating highly standardized and repetitive routine laboratory tasks while wearable technologies, connected diagnostic and monitoring tools are facilitating the delivery of care to patients. The digital healthcare transformation is taking place globally, the future is connected, patient centered, mobile and social.

This digital paradigm is exerting a profound impact in Lab medicine. Digital lab medicine is totally disruptive because the changes in the capabilities to integrate and visualize complex diagnostic data. This represents an opportunity for radical changes to diagnostic health strategies in the rapid changing healthcare environment. These innovations are changing the facts like how we live, how we acquire information, how we interact with each other, and how we practice the profession of specialist in lab medicine. In the face of exponential growth of applications in telemedicine, tele-biology and m-health with the smart phone applications, the laboratory systems need to meet new demands for data exchange with clinical electronic record systems for test requesting and results reporting.

Properly implemented digitization can enable better patient outcomes, improve convenience, potentially lower healthcare costs. The new tools that can give us a much more high-definition view of the patients; because the wearable sensors that track a wide range of important physiologic parameters continuously. The digitization of health care and lab medicine can also improve the clinician-medical biologist-patient relationships, allowing more time for human interaction when care is boosted by digital technologies that better individualize diagnostics and patient monitoring. The future of Lab medicine is challenging with the integration of these disruptive technologies, increasing innovation and transformational changes. The specialist in lab medicine must reinvent his leadership in face of the digital transformation, as well as reinforce strong relationships with patients and practitioners to provide always-on services. Because the pletora of existing apps, it is important to continually evaluate which apps are effective for which patients and situations. Digitalization and e-health characterize not only a technical development, but also a state of mind, a way of thinking and a commitment for networked, global thinking to improve health care locally regionally and worldwide.

016 MODELLING OF A WEAK COMPONENTS IN THE DYNAMIC SERIES

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Different areas of theoretical or applied medical research deal with dynamic series. For example, the dynamic series is formed from consequent measurements of the patient's number at fixed moments of a certain observation period. Statistical analysis of the series reveals the dynamics of medical indicators and determines the forecast of their changes in the future. As a result, negative trends can be suppressed in advance, preparing for this a set of necessary therapeutic and preventive measures.

Many practically important in health statistical indicators (such as the trend in the development of the process, operational and long-term forecasting, the dominant mechanisms in the pre-emption period and so on) can be obtained on the basis of time series computer modeling. The main problem is to determine the component composition of the time series through the procedure of its levels decomposition. Trend, cyclic, seasonal and random components reflect the impact of a number of different nature factors on the studied characteristic. It is therefore quite difficult to analyze the time series as its components interact, mask and distort each other. To overcome this obstacle different decomposition techniques are used to help disentangle and quantify the impact of various causal factors. Analysis of individual components and consideration of the contribution they make into the time series levels helps us to increase the forecast reliability as well as adjust the future process development in the desired direction.

The most important component is the trend component, which displays the dynamics of the analyzed indicator in the long-term perspective. Medical and social processes are not stationary, so the trend identification is always a pressing task. The methodological and applied significance of the trend is determined by the fact that it represents the basis of long-term forecasts.

However, medical observations (especially long-term) do not always reflect the presence of trend in the dynamics of the phenomenon under study. Quite often, high-amplitude periodic oscillations of either cyclical or seasonal nature hide the trend in the data series (seasonal influenza outbreaks, for example). To know whether or not trend is the case, we need to remove cyclic and seasonal components from the time series. This procedure provides a cleaner way to detect the trend.

Such a situation, of course, can be repeated in relation to other components of the series.

The standard approach to decomposition of these series does not provide their adequate representation, since weak components fall out of the model at the initial stage, that is, after the correlation function evaluation. In this regard, the standard decomposition algorithm was supplemented by a procedure that allows identifying any weak components of the time series. Namely, at each step of the cycle the correlation function is evaluated. Its maximum value determines the current dominant component, which is further excluded from the series levels. The resulting reconstructed series goes through a new cycle, that is, the definition and exclusion of the next current dominant component. The process of modeling the systematic part of the series is completed by obtaining random series residues.

017 "PERSONAL ACCOUNT" ON THE WEBSITE OF A MEDICAL ORGANIZATION. THE WAY FROM AN ALTERNATIVE METHOD OF COMMUNICATION WITH THE PATIENT TO THE MAIN SOURCE OF INFORMATION

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The prerequisites. The southern Russian regions with the area of 447,821 km² and the population of 16,441,852 people traditionally fall into the "maintenance" zone of the clinic, wherein the overwhelming majority of patients live at a significant distance. The implementation of the remote communication program with the patient seems to be actual process.

The purpose. To obtain a full-fledged communication channel with the patient; ensure the information exchange "without intermediaries" in a bunch of "the doctor-consultant (doctors' concilium) — the patient."

The methods. 1. Creation of the patient's "Personal account" ("PA") module on the official website of the clinic with certain set of instruments for information exchange. The patient is given the opportunity to track the processing of medical records on the fact of their entering the clinic. If a positive decision about hospitalization is made, the patient is informed of the planned date of hospitalization and the type of planned surgical treatment. The personal recommendations and a memo list of studies and analyzes necessary for hospitalization are displayed. During the patient's stay in the clinic, his relatives through the "PA" can receive the following up-to-date information: about the separation of the stay and chamber's number, the state of the patient's health, the attending physician (with the opportunity to see the doctor's personal site page), the planned and conducted operations, the schedule of the patient's visit, as well as personalized comments from the attending physician or surgeons.

2. Organization of information exchange process — creating the reliable interface between the patient's "PA" and the Hospital Information System (HIS), namely: providing access to authorized information through the web-service; creating restrictions on access to data by forming access levels and organizing the process of granting access to each level with validation of minimum data set; minimization of HIS users additional work related to data provision to the patient's "PA" and the integration of additional capabilities into the existing workspace.

The result. The project "PA" has been implemented to the medical organization site and launched into trial operation since March 2018.

To date, the project is actively involved in more than 1000 patients.

Using this module in the medical personnel daily practice can reduce their burden of providing information and, at the same time, increase the awareness of the patient and his relatives.

The conclusions. The implementation of the "PA" project on the clinic's website in the daily activities of the doctor leads to the achievement of such important indicators of the medical care quality as:

Availability and timeliness — the possibility of feedback from the patient. "PA" has become the tool for patient information support.

Orientation to the patient — follow-up after the completed surgical treatment.

Optimization of the workflow between the patient and the clinic.

018 UNDERSTANDING AND MANAGING UNCONTROLLED HYPERTENSION USING REMOTE REAL-TIME MONITORING AND MANAGEMENT STRATEGIES

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The prevention and management of disease represents one of the most important challenges for our society. Given the current growth in the number of chronic disease cases, the traditional approaches for the prevention and management of disease are rapidly approaching a point of no return. Reasonable estimation of the offer and demand for medical treatment indicates that it will not be long before such services become so expensive and inefficient that society will simply not be able to afford them, and traditional treatment delivery services will no longer be able to provide them. However, there is a true revolution brewing in both prevention and disease management which has a clear, and rapidly growing potential to save the day. I will discuss the aspects of sensor technology, user engagement, big data, advances in

disease and exacerbation predictive models, and smart apps driven by artificial intelligence which are at the core of this revolution.

In particular, I will describe the use of our own platform, remsmed/ EMMA Care, in a multicenter study of Uncontrolled Hypertension. This platform is currently at the center of several studies in Switzerland and elsewhere.

019 NOVEL REGULATION MECHANISM OF CARDIAC SYSTOLIC AND DIASTOLIC FUNCTION IN MYOCARDIAL ISCHEMIA–LNCRNA ZFAS1

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Ca^{2+} homeostasis — a critical determinant of cardiac contractile function — is critically regulated by SERCA2a (sarcoplasmic reticulum Ca^{2+}-ATPase 2a). Our previous study has identified ZFAS1 as a new lncRNA biomarker of acute myocardial infarction (MI). **Objective:** To evaluate the effects of ZFAS1 on SERCA2a and the associated Ca^{2+} homeostasis and cardiac contractile function in the setting of MI. **Methods and Results:** ZFAS1 expression was robustly increased in cytoplasm and sarcoplasmic reticulum in a mouse model of MI and a cellular model of hypoxia. Knockdown of endogenous ZFAS1 by virus-mediated silencing shRNA partially abrogated the ischemia-induced contractile dysfunction. Overexpression of ZFAS1 in otherwise normal mice created similar impairment of cardiac function as that observed in MI mice. Moreover, at the cellular level, ZFAS1 overexpression weakened the contractility of cardiac muscles. At the subcellular level, ZFAS1 deleteriously altered the Ca^{2+} transient leading to intracellular Ca^{2+} overload in cardiomyocytes. At the molecular level, ZFAS1 was found to directly bind SERCA2a protein and to limit its activity, as well as to repress its expression. The effects of ZFAS1 were readily reversible on knockdown of this lncRNA. Notably, a sequence domain of ZFAS1 gene that is conserved across species mimicked the effects of the full-length ZFAS1. Mutation of this domain or application of an antisense fragment to this conserved region efficiently canceled out the deleterious actions of ZFAS1. ZFAS1 had no significant effects on other Ca^{2+}-handling regulatory proteins. **Conclusions:** ZFAS1 is an endogenous SERCA2a inhibitor, acting by binding to SERCA2a protein to limit its intracellular level and inhibit its activity, and a contributor to the impairment of cardiac contractile function in MI. Therefore, anti-ZFAS1 might be considered a new therapeutic strategy for preserving SERCA2a activity thereby cardiac function under pathological conditions of the heart.

020 REMOTE MONITORING IN THE DIAGNOSIS OF POST ABLATION ATRIAL TACHYCARDIAS

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Objective. To identify an optimal diagnostic method of remote monitoring of patients underwent catheter ablation of atrial fibrillation (AF) in the postoperative period.

Research methods. The analysis included 126 patients with a paroxysmal and persistent AF who underwent catheter isolation of the pulmonary veins with and without substrate modification of the left atrium (LA). All the patients received standard medical therapy, including anticoagulant and antiarrhythmic drugs, also they were under the dynamic supervision of the cardiologist in their local polyclinic.

All of these 126 patients received remote monitoring systems during three month post operative period and were divided into 3 groups. Group 1 (n=40) got standard pulsometer; group 2 (n=38) got one-channel ECG device, which is connected to a mobile phone and is operated by applying thumbs on it; group 3 (n=48) got 6-channel standard (I, II, III, AVR, AVL, AVF) ECG device, which is also connected to a mobile phone and is operated by applying 4 electrodes on body surface.

All patients in case of complaints about rapid heart palpitations or irregular heart rhythm were able to immediately contact the call center to transfer data from their devices. After that these patients were brought to our clinic.

Results. There were 4 patients who faced rapid heart palpitations or irregular heart rhythm in group 1. The device showed from 80 to 150 beats per minute. All of these patients transferred the data to call center and were brought to our clinic then. Post ablative atrial tachycardia (atypical atrial flutter) was confirmed only with one patient, all the other patients had a sinus rhythm.

There were 7 patients who stated the same complaints in group 2. The specialists of the call center had hard times to remotely tell post ablative atrial tachycardia from sinus tachycardia. Upon arrival to our clinic the former diagnosis was confirmed only with 2 patients, and 5 patients were diagnosed the latter.

And finally there were 5 patients who experienced problems in group 3. The specialists of the call center were able to remotely diagnose post ablative atrial tachycardia with 3 patients, 2 patients had sinus rhythm according to the device. All of these data and diagnoses were later confirmed at our clinic after the patients arrived in person.

Conclusion. Remote monitoring using 6-channel standard ECG device showed the best results in timely and precise diagnosis of post ablative atrial tachycardia (atypical atrial flutter).

021 STOCHASTIC DESCRIPTION FOR SOME HEART RATE VARIABILITY (HRV): SINUS ARRHYTHMIA AND EXTRASYSTOLES

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Introduction. Time between two heart beats (RR) is variable. Leading causes for the irregularity RR are the sinus arrhythmia (SA) and extrasystoles (ES). The existing explanations of irregularity RR, physiological as well as pathological, use a few quantity parameters that not easy to apply for a comparison between and within groups.

Aim. To reveal that stochastic model for ECG could present as characteristic of the SA, one number, R, which can be named intensity of SA. In some cases, the R must be followed by the estimation of respiratory induced SA, RSA, and/or by not random frequencies around 0,1 Hz (Mayer waves). Presence of ES demands additional (to the R) characteristic named the intensity of extrasystoles, λ, equals to the number of ES per 1000 RR.

Model (a) It is known that during slow depolarization Ca-channels are in two states, open and close. The more Ca-channels are open, the shorter is the time to approach the threshold thus the time RR is down. Versa, if the number of open Ca-channels drops. Let assume that at the start of a new slow depolarization each Ca-channel randomly preserves or changes its state on previous cycle. Thus we have math model, type of random walk for the number of open Ca-channels. Outcome of the model is a sequence of RR. Main characteristic of model is the sum of two probabilities: probability for open channel to become close and probability for close cannel to become open. It can be named intensity of SA, R. The model's sequence of RR is transformed into spectrum. Between mean frequency of spectrum of RR, f(mean), and the R is established relation. Real RR is treated the same way. Due to relation between f(mean) and R we know R for the real RR. (в) Description of ES was based on Poisson distribution and Poisson parameter λ is used as an additional characteristic for RR arrhythmia.

Results. RR series were taken from PhysioBank Databases. The characteristics of SA were obtained from 220 people by analyzing

35000 RR series each about 10 min (512 points). In 60% of series the R completely describes the SA. In 10% series there are no stable conditions. In 20% series there are, additionally to the R, respiratory sinus arrhythmia. In 20% series the spectrum was not randomly increased around frequency 0.1 Hz (Mayer waves) meaning that additionally to the SA estimated by R we have the addition from Mayer waves. Also two groups without heart problems were analyzed. Both include 20 people. First group are of 20-30 ages, and second one of 60-75 ages. Intensity of SA was higher in first group ($p<0.05$). For analyzing and estimation of λ was used Holter monitoring i*n* 120 patients. The intensity extrasystoles, λ, vary from 2 till 150 per 1000 RR.

Conclusion. Stochastic description for heart rate variability in patients with sinus node as main source for ECG permits (a) to characterize sinus arrhythmia by one number, with possible addition of the breathing arrhythmia and/or Mayer waves (2) to introduce the characteristic of intensity of extrasystoles.

022 COMMON INFORMATION SPACE TO SUPPORT MEDICAL AND SCIENTIFIC ACTIVITIES OF THE REPUBLICAN SPECIALIZED SCIENTIFIC-PRACTICAL MEDICAL CENTER OF CARDIOLOGY (UZBEKISTAN) AND CARDIOLOGICAL SERVICES

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The project titled "Common information space to support medical and scientific activities of the Republican Specialized Scientific-Practical Medical Center of Cardiology and cardiological services" aims at experimental adaptation of international standards, methods and experience in exchange of PC-based healthcare information, architecture of electronic medical records and formalization of clinical data.

Electronic Medical Record (EMR) was developed in accordance with requirements and standards accepted in the Russian Federation to create common information space aiming at support of medical and scientific activities of the Republican Specialized Scientific-Practical Medical Center of Cardiology and cardiological services. A set of the EMR fields coincides with those in the ambulatory medical record (AMR), approved by Uzbekistan Public Health Ministry. The EMR is the core of the common information space of the Republican Specialized Scientific-Practical Medical Center of Cardiology covering demands of the cardiological services. Based on the EMR conceptual, logical and physical database models, for MysQL database management system, in particular, were developed.

As the output of the project, the software tools, methods and practical recommendations provide automation of: (i) a patient's registration and fixing an appointment, (ii) keeping of his AMR containing medical history (appointments and contacts, details of management, diagnoses and treatments, laboratory findings) and other data, (iii) registration of complaints, diagnoses and typical regimens, (iv) preparation of documents for a patient's management in the outpatient clinic and (v) medical statistics and clinical data analysis.

All over the world, Health Level-7 or HL7 as a set of international standards for transfer of clinical and administrative data between software applications used by various healthcare providers appears for a superstructure facilitating consistency of specifications and methods for development of healthcare information systems stipulated by the "National Integrated Information System of Public Health of Uzbekistan" concept (2009).

Currently, potential for use of SNOMED CT to encode healthcare information in the Republican Specialized Scientific-Practical Medical Center of Cardiology is under study. Consequently, efforts on localization and reduction of the terminology to medical practice in Uzbekistan should be made. Compliance with international standards in the electronic communication development of healthcare, and creation of the unified information model for healthcare and technologies of semantic clinical data relationship will help overcome negative consequences of current "patchwise" communication development of healthcare, and spontaneity in national development of health information systems.

023 EFFECTS OF 58-DAYS HEAD-DOWN BED REST ON CARDIAC TIME AND AMPLITUDE PARAMETERS EXTRACTED FROM SMARTPHONE'S ACCELEROMETERS

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Introduction. Smartphone accelerometers can measure cardiac activity due to heartbeat-induced vibrations. The acquired waveforms resemble the seismocardiogram (m-SCG) or the ballistocardiogram (m-BCG), according to the position of the device, on the chest or on the belly, respectively. Accordingly, specific fiducial peaks such as the isovolumetric contraction (Ivc) and aortic opening (Ao) waves on the m-SCG, or the moment of blood acceleration into the ascending (I) and descending (J) aorta on the m-BCG, can be detected by an ECG-free beat detection algorithm and then used to compute time and amplitude beat-to-beat parameters potentially useful to characterize cardiac conditions.

Purpose. Our hypothesis was that cardiovascular deconditioning related to reduced activity and prolonged immobilization, a condition related to ageing and chronic cardiac disease, could be monitored by these parameters. Our aim was to evaluate which time and amplitude parameters extracted from m-SCG and m-BCG could be sensitive enough to monitor deconditioning induced by long-term (58 days) head-down (-6°) bed-rest (BR) in healthy volunteers. The aim was to obtain an average waveform from a sequence of m-SCG and m-BCG beats by applying the discrete time warping averaging (TWA) and then to assess the changes of time and amplitude parameters.

Methods. Ten male subjects (age: 34±9; BMI: 24±2 kg/m^2) were recruited. One minute m-SCG and m-BCG signals were acquired by two smartphones (100Hz) simultaneously while in supine position, before (BDC) and after 58 days (HDT58) of BR. After removing baseline wander due to respiration, fiducial peaks were detected on signals, respectively. Time warping averaging was used to obtain a non-linear average of 32 consecutive beats, from which the following T_{IVC-AO} and T_{IJ} temporal intervals were computed and normalized ($T_{IVC-AO\%}$ and $T_{IJ\%}$) by the corresponding mean beat duration. Peak-to-peak amplitude parameters were calculated (A_{IVC-AO} and A_{IJ}) and normalized by the BMI Results are presented as median and 25th — 75th percentiles. BDC and HDT58 results were compared by paired Wilcoxon test (* $p<0.05$).

Results. The averaged waveforms (Fig.1, in red) computed in one subject at BCD and at HDT58 are shown for m-SCG and m-BCG. To cardiac deconditioning, in both signals, the heart cycle duration was found significantly reduced at HDT58 (Table 1). In addition, a significant decrease of $T_{IJ\%}$ was found, together with a trend of decrease in $T_{IVC-AO\%}$. Conversely, amplitude parameters seemed not affected by BR.

Conclusions. These signals with a large inter-beat morphological variability can be evaluated by TWA to obtain representative parameters of a short acquisition. The obtained time interval parameters, in particular for m-BCG, are sensitive enough to measure cardiac deconditioning induced by BR. This approach could be extended to chronic cardiac patients to daily monitor their condition, thus providing a new potential tool for self-tracking.

024 INFORMATION-ANALYTICAL SYSTEM AS AN AUTOMATED WORKPLACE FOR HEALTH SYSTEM MANAGEMENT

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The digital era provides tremendous opportunities for solving modern challenges and changes in all industries and sectors of the economy. The adoption of management decisions and evaluation of their implementation is based on the processing of a large amount of data. The main role in solving problems of effective management is the processing of statistical data.

The actual medical and statistical indicators obtained as a result of processing the statistical data allow conducting research of processes and phenomena in medicine, to identify the most significant patterns and trends in the health of the population, to study and assess the status and dynamics of the network development, the activities of health facilities and medical personnel. Thus, data on the demographic situation in the country, provided by Rosstat, allow forecasting and planning the resources of the health care system.

One of the most important areas for processing management information in the healthcare sphere can be considered the application of the "Internet of things" (IoT). Occupying a worthy niche in medicine, IoT will help to increase the efficiency of medical institutions, reduce the time spent in hospital, provide doctors and patients with new services for monitoring health, collecting and analyzing additional information on the course of treatment. IoT can be applied in the administration and management of medical organizations and processes in them.

In today's world, it is impossible to process information that is heterogeneous in the way it is formed, received and submitted without means of automation. For successful management of the industry, a digital platform must be created that provides integration capabilities, manageability and availability of applications, mobile devices, services, large amounts of data, interfaces and APIs.

As an example of the implementation of an automated system for managing health care resources based on these principles, one can cite an application developed in the Federal Research Institute for Health Organization and Informatics of Ministry of Health of the Russian Federation — the Automated System for Informing the Leader (ASIR).

The system's data storage processes information that is heterogeneous, both in composition, form and content, obtained from various sources. At the moment, the repository contains statistical data on health system performance and is measured by hundreds of thousands of electronic documents and 40 million records over the past 25 years.

To solve the problem of interoperability, mobile access to information, relevance and the possibility of integration with other information resources of the healthcare and external sources of information, as well as solving the problem of independence from the hardware and software operating environment, ASIR is created as a web application for Rich Internet Application technology. In order to increase the speed of the application, Ajax technology was applied.

The approach, presented on the example of ASIR, to the construction of a digital health management platform allows to concentrate the efforts of the heads of healthcare management bodies at various levels on making informed decisions and allows to solve a number of problems:

— perform operational search of statistical indicators for a number of years;
— compare the analyzed indicators;
— produce graphic visualization of data;
— provide operational access to the information store;
— generate reports and inquiries in automatic mode.

025 THE MAIN TRENDS IN THE DEVELOPMENT OF DIGITAL HEALTH AND THEIR TEACHING IN A MEDICAL UNIVERSITY

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Digitization of health is a modern trend in the development of health care. This is an integral part of the digitalization of the economy of the Russian Federation. Therefore, the introduction of digital methods into the activities of the health authorities and institutions of the Russian Federation is an urgent, complex and responsible task aimed at improving the quality, accessibility and effectiveness of medical care. Digital health includes electronic document circulation in the health care system, the use of telemedicine technologies in the provision of medical care, the use of mathematical methods (including artificial intelligence methods) in the processing of medical data.

To solve the problems of the development, implementation and dissemination of digital technologies in medicine, the Digital Health Institute was established at Sechenov University. Its tasks are:

1. Introduction of digital technologies in the activities of the Clinical Center.
2. Development of plans for the development of the electronic medical system of the University, calculation and justification of the required financial resources for its development.
3. Construction of the digital platform of the University on the basis of the integrated electronic health record, PACS-system, Federal electronic medical library, normative-reference information of the Russian Ministry of Health, information system of evidence-based medicine and open international data stores designed for:
   a. For early diagnosis and analysis of the risks of disease occurrence, a predictive prognosis for the development of the disease;
   b. To search for precedents for electronic medical records, including on time intervals and other biomedical content;
   c. For a predictive prognosis of the disease;
   d. To search for precedents in foreign biomedical resources and risk assessment;
   e. To monitor and deliver to the physician intellectually processed specialized content on the issues of interest (daily volume ~15,000 publications).
4. Improving the quality of mathematical analysis of factual data.
5. Development of ideology and methodology for the development of digital medicine in the Russian Federation.
6. Introduction of innovations and their commercialization by searching for new solutions, supporting promising projects, cooperating with leading developers of digital technologies in Russia and the world.
7. Implementation of training programs:

For the education of all students studying in the 1st and 2nd year of studying in the disciplines: Information systems and technology, Information technology in professional work;

For the students of the direction, the doctor-researcher within the framework of the "Medicine of the Future" project will study the discipline of IT technology and e-health: planning, implementation and management ".

Additional specialization of physicians in the field of IT-doctor and network doctor.

Bachelor's degree in Information Systems and Technology with additional specialization in German universities.

Master's Degree in Information Systems and Technology in Medicine with additional specialization in German universities.

026 ELECTROCARDIOGRAM STREAMING OVER BLUETOOTH LOW ENERGY

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Introduction. Bluetooth Low Energy (BLE) has become the de facto standard for communication between fitness devices and other health-related wearables with a smartphone due to its reduced power consumption, which is normally associated to a low data transmission. There already exists BLE Heart Rate profile and service that provides

average values of the heart rate. However, for some applications, the complete electrocardiogram (ECG) is needed.

Moreover, there are many wearable devices available nowadays, each with its own app and synchronising with its own cloud provider. However, some applications would profit from receiving and processing in parallel the information from several devices (for example, ECG and muscular activity). Data fusion can take place already in the smartphone. Parallel streaming of several real-time signals over BLE is an even larger challenge.

Purpose. The purpose of this work is to find out if it is possible to stream the ECG signal through BLE with enough quality and in that case, if it would be possible to parallelize the streaming of several BLE signals to a smartphone.

This work is part of the development of a system with a smartphone-based personal gateway to synchronize data from different BLE health-related devices with the HIS (Fig. 1-a). One of the devices is a T-shirt to measure a long-term ECG using textile electrodes (Fig. 1-b). To provide a general and sustainable solution, a BLE ECG profile is needed. This profile should be downloadable from an open server (BLE Toolbox) to be used by third parties. All requirements are stated in Table 1.

#	Requirement	Component	Result	
1	Continuous measurement over 24 h.	ECG Sensor	ECG Sensor (with Arduino 101): 4 days duration with powerbank Smartphone: strong dependencies on device	√
2	Sample and transmission rates of at least 500 Hz	ECG Sensor	Distance Sensor/Smartphone: Rate (BQ Aquarius U Lite with Android 7.1) * 3 meters: 550 Hz * up to 1 meter: 850 – 950 Hz	√
3	Accuracy of milliseconds for HRV calculation	ECG Sensor	Each ECG value is stored and transmitted with a timestamp in milliseconds	√
4	Parallel BLE streaming of several ECG or other biosignals	App	Three parallel streams tested without decrease in performance	√
5	Downloadable ECG-BLE profile configuration information for app	BLE Toolbox	Available from a REST-API	√
6	Downloadable source code for ECG-Sensor	BLE Toolbox	ECG Sensor code can be visualized and downloaded.	√
7	Generation of Zephyr-source code for further profiles defined with BLE-Toolbox	BLE Toolbox	Source code can be generated and downloaded	√

Methodology. After the specification of the requirements, the system was modelled, implemented and tested. The BLE ECG profile allows each notification (limited to 20 bytes) to include three ECG values each with a timestamp. This profile is used by the ECG sensor and by the app. The code for the ECG sensor has been written for a Real-Time Operating System with a Hardware Abstraction Layer, so that the same source code can be compiled on all supported microcontrollers. The RTOS allows also better a configuration of BLE parameters (connection interval, slave latency, connection timeout). Zephyr was the selected RTOS, running currently on Arduino 101 and in the future on Aconno ACN52832. The BLE client was programmed on an Android app that allows several parallel connections (Fig. 1-c).

Results. Fig. 1-d shows an ECG transmitted with the ECG profile with the t-shirt without timestamps, reaching 2.480 ECG values/second. Fig. 1-e shows the final result using timestamped values, reaching between 550 and 950 ECG values/second. The results regarding all requirements can be found in Table 1.

Conclusions. Streaming of ECG over BLE in parallel to other signals is possible. Current work concentrates on the support of other microprocessors, pre-processing in the t-shirt, improvement of the middleware for the app and support of non-Android Smartphones.

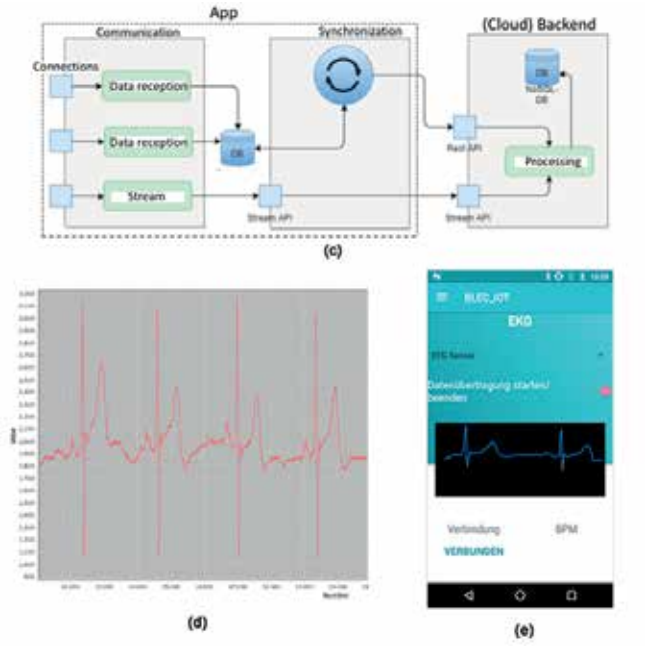

Figure 1. (a) App as personal gateway for several parallel devices; (b) ECG T-Shirt; (c) App architecture; (d) BLE-ECG streaming (without timestamps); (e) End-to-end transmission with timestamps.

027 USING MACHINE LEARNING TO BUILD NEXT GENERATION TOOLS FOR CARDIO VASCULAR DIAGNOSIS

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Introduction. To train machine learning algorithm to do task at hand requires two major steps. Step one is data collection and step two is data labeling. If data is labeled by people who poses expert knowledge about tasks at hand then machine learning algorithm can produce results on par with best experts in the field.

Such algorithms can be used in numerous ways, depending on specific task they were trained to accomplish. Currently there are no general frameworks that allow businesses or medical institutions to collect data and label it in a format suitable for machine learning.

Goal. Creating framework for data collection, labeling and learning. It can be used by businesses and medical institutions to create next generation diagnosis tools. This tools can be integrated into consumer products or used in places where you'd typically use medical experts.

Methods. Each particular task is different because of different inputs or a mixture of thereof. Before solving the task we propose to create a framework for data aggregation and labeling. This system will be data type agnostic and should be able to work with multiple data types, like images, audios, and other kinds of electrical signals. Data is coming from patients and labeling is done by experts in the field.

Based on aggregated labeled data a machine learning algorithm can be trained. To train algorithms we currently use deep learning techniques as those produce state of the art results. When training has finished further labeling of new data sent from patient can be done without medical expert. Meaning it can be integrated into consumer products to give expert opinion instantaneously.

Particular example where it can be used includes providing expert level recommendations based on data gathered from electroscope device.

Results. Our prototype consists of iphone application for collecting imagery and audio data plus an interface for medical experts to

label that data according to task at hand. After collecting enough data algorithm can be trained to label the data without medical expert. The result is autonomous system that can process inputs sent by patients returning recommendations.

Outcomes. We believe such framework will be able to provide businesses a new way to build consumer level tools for diagnosis of diseases. Also creating opportunities for telemedicine, getting expert opinion on data can be hard, but when algorithm is able to perform at the same level as world experts then more people have access to it.

028 PRACTICAL EXPERIENCE OF APPLYING ARTIFICIAL INTELLIGENCE METHODS FOR DATA ANALYSIS IN MEDICINE

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Medical development in Russia involves active introduction of digital technologies into the practical activities of doctors. The use of mathematical methods for processing medical data leads to medical care quality improvement, reducing medical errors, speeding up diagnosis and providing a more accurate assignment of necessary treatment methods. Artificial intelligence practices have been applied by authors in several branches of medical diagnostics.

The authors propose the following solutions.

Recognition of cancer cells in blood and bone marrow smears (automatic morphological analysis), performed on scanned images of colored smears applied to the glass. Out of 120 known blood cell pathologies, 33 are recognized with 85-90% probability. Over 30,000 images have been processed and "colored" by experts, over 78,000 cells have been marked. It is expected that, by the end of 2018, 50-60 of such pathologies will be recognizable. The limitations, restricting the mass application of this method, are: the complexity of preparing the source material, its choice, coloring, scanning; lack of common standards in preparing the material and in transferring the data; high cost of relevant equipment.

Recognition of pathological changes in the lungs by chest radiographs (automatic interpretation of radiographs). Over 48,000 lung radiographs have been processed, over 60,000 objects have been identified, and the suspected cases of tuberculosis, pneumonia, and lung cancer are recognized with 90% probability. 9 out of 46 pathologies are recognized. The transmitted data are well-formalized in the DICOM format. The method has mass-use potential, allowing to send digitized images for processing out of almost any office. Arranging a mass-use automated screening procedure will allow detecting diseases at early stages.

Recognition of pathological changes in the body by fundus images. An experienced ophthalmologist can recognize over 100 different body pathologies during a fundus exam, from diabetic rhinopathy to hypertensive disease. The authors have studied over 15 thousand fundus images and now the system automatically recognizes 9 pathologies. The method has mass-use potential, as today ophthalmic departments have modern equipment allowing to store and transfer digitized images.

Recognition of urinary bladder diseases by ultrasound scans. The bladder itself and its fullness level can already be recognized with 80% probability. The method can be useful for patients with genitourinary system disorders for remote bladder filling/emptying control when using mobile ultrasound scanners at home.

The results obtained witness the unlimited possibilities of using mathematical methods (including artificial intelligence) for medical data processing. The development and adoption of information exchange standards and the legalization of mathematical methods application will lead to a serious improvement in the quality of diagnostics and in the detection of diseases at early stages.

029 EFFICACY ASSESSMENT OF OUTPATIENT MONITORING CHRONIC HEART FAILURE PATIENS WITH CARELINK TECHNOLOGY DEVICES

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The purpose of the study is to estimate the results of dynamic obsevation for chronic heart failure patients with ICD/ CRT-D devices.

Materials and methods: 118 ICD/ CRT-D/ CRT-P devices were implanted in a period from january 2015 till december 2017 in Surgut Region Cardiocenter. 22 of them were with Carelink remote monitoring system. 44 patients were under the supervision. We divided this patients into two equal groups (10 CRT-D/ CRT-P and 12 ICD in each group). Patients with Carelink system were included in the first group. All patients were visiting hospital 4 times per year. At the same time information from first group patients was receiving continuosly.

There were 86% male patients in our study. The average age of patients was 61±5 years old in first group and 63±7 years old in second group.The average NT-proBNP value was 2799±576 pg/ml in first group and 2567±477 pg/ml in second group. The average ejection fraction value was 36±4% in first group and 35±6 % in second group. 14 patients from first group were in II CHF functional class, 5 patients — in III CHF functional class, 3 patients — in IV CHF functional class. 17 patients from second group were in II CHF functional class, 3 patients — in III CHF functional class, 2 patients — in IV CHF functional class. The ejection fraction, NT-proBNP value and CHF functional class were estimated during this study. All patients were receiving optimal medical treatment. Microsoft Excel attachment was used for statistic processing.

Results: 10 patients from first group and 8 patients from second group has mooved into I CHF functional class. 7 patients from first group and 10 patients from second group has mooved into II CHF functional class. 3 patients from first group and 2 patients from second group has mooved into III CHF functional class. 2 patients from first group and 2 patients from second group has mooved into IV CHF functional class. Ejection fraction has increased to 36±4% in first group and to 35±6% in second group. The average NT-proBNP value became lower: 801±376 pg/ml in first group and 867±408 pg/ml in second group. 4 (18%) patients from first group had tachy AF episodes inside the VT zone. One of these patiens received ICD — therapy. AF paroxysms were recognized for the first time in 3 (14%) patients from first group. 2 (9%) patients from first group had increasing intrathoracic impedance, which could be assosiated with CHF progression. 4 (18%) patients from first group had ICD — therapy (ATP and shock) because of stable VT. 1 (4%) patient from first group had nonstable VT episodes.

Resume: modern methods of CHF patients treatment increase their quality of life. Carelink remote monitoring system gives us information about patients' arrhytmias and ICD-therapies, wich help us to treat these patients better.

030 USE OF NATURAL LANGUAGE PROCESSING TO CLASSIFY MOBILE HEALTH APPS: PERFORMANCE EVALUATION

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Background. Use of conventional keyword-based search (KBS) to find mobile health apps on the app stores has limitations as the user is provided with long lists of apps with little insight into the apps' relevance to the search.

Purpose. The aim of this study was to develop a novel method, based on natural language processing (NLP), able to identify apps in a given topical area more accurately than KBS.

Methods. We developed an automated NLP method based on MetaMap and the Unified Medical Language System (UMLS) to extract medical concepts from the apps' description reported on the store webpages. We built a classifier able to identify, based on the medical concepts retrieved, the most relevant topical area(s) of the app. We extracted a random sample of 800 apps from the Medical and Health & Fitness categories on the US iTunes app store and we built a training set and a test set of 400 apps each. We classified apps into topical areas (e.g., cardiology, emergency medicine, neurology, oncology, surgery, fitness & wellness), one or more whenever relevant, or none in case of no medical content. Classification was performed: (i) manually (gold standard); (ii) by using NLP; and (iii) by using KBS, which was implemented by using comprehensive lists of keywords for a safer estimate. We evaluated the performance of the NLP and KBS methods by computing multi-label classification metrics such as accuracy (i.e., the average of accuracy values across topical areas), exact match (i.e., the proportion of predicted sets matching the true sets exactly), recall (i.e., sensitivity), and Hamming loss (i.e., the fraction of topical areas not correctly predicted).

Results. By optimizing the proposed NLP method on the training set we obtained 94% accuracy, 49% exact match, 88% recall, and 6% Hamming loss. On the test set, the performance of NLP was similar as in the training set whereas the performance of KBS was lower (accuracy: 92% NLP, 39% KBS; exact match: 36% NLP, 28% KBS; recall: 63% NLP, 50% KBS; Hamming loss: 8% NLP, 9% KBS). KBS performance in real settings is likely to be lower as typically few keywords are used in app searches. NLP performance was higher in some topical areas (e.g., endocrinology, oncology, gastroenterology) and lower in others (e.g., surgery, fitness & wellness) due to less specific vocabularies.

Conclusions. The proposed NLP method performed better than KBS in classifying health apps into topical areas as the former is able to extract medical concepts from their context and uses optimized classification rules whereas the latter simply retrieves keywords from a text. The NLP method can be further improved by inclusion of additional vocabularies and more complex classification rules. The proposed method is context-aware and able to classify apps into multiple categories whenever relevant and, as such, it may be the basis for novel filtering tools to support patients and healthcare professionals in informed adoption of apps.

031 EFFECTS OF TWO DIFFERENT PREVENTIVE COUNSELLING PROGRAMS WITH REMOTE SUPPORT ON STRESS LEVEL AND QUALITY OF LIFE IN CORONARY PATIENTS WITH ABDOMINAL OBESITY

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Background. Patients (pts) education has a potential to improve quality of life (QoL) and stress level reduction in coronary heart disease (CHD).

Purpose. To assess the impact of 2 preventive counselling programs with subsequent remote support resulted after hospitalization on stress level and QoL in CHD pts with abdominal obesity.

Methods. A prospective randomized parallel-group study in hospitalized nonsurgical pts with confirmed stable CHD. Most hospitalizations were due to elective percutaneous coronary intervention. Pts were randomized (1:1:1) into 3 groups. Before discharge, Groups 1 and 2 received comprehensive counselling with focus on diet followed by remote counselling by phone (Group 1) or via text messages (Group 2). Remote counselling was delivered weekly (Months 1-3) and then monthly (Months 4-6). Group 3 received standard advice only. The 10-point visual analogue scale (VAS) for stress and HeartQol for QoL were used.

Results. A total of 120 pts (mean age±SD, 57,75±6,25 years, men, 83.4%) were enrolled. The Table presents the stress levels and QoL at baseline and at 12 months. At 1 year, significant improvements of stress level and QoL vs control were seen in both intervention groups.

	Group 1 (n=40)	Group 2 (n=40)	Group 3 (control) (n=40)	Group 1 vs 3, P for change from baseline	Group 2 vs 3, P for change from baseline
Stress level, VAS points, mean ± SD					
Baseline	7,10±1,93	6,73±2,16	6,75±2,68		
At 12 months	3,08±1,67	3,18±1,55	6,73±2,05	<0.01	<0.01
HeartQoL global score , mean ± SD					
Baseline	1,77±0,50	1,80±0,65	1,76±0,49		
At 12 months	2,84±0,13	2,77±0,46	1,70±0,58	<0.01	<0.01
SD, standard deviation					

Conclusion. Pre-discharge preventive counselling with subsequent remote support in coronary patients with abdominal obesity resulted in significant improvement of stress level and QoL.

032 THE EFFECT OF PREVENTIVE COUNSELING WITH FOCUS ON DIET MODIFICATION AND REMOTE SUPPORT BY PHONE ON METABOLIC PARAMETERS IN PATIENTS WITH HIGH CARDIOVASCULAR RISK

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Introduction. Unhealthy eating behavior is one of the most important modifiable cardiovascular (CV) risk factors (RFs). It is closely associated with overweight/obesity, hypercholesterolemia, hypertension and type 2 diabetes mellitus.

Objectives. To assess the impact of preventive counseling with focus on diet modification on metabolic parameters in patients (pts) with high/very high CV risk who visited Health centers.

Methods. This is a prospective randomized controlled study of pts aged 40 to 65 years with high/very high CV risk (⩾5% according to the Systematic Coronary Risk Evaluation scale [SCORE]) and any 2 criteria for metabolic syndrome. Pts were randomized into 2 groups in 1:1 ratio. The intervention group received comprehensive preventive counseling with focus on diet modification followed by remote preventive counseling by phone every two weeks for the first 3 months after enrollment (a total of 6 sessions). The control group received usual care in Health centers which also included basic preventive counseling.

Results. A total of 100 pts (women — 82%, aged 59.74±4.66 years) were randomized. At baseline 93% pts had high and 7% — very high CV risk. The groups were well balanced according to demographic and clinical features. At 1 year of follow-up pts from the intervention group experienced significant improvement of metabolic parameters vs control: their diastolic blood pressure (BP) decreased by 5.62±7.7 mm Hg, total cholesterol (TC) by 0.5±0.83 mmol/l, low-density lipoprotein cholesterol (LDL-C) by 0.46±0.62 mmol/l. Both groups experienced statistically and clinically significant decreases in systolic BP (intervention group, -17.76±16.2 mm Hg; control group, -13.44±15.6 mm Hg; both groups p<0,001). Nevertheless, the difference between groups at 1 year was not significant.

Table. The effects of preventive counseling with focus on diet modification and remote phone support.

	Intervention group		Control group		P for change from baseline
	Baseline	After 12 months	Baseline	At 12 months	
Systolic BP, mm Hg, mean ± SD*	148±19.9	130±13.19	147±18.9	134±14.2	n/s
Diastolic BP, mm Hg, mean ± SD	85,5±9.5	79.9±8.2	84.8±8.8	82.7±7.6	p<0.05
TC, mmol/l, mean ± SD	6.37±1.24	5.87±1.13	5.94±0.94	5.82±1.04	p<0.01
LDL-C, mmol/l, mean ± SD	4.16±0.97	3.74±0.90	3.97±0.84	3.85±0.96	p<0.01
Blood glucose, mmol/l, mean ± SD	5.45±0.57	5.56±0.48	5.19±0.65	5.35±0.55	n/s

* SD – standard deviation.

Conclusion. Preventive counseling with focus on diet modification followed by 3 months remote support by phone provided a significant improvement of metabolic parameters.

033 COMPARATIVE EFFICIENCY OF HOUSE AND OFFICE TELEMETRIC CONTROL BP AND THE ECG IN IDENTIFICATION OF CARDIOVASCULAR INCIDENTS AT PATIENTS WITH HIGH CARDIOVASCULAR RISK IN THE REMOTE AND HARD-TO-REACH LOCATIONS OF WESTERN SIBERIA

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The traditional telemedicine technologies, such as remote "doctor-patient" or "doctor-doctor" consultations, allows reducing the frequency of hospitalizations and emergency calls, but has no significant effect on mortality and the incidence of complications in patients with high cardiovascular risk. Against this background, remote health monitoring using telemetry control of blood pressure (BP) and the electrocardiogram (ECG) may have better results. 997 patients with high cardiovascular risk permanently living in far and hard-to-reach locations of Western Siberia were investigated with the help of the BP and ECG remote control data. Electronic BP monitors and single-channel mobile ECG recorders with data transmission over radio units were used as sensors. The observation period was 24 months. Data processing was carried out in the regional telemedicine center, with subsequent informing of patients, therapists, and medical emergency wards, if necessary. The 18,342 measurements performed by medical personnel at first aid-obstetric stations and outpatient clinics conditions, and 11,412 measurements performed by patients independently at home, in "on-demand" mode. Cases of deviations from target BP and all types a rhythm and conductivity disorders considered. In addition, the presence or lack of complaints at patients at the time of BP and ECG registrations considered. As the end-points, cases of hospitalization, calls of ambulance and sanitary aviation, were accounted. The number BP deviations from target values, detected during measurements at medical organization conditions and home conditions, was similar (12,43±0,84% and 10,62±0,76%, p>0.05), asymptomatic incidents are registered approximately in half of cases (7,03±0,98 and 5,86±1,02, p>0.05). The number of a rhythm and conductivity disorders also doubtfully differed at registration of the teleECG on in medical office conditions and at home (5,32±0,22% and 5,98±0,24%, p>0,05), the lack of active complaints of patients is noted almost in every second case (3,21%±0,55 and 2,86%±0,72, p>0,05). The number of hospitalization, calls for ambulance and sanitary aviation concerning cardiovascular diseases in group of patients with the revealed "office" BP/ECG incidents was significantly higher, than at patients with "house" BP/ECG incidents (5,37±0,12% and 2,08±0,10%, p<;0,05), but the benefit of hospital care and emergency medical service wasn't verified. No cardiovascular deaths were registered at patients during observation. Rather high level of asymptomatic BP/ECG deviations, no depended of registration conditions, discovered. Significantly higher level of hospitalizations cases and air/common ambulance calls for patients with "office" BP/ECG incidents observed, irrespectively the results of rendering the hospital care, which can reflect only increased alertness in the provision of medical care in a medical office conditions, into account zero mortality in group. Expected, that a direct relationship between effectiveness of remote health monitoring and the number and frequency of measurements exist. Further researches will concern to explore the opportunities of noninvasive, continuous, and time-consuming remote monitoring of human biological parameters, such as BP, ECG, and hemostasis at patients with high cardiovascular risk. The main problems in the development of such systems are the selection of safe and comfortable biological sensors, the construction of effective big data transfer and processing systems, search of the online date mining software and algorithms of the corrective and protective actions.

034 USE OF AUGMENTED REALITY IN IMPROVEMENT OF PATIENT EXAMINATION/MONITORING PROCESS ON THE EXAMPLE OF A WIRELESS HEART RATE MONITOR

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Main goal of Augmented Reality (AR) technology is that it extends what people can see with additional data/information. People can get information without need of using any input devices like mouse or keyboard. Until recently this technology was not evolving very well as there were a lot of technological limitations. Now everything changed and many different types of AR devices appeared on the market.

Currently the entire process of patient examination is done by doctors with many hi-tech devices which still present results on separate screens/outputs. Each device contains a screen where the physician needs to look for result/progress, without a unified layout. This pulls their attention away from patient, which is unwanted especially at Intensive Care Unit's (ICU) or Critical Care Unit's (CCU). A universal device, which would contain all the information in one place would be greatly appreciated in these settings.

Main goal of this work is to show the capability of Augmented Reality to be used during patient's examination by looking at him without the need to look away to view important vital signs on various devices around the bed, specifically to show how information from a medical device can be collected and broadcast to a AR-capable device over WiFi. To make it work, a dedicated interface between diagnostic devices and Augmented Reality Glasses was developed. This was realized using a Raspberry Pi microcomputer connected to the HeartRate sensor. Heart rate sensor returns very exact values from heart reads. Value range of sensor is from 1 to 1024 which is very good for precision and future development of solution (Fig. 1). The computer collects patients' heart rate data and after analysis sends it over WiFi network to AR device where the patient's heart rate is displayed. Specifically, for every new value of heart beats per second, application executes a linux-based command which opens a dedicated UDP port and shares data from the algorithm over it. Data can be accessed by any software/device which knows Raspberry Pi's IP address and UDP port number. Next, we have used AR device, running Windows-based operating system, to access the data sent from Raspberry Pi. Applications running on AR device are written in Unity Engine, which allows to use all advantages of Augmented Reality technology. In our case, the application connects to a specific IP address and UDP port, and listens on them for incoming data. New information is automatically presented to the doctor in real time, whilst allowing continued and undisturbed doctor-patient interaction.

The purpose of this solution was to show how easily it can be to relay information from medical devices onto AR apparatus. For the first time the physician is not limited to the place where the device screen is placed/installed. Thanks to this solution, one can imagine that every medical information can be digitalized, sent and displayed on AR devices.

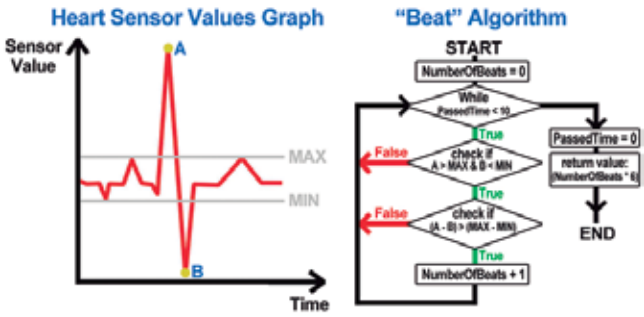

Fig. 1. Value range of sensor.

035 ROBUST TOPOLOGICAL APPROACH TO ECG ANALYSIS FOR EXPRESS ASSESSMENT OF THE PATIENT'S CARDIAC STATUS

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Due to the rapid increase of the variety and quality of mobile gadgets designed to make express cardiac status analysis, and also due to improvements of ECG processing and analysis methods, the efficiency of cardiomonitoring has significantly increased. For patients with mobile cardiogadgets, it is nowadays possible to track changes in their own cardiodynamics in real time and to record their episodes of negative cardiodynamics. However, there is still a range of situations in which available methods of ECG analysis do not provide correct results. Such situations, in particular, include the cases of so-called "transitional cardiodynamics", when the diagnostically significant changes on the ECG are not clearly expressed.

The report will present our approach to ECG analysis, based on the topological analysis of the wavelet spectrum of the electrocardiograms (there is a patent for the invention). The use of this approach is demonstrated on examples with different cardiodynamics. In particular, scenarios of the initial development of myocardial ischemia and scenarios containing the onset of an episode of atrial fibrillation will be considered. With the help of the developed approach, new significant indicators of negative cardiodynamics were found. The internet service that makes it possible to analyze ECG signals online was developed and launched.

The proposed approach to ECG analysis can be used in addition to existing methods of ECG analysis for the purpose of primary assessment of the patient's cardiac status. The use of topological methods will allow to expand the possibilities for identifying and preventing critical states in cardiodynamics.

036 MATHEMATICAL MODEL OF HEMODYNAMICS

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The presentation covers the results of the study of transport function of blood circulation system which have the underlying basis of the original hydrodynamic theory of the 'third' mode of liquid flow. It has been shown that blood flows in vessels in exactly this mode. It allowed us to work out a mathematical model of hemodynamics which in its turn led to the development of a new method to indirectly determine volumetric parameters of hemodynamics using lengths of heart cycle phases.

The speed of liquid flow must change with every impulse according to strict rules. Specifically:

• instantaneous speed of liquid flow along an elastic tube changes in the impulse according to the following formula:

$$U_t = U_0 (t_0 / t)^{0.4}; \quad (1)$$

• instantaneous radius of the opening of an elastic tube during its expansion changes according to the following formula:

$$r_{+t} = r_0 (t / t_0)^{0.2} \text{ при } t_0 \leqslant t \leqslant t_1; \quad (2)$$

• instantaneous radius of the opening of an elastic tube during its contraction changes according to the following formula:

$$r_{-t} = r_0 \{\varepsilon + \beta [\varepsilon - (t / t_0)^{0.2}] / 2\} \text{ при } t_1 \leqslant t \leqslant t_2; \quad (3)$$

• maximum speed of liquid flow in an elastic tube in the impulse equals:

$$U_0 = 37.5\, g\, t_0 [(5\varepsilon - 2)^3 - 27] / [(5\varepsilon - 2)^5 - 243]. \quad (4)$$

The developed mathematical model of how the optimum hydraulic system operates has been adapted to describe the processes in blood circulation system.

The equations that have been worked out have made it possible to measure the following parameters in each heart cycle:

SV — systolic volume of blood, (ml);

MV — blood circulation volume per minute, (l/min.);

PV1 and *PV2* — blood volumes flowing into the ventriculus of the heart during early diastole and atrium systole respectively (ml);

PV3 and *PV4* — blood volumes driven out of the ventriculus during fast and slow outflows respectively (ml);

PV5 — blood volume that the ascending aorta pumps during a systole working as a peristaltic pump (ml).

Clinical studies have confirmed theoretical calculations, which allowed to use this method effectively in cardiology practice.

037 INFORMATION SECURITY RISKS IN TELEMEDICINE

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Information technology has become an integral part of our lives, we communicate on social networks, register, exchange contacts, make payments through mobile applications, businesses make multimillion-dollar transactions, storing a variety of data in the cloud, which, in turn, contain confidential and trade secret.

Health care is not an exception, against the background of the widespread introduction of telecommunications, reducing the cost of communication channels, the position of the state, which determined the priority of public policy to preserve and strengthen public health through the formation of a healthy lifestyle and improve the availability and quality of health care — health care is an Outpost due to the growing interest of the population to their own health.

The rapid development of new information technologies in health care in recent years is characterized by the fashionable term *telemedicine*. Having gone through a complex and thorny process of evolution from the transmission of cardio readings with the use of the phone at the beginning of the last century to the conduct of teleconsultations of patients and staff, the exchange of information about patients between different institutions, remote recording of physiological parameters, control of operations in real time, at the moment telemedicine is a promising trend. This situation brings health care to a new level of development, having a positive impact on all aspects of its activities.

The world health organization defines this modern branch of medicine at the intersection of high technology and medical science as *activities, services and systems related to the medical care from a distance by means of information and communication technologies aimed for promoting development of health, epidemiological control and the provision of medical care, as well as training, management and research in the field of medicine.*

The most complete definition of telemedicine technologies was introduced in the article *Remote medicine: Problems and*

Experience (Karpov O. E., Lyashchev S. A.) — it is a set of organizational, technical and other measures used in the provision of medical services to the patient with the use of procedures, tools, and methods of data transmission over communication channels, ensuring the reliable identification of participants in the information exchange — the doctor, the patient or his legal representative.

But regardless of the definition telemedicine, as a technological alternative to traditional processes in health care, must necessarily meet the requirements of information security in general and the requirements for personal data security in particular. More specifically, telemedicine should implement a set of organizational, technical measures to protect information from unauthorized access, destruction, modification, disclosure, and access delays, ensuring confidentiality, integrity, availability, authenticity, reliability, resiliency, and identity, in accordance with applicable international ISO standards and regulatory and legal support.

A series of ISO standards, containing practices and recommendations for the creation, development and maintenance of information security management has an index of 27000 and includes 15 provisions with consistent numbering. Conditionally this series of standards can be divided into 4 sections:

- review and introduction to terminology, description of terms used in the field of security;
- mandatory requirements for the information security management system, a detailed description of the methods and means of system management. Is the main standard of this group;
- audit recommendations, guidance on safety measures;
- standards recommending practices for implementation, development and improvement of information security management system.

Non-compliance or insufficient security measures in the provision of telemedicine services can have a negative impact on the quality of medical care itself, and undermine confidence in the service which is especially important when the number of personal data leaks increases. Thus, according to the research of Infowatch, in 2016 in comparison with other industries the largest percentage of data leaks (25.8%) occurs in medical organizations which is 5.6% more than in 2015 (see Fig. 1).

Fig. 1. Distribution of the number of leaks and the volume of compromised personal data by industry.

The number of leaks caused by the external spoilers increased by 3.5%, which indicates a special *attractiveness* and liquidity of these data in the market (see Fig. 2,3).

There are quite a lot of types of telemedicine classification according to the method of application and data transmission. At the same time, in relation to personal data (PD), the area of telemedicine can be divided into two parts, clinical and home. Between the areas there is a bidirectional information transmission (synchronous, asynchronous) in any of its manifestations: text, video, audio, formats of various medical standards — ASTM, ASC X12, IEEE / MEDIX, NCPDP, HL7, DICOM, using all types of communication-mobile devices, removable media, network, e-mail, messengers, cloud services, etc. Below is a schematic representation of the information transfer process (see Fig. 4).

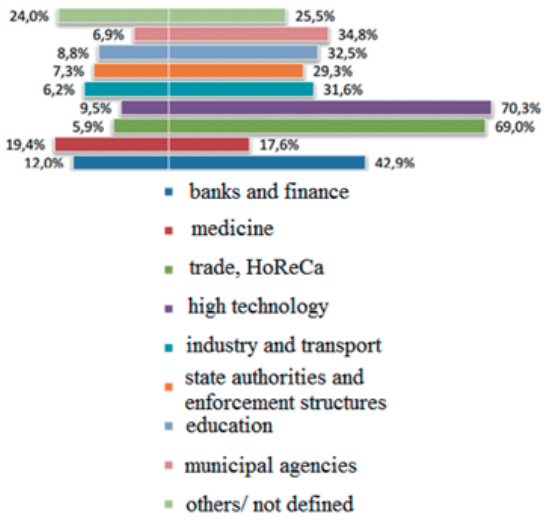

Fig. 2. Percentage of intentional PD leaks under the influence of internal (left) and external (right) attacker of the total number of PD leaks by industry, 2016.

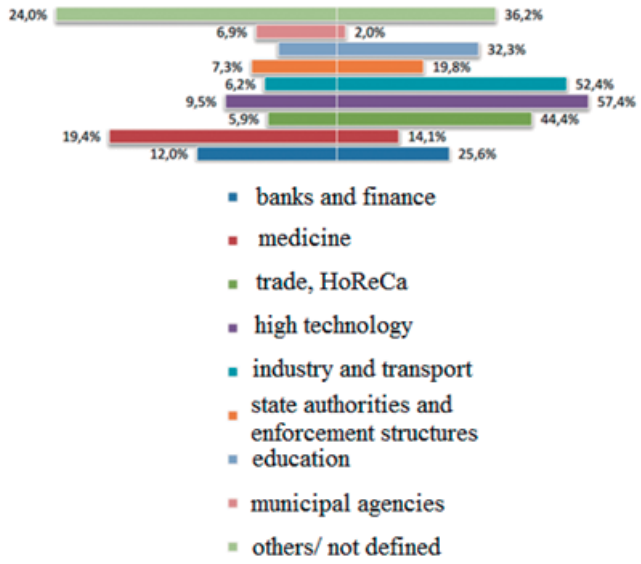

Fig. 3. Percentage of intentional leaks of PD under the influence of external (left) and internal (right) attacker from the total number of leaks of PD by industry, 2015.

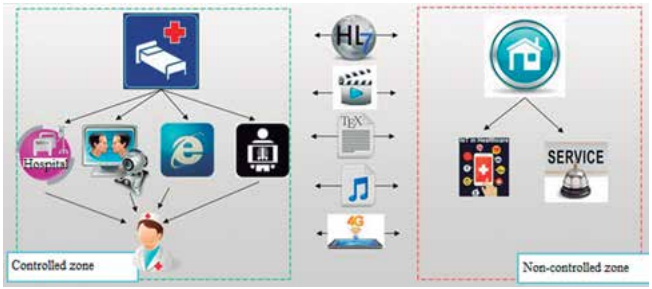

Fig. 4. Process of information transmission in telemedicine systems.

Distortion, falsification, deletion, disclosure of some information, as well as disruption of its processing and transfer to information automated systems can cause moral, material and, as a consequence, reputation damage to all participants of the information exchange.

Unfortunately, the issue of information security is usually raised only after the leakage of confidential information. And medical organizations are not always able to provide an adequate level of

data protection, and to resist different kinds of impacts on critical information. The reasons for the lack of data protection corresponding to its importance can be the lack of funding and the lack of trained professionals in information security.

Therefore, in the clinical zone, we have a *conditionally* controlled area. Only when a medical organization fulfills all the requirements for the personal data protection and the security process itself is systematic, the data are transmitted through encrypted channels, information security tools are implemented and effectively operated, routine work is performed, staff with access to data are trained, instructed, have a proper level of knowledge in the field of information security and can apply knowledge in practice.

Home zone is potentially dangerous due to several factors:

• low level of computer literacy of end users, patients, like most users do not attach due importance to the instructions and privacy policies;

• inability to control the operation of the patient's personal devices (smartphone, computer, tablet, Wi fi point, Bluetooth, USB).

Except the standard risks and threats to information security the world of telemedicine brings new. Their underestimation can further lead to mass leakage of information, loss of confidence. The problem is particularly relevant in conditions of increasing exponentially the number of smart things, in particular, in medicine too (Fig. 5).

Fig. 5. Growth tendency of IoT devices.

With the constant increasing the number of devices involved in telemedicine information exchange new vulnerabilities are emerging. Lack of security leads to an increase in the number of cyber attacks, and the attacker gets access to confidential information and the device itself, and it can be a vital device.

In 2008 a team of researchers from the Archimedes Center for Medical Device Safety at the University of Michigan confirmed the possibility of hacking pacemakers, resulting in possible access not only to personal information, but also to make configuration changes. For this reason, in 2013 doctors of the former Vice President Dick Cheney disabled the wireless capabilities of the pacemaker to stop possible attacks.

Against the background of scandals in 2017 with the leakage of personal data and cyber attacks of the encoder WannaCry and extortionist Petya, there may be a decrease in the patient's confidence in telemedicine services. According to Kaspersky lab, the number of attacked users in this period reached two thousand. Most incidents were recorded in Russia and Ukraine, as well as cases of infection were observed in Poland, Italy, Great Britain, Germany, France, the USA and a number of other countries.

Causes and risks:

• companies engaged in the development of devices, mobile applications and software are primarily focused on capturing the market for maximum economic benefit, so they do not always pay due attention to security, as this requires additional testing and the involvement of information security specialists;

• There are no specialized committees governing standards, protocols, and services. Each producer uses its own convenient protocols, which makes it extremely difficult to use standard means of information protection, and makes it necessary to study additional threats and build specialized protection;

• Many devices do not assume the possibility of updating, and their service life is very high. So, the vulnerability set out by the producer will remain the entire useful life;

• Some devices work in such a way that the patient has no or almost has no idea about the internal functioning of the device, not to mention his control;

• There are no options to prevent the occurrence of security problems;

• There is the possibility of using security holes of a device to capture all the network and transmit confidential information on the activities of the patient — physical, intimate, religious;

• Devices are used as reference points to gain control over other systems and can also be used as botnets;

• Standard account from the producer, weak authentication without a possibility of change;

• Use of insecure cloud infrastructure;

• Lack of encryption when transferring data, sometimes the transfer is in text format;

• The physical security;

• Under such conditions, there is an urgent need to ensure;

• State regulation and standardization of protocols and services between devices;

• Adequate protection, both in the transmission and storage of all collected personal data, with the possibility of limiting access;

• If necessary, the de-identification or anonymization of data;

• minimization of the collection of personal information from the patient, clear regulation of the volume of transferred information;

• Carrying out educational and training activities, both among patients and among medical personnel, as an important factor aimed at reducing the risks of information leakage;

• Development of specialized means of information protection considering medical specifics.

038 EMPIRICAL RESEARCH ON THE ACCEPTANCE OF DIGITAL TECHNOLOGIES IN MEDICINE. HEALTH CARE OF AN AGEING POPULATION IN RURAL REGIONS

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Problem, Aim. The sustainability of digital innovations in medicine is determined mainly by its acceptance: from patients, doctors and physicians' assistants, and nursing services.

On that point, we analyzed possible predictors. These predictors tested we referred them to the dissemination (market development), the use (uptake) and experiences of health apps *(EPatient Survey* 2018). Thereby results a current, comprehensive view on acceptance and market of digital technologies in medicine.

Methods. *EPatient Survey* 2018 is the largest (N = 9.700) online survey on digital health in German-speaking countries. Each year in March and April approximately 80 health portals, health insurance companies, startups, media houses, patients' organisations put the survey online. The questionnaire comprises about 80 items, so that dissemination, effects and dynamics of digital health applications can be dtermined in an unprecedented level of detail.

Results. For the development of new digital solutions in care the knowledge of digital markets and consumer psychology and behavior are crucial: for a focused strategy, product development and business models. End product properties, scenarios of care, trends of scaling-up of applications in the health market as well as willingness to pay form the basis and are the drivers for all companies in this market.

Conclusion. In conclusion, acceptance research shows up the factors which contribute to a maximum acceptance and usage of new digital technologies. Comparison and correlating of indices of acceptance with data on market penetration, utilization and valuations of health applications by the end-users leads to recommendations for action for digital care concepts and applications.

039 DIGITAL SOLUTIONS FOR CROSS-SECTOR MEDICAL CARE

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Introduction, background, problems. "Digilog" is an acronym for "digital and analog companion for an aging population". The objective is the safeguarding and continued development of health care with digital health applications and multidisciplinary cooperation in remote regions away from major centers: initially for chronically ill and secondarily for acutely ill patients. It's core is an *eHealth Center* for all digitally received health-related data.

Utilizing the digital transformation of medicine, sensor systems, mobile digital patient files and other innovation paths are linked in digilog to regional medical care.

Approach, methodology. In contrast to many telemedical initiatives, the established, predominantly proprietary stand-alone solutions of established entrenched or medical c*all centers*, whose services are intended for subscription, the digilog *eHealth Center* is a "substation", in which entirely different streams of data converge (currently ECGs, blood pressure, laboratory and microbiological data, image scans etc.). The unique characteristic of this approach is the interweaving of consumer health innovations from and for the living environment of the patients with the IT infrastructures of the outpatient and inpatient care facilities. The integration of these new applications at the level of professionals ensures acceptance and continued education based on it.

These are currently being analyzed and integrated 24/7 by medical personnel in accordance with *"artificial intelligence"* algorithm training methods and the findings are distributed to the treating family doctors, to the patients themselves or their relatives. "Digital interventions" help the patient in his/her daily routine with solutions on his/her smartphone.

Results, conclusion. Digilog is a hybrid model of an "analog" care network and digital, mobile, point-of-care diagnostic and Internet medicine with the objective of simultaneously personalized and resource-conserving care. The underlying philosophy is the *'boundaryless hospital'* that is characterized by micromedical technology compatible with everyday life. All regional care-relevant partners such as networks of physicians, home care services and district nurses are integrated as "analog" companions and shape the care based on the available digital real-life patient data. The digital approaches and care solutions link the data from the patient world and the professional medical world into a database to be used by both the medical professionals and the patients. This approach is currently being constructed and tested in a model region of the Federal State of Brandenburg around Fontanestadt Neuruppin. It also assures a digitalization strategy for rural areas with an aging population that is independent of standards and open to innovation.

Note. Only relevant for the publisher digilog is a research association of a total of 37 partners, which is being supported by the Gesundheitscampus [Health Campus] Brandenburg together with two other research associations of the MWFK [Minsterium für Wissenschaft, Forschung und Culture (Ministry of Science, Research and Culture)] during its establishment and was launched on March 1, 2017. The spokesperson and overall coordinator is Prof. Kurt J. G. Schmailzl.

040 EN ROUTE — GENETICALLY INFORMED, DIGITALLY ACCOMPANIED

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Background. The supposed big changers of medicine today — genetics and digital care — are not yet integrated in daily practice. Either you look for mutations in a given suspected gen, or you go for monitoring vital data like heart rate. Bringing together background information on the genetic risk profile with real-time vital data will enhance the prognostic power of each.

Approach. As a spin-off of the digilog ('Digital and analog companions of an ageing society') project (funded by the Federal State of Brandenburg, Germany), a bundle of vital data like ECG, blood pressure, fitness tracking, blood chemistry, microbiology, and mobile imaging becomes available on a tight time scale. Whenever you get a trend out of the various health-related data you can re-analyze the exome of the patient regarding the most recent deviations.

We looked for the association between short and mid-term risk trends and risks in the long-term.

Results. Using short and mid-term risk terms based on digital companions (like wearables) can be used to guide in-deep genetic diagnostics. This was done as a proof of concept with genetically induced or mediated arrhythmias, either inherited electrical heart diseases or because of heart failure. We found a higher hit ratio of genetic testing if based on trends of heart rate, heart rate variability and complex arrhythmias.

Conclusions. Genetic testing should probably be done according to risk profiling by using corresponding vital signs. On the contrary, monitoring should still be oriented towards genetic background information.

041 BOUNDARYLESS HOSPITAL

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Background. Demographic trends in rural regions may be summarised simply. People and their doctors run low and the municipalties age with those who stay. The increasing incline between modern high-tech medicine in the cities and the country doctor boosts the demographic effects; as a result historically, evolved structures are disintegrating more and more despite the increasing needs.

Approach. In the digilog ('Digital and analog companions of an ageing society') project (funded by the Federal State of Brandenburg, Germany) the provision with care and health services in rural regions becomes secured and updated.

It uses and integrates ECG, blood pressure, fitness tracking, blood chemistry, microbiology, and mobile imaging.

The interconnecting clamp for new structures of care on a large scale responding to new needs is an eHealth Center. The eHealth Center carries highly advanced medical technologies which are traditionally hospital-based to the individual patient's home. This redefines the hospital that increasingly acts beyond its walls (boundaryless hospital) by a network digital and analog companions (from digital monitoring to community nurses).

This joint research project is put to the test in the Mark Brandenburg, 60-120 km to the west of Berlin.

Results. An eHealth Center as a solely monitoring center is neither economically efficient nor medically effective. Heart of such an institution instead must be the cross-linking and dissemination of health care services provided until now only centrally.

Digital health tools enhance the administration, steering, and execution of health care at various sites while following uniform, modern standards of care.

The Brandenburg experience could be a blueprint for similar regions of jeopardized traditional health care.

042 WEARABLE MULTI-SENSOR PLATFORM WITH 7 DAYS-ECG

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Background. Today you either get a fitness tracker out of the consumer health products' world easy to apply but with seriously limited informative value, or you go for a medical product like a traditional Holter ECG with proven validity but limited suitability for

daily use. There is a need for serious monitoring of vital data beyond pulse rate and counting steps, data which could be integrated in a professional setting.

Approach. As a spin-off of the digilog ('Digital and analog companions of an ageing society') project (funded by the Federal State of Brandenburg, Germany), we developed a wearable multi-sensor platform with a 7 days-ECG implemented. The device is glued to the thorax and does not have any cables; you even can have a shower with it. You get a full-disclosure ECG with 3 leads. We tested validity and reliability with 200 patients and compared the results in a subset to a simultaneously applied conventional (24 h) Holter ECG.

Results. Drop-out rate (mainly due to operating errors or technical problems) was 3 % (6/200). Acceptance by patients and referring doctors was excellent. Atrial fibrillation was detected in the 7 days-devices more often and more reliable than in the 24 h-Holter ECGs. Detected heart rates, ectopic beats and atrial fibrillation were comparable. The rate of artifacts was significantly lower in the wearable group.

Conclusions. A wearable multi-sensor platform with a 7 days-ECG implemented was successfully tested as proof-of-concept and compared to conventional Holter ECG.

043 DISTINCTION OF PHYSICAL ACTIVITY AND STRESS USING RR INTERVALS

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Introduction. According to the WHO, adverse stress can lead to increased anxiety and depression, alcoholism and substance abuse disorders, as well as violence and suicidal behaviour. The conduct of the heart in light of pressure and physical activity is fundamentally the same as the arrangement of observed parameters is lessened to one. Therefore, a more definite examination is important to identify contrasts and along these lines to keep checking with a diminished arrangement of parameters. The behaviour of the heart in response to stress and physical activity is incredibly similar just in case the set of monitored parameters is reduced to a single one.

Purpose. ECG (mobile) devices and activity observation devices can be used for crucial stress, however the most challenging remains: the proper classification between stress and (sport) activity. For this purpose, a test has been created. The obtained knowledge ought to supply a chance to differentiate stress from physical activity. The experiment was designed to come up with a set of different datasets for each phase: (1) resting, (2) active, (3) relaxing and (4) mental stress.

Methods. We collected information from healthy candidates engaged in regular physical activity. A system with three wireless mobile nodes was used: two EMG and one ECG node. The EMC nodes were placed on biceps brachii and the deltoideus medius for diagnostic technique information and with reference to the pectoral muscle major for EMG information. The heart rate was extracted from the ECG and every peak was compared with the previous and the RR interval was calculated.

Results. In 'resting' phase (1) (Figure 1) the information provided no reasonable changes, the interim stayed between 60-80 bpm and the variation between heartbeats stayed between 65-105 ms. Switching to the phase (2) 'active' (Figure 1) we watched an increase for heart rate and a shift in variation of heartbeats: interim changed to 150-180 ms. It is expected to use this shift to be the discriminator between stress and physical activity.

Conclusion. It is relied upon to utilize this move to be the differentiator amongst stress and physical action. It is additionally expected that there will be a critical distinction between each of the four phases of the test. Stress and physical action have comparative properties like variety in the pulse. It is essential for the advancement of a framework utilized for stress recognition to limit the misdetection of stress caused by physical exercises. Presently, the separation of physical action and worry for approval proposes can be acknowledged with a movement observing framework. To additionally affirm this starting result, a greater study with more members must be performed, which is currently under planning.

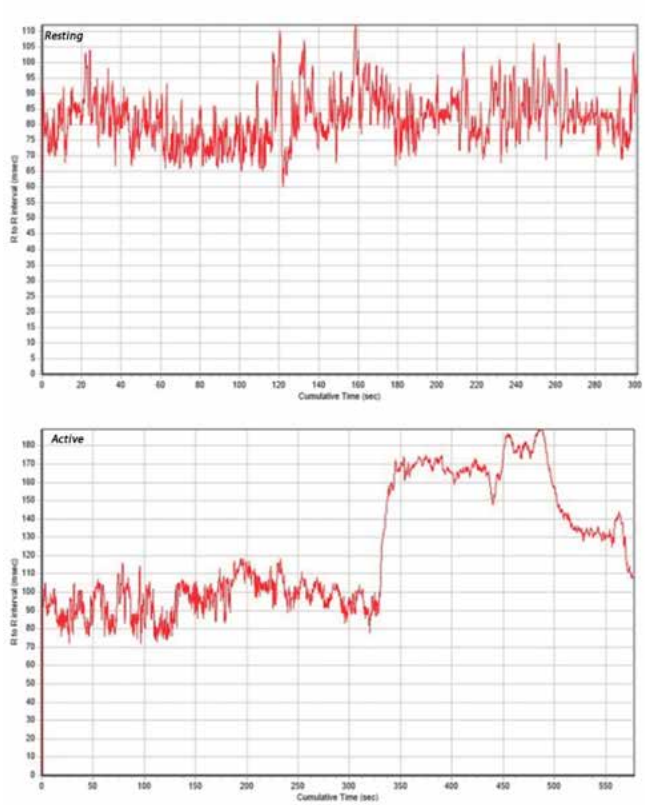

Figure 1. RR Intervals in resting (upper diagram) and active phase (lower diagram).

044 SAFETY ASSESSMENT OF AN EARLY DISCHARGE OF PATIENTS FOLLOWING ENDOVASCULAR TREATMENT OF CORONARY ARTERIES WITH TELEMETRIC ECG MONITORING

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New methods of managing patients with coronary heart disease (CHD) after endovascular treatment procedures allow to reduce the time of a patient's stay in the hospital down to 24 hours, but one of the biggest challenges is to make sure patients are provided with the same level of safety they would usually get during a regular hospital stay of 3 to 7 days.

The aim of this study was to assess the safety of an early discharge of patients following endovascular treatment of coronary arteries. We have performed the standard Holter ECG monitoring as well as the ECG telemonitoring. Telemonitoring was performed with a single-channel device AATOS-ECG (Finland). Consisting of a compact portable recorder with electrodes, it can be connected to a smartphone via Bluetooth and can transmit data to a 24/7 online monitoring center with a minimum delay of 3-9 seconds. The monitoring center provided technical and medical support; patients had the opportunity to call the monitoring center and the attending physician in case of need. The physician had personal access to the central portal of remote ECG monitoring and could interpret patients' ECGs in real time.

Results. 363 patients were included in the study, 334 of them were treated with one stent (92%), 29 patients (8%) with two stents;

392 arteries were treated. The total duration of a patient's stay in the hospital was 23±1,5 hours, the average stay after endovascular treatment was 19±1 h. Telemonitoring was performed on 55 patients (15% of all patients included in this study), the monitoring channel was chosen based on target artery. The study was successfully conducted in 54 (98.2%) patients, in one patient (1.8%) the study failed due to a discharged smartphone battery. The quality of recording and transmission was good in 47 patients (85.5%) and satisfactory in 7 patients (12.7%). During the observation period, patients' smartphone batteries were recharged several times since they could operate without recharging 5±0.5 hours. Online monitoring did reveal neither the life-threatening arrhythmias nor any ischemic changes in the terminal part of the ventricular complex. During offline interpretations of full record transcripts life-threatening arrhythmias were also not detected. However, supraventricular and ventricular ectopic activities were observed, notably unstable SV tachycardia (from 4 to 13 QRS complexes) was recorded in 2% of the cases, and prognostically unfavorable VES (3-4 grades according to Lawn-Wolf) was detected in 3% of the cases. No instances of ischemic changes of the ST segment were detected on the ECG.

Conclusion. The use of portable devices for ECG monitoring with real-time data transmission allows to efficiently monitoring patients after endovascular interventions with short-term hospitalization. The deficiencies of the used in the study telemetry technology include an insufficient number of monitoring parameters and weak batteries that require a recharge every 5-6 hours.

045 SIMULATIONS OF NON-TRANSMURAL INFARCT IN HUMAN VENTRICLES

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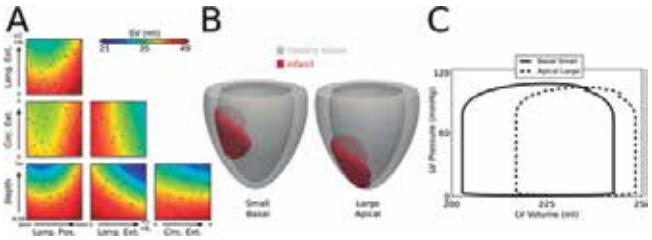
Introduction. Myocardial infarction is a leading cause of premature disability and death. Determining which patient will experience heart failure after an acute myocardial infarction is difficult for clinicians with established biomarkers. Recent studies have demonstrated that computational models provide new and potentially better biomarkers for prediction and diagnostics of cardiac function after myocardial infarction [1]. However, one major limitation of existing FEM models is their inability to simulate mechanics of non-transmural infarction. In this study, we developed high-resolution computational model that allows transmural infarct depth to be parametrically varied. In addition to depth, we study the effects of infarct shape and location on stroke volume.

Methods. Simulations were performed on a 3-D FEM model of left ventricle contraction [2] using linear P1/P1 stabilized elements for efficient computations. We randomly selected 30 sets of parameters describing the infarct region and applied kriging approximation to infer cardiac output for an arbitrary set. The infarct shape and location were parameterized by four variables: longitudinal location, extension in the longitudinal and circumferential directions, and depth of the infarct region. A customized meshing procedure allowed us to accurately outline the infarct boundary with finite element faces.

Results. The figure shows maps of stroke volume with respect to infarct shape and location (panel A). Black dots represent samples of the training set. The depth of the infarct has the strongest effect on the stroke volume. For example, increasing infarct depth from 50% to 100% reduced stroke volume by 40% from SV=37 ml to SV=22 ml, respectively. Longitudinal position of the infarct region had a weaker influence, with infarcts centered at ~1/4 of the apical-basal distance exhibiting a slightly worse stroke volume when keeping the other parameters fixed at mid-range values. Circumferential extension had instead only minimal effects. Panel B shows two representative cases of infarct models with different shapes: a small basal lesion and a large apical one. Panel C shows simulated PV loops for these two cases (SV =31 ml for dotted line, and SV =38 ml for solid line), demonstrating comparable stroke volumes despite the difference in infarct shape and location.



Conclusion. In this study, we performed parametric studies on high-resolution FEM models that accurately describe non-transmural infarct. We show that transmural extension of the infarct strongly affects stroke volume. Extension of this approach has potential to assist in diagnostics using cardiac magnetic resonance or ultrasound imaging.

Acknowledgements. Decree of the RF Government #211, 16/03/2013, Program #27 of Presidium of RAS.

046 LONG NON-CODING RNA CCRR CONTROLS CARDIAC CONDUCTION VIA REGULATING INTERCELLULAR COUPLING

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Our study therefore revealed a novel molecular mechanism for arrhythmogenesis in HF at the lncRNA level with CCRR (cardiac conduction regulatory RNA) playing a critical role in preventing ventricular tachycardia in HF, and suggested that lncRNA replacement might be a potential therapeutic approach to strengthen the intrinsic anti-arrhythmic potential of the heart. Here we show that a lncRNA designated CCRR was downregulated in a mouse model of heart failure (HF) and in patients with HF, and this downregulation caused cardiac conduction disturbances with enhanced arrhythmogenicity (increased incidence and duration of ventricular tachycardia). CCRR overexpression by lentivirus carrying the CCRR gene eliminated these detrimental alterations in HF mice, whereas CCRR silencing by lentivirus vector carrying a siRNA promoted arrhythmogenicity in otherwise healthy mice. In our efforts to decipher the electrophysiological mechanisms for the enhanced arrhythmogenesis, we observed that either HF or CCRR knockdown caused significantly destruction of the intercalated discs and rupture of gap junctions that are critical for cardiac excitation-contraction coupling, both in mice and patients. Consistently, CCRR knockdown slowed longitudinal cardiac conduction velocity, whereas CCRR overexpression improved it. Furthermore, CCRR overexpression blocked endocytic trafficking of connexin43 (Cx43) from the plasma membrane so as to prevent Cx43 degradation by binding to Cx43-interacting protein CIP85, whereas CCRR silence enhanced endocytic trafficking of Cx43 and reduced Cx43 density in the cytoplasmic membrane. We have also identified the functional domain (FD) of CCRR, which could reproduced the functional roles of the full-length CCRR.This study characterized the role of CCRR downregulation in inducing arrhythmic phenotypes, defined intercellular uncoupling as a subcellular mechanism for the arrhythmogenesis, and deciphered backward trafficking as a signaling mechanism for reduced Cx43 protein in the plasma membrane in HF.

047 ANALYSIS SYSTEM BASED ON DIGITIZING PAPER ECGs

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Introduction. The electrocardiogram made on the digital cardiograph is still printed on the classic linear graph paper and described by the doctor by hand. Medical personnel are not able to use the new equipment with all its functions and devices that could facilitate the workflow of the medical worker and reduce the time to make important decisions. Also, in Russia we witness the shortage of doctors specializing in functional diagnostics. The need of the population in the services of functional diagnostics is many times higher than the number of medical personnel which are currently on the staff of a medical organization.

Goal. The first goal is to recognize ECGs from paper and bring them to digital presentation. The second is to make a system where patient can sent the ECG using Internet as digital signal to doctor and then obtain medical opinion fast and easily. We focus on the first task as the kernel of our idea.

Methods. The ECG must be properly scanned and saved as a digital picture after the patient records it. Our Internet service gets this picture and convert image to digital ECG signal.

The primary task is the image segmentation: each ECG channel (I, aVL, aVR, etc) must be marked. Automatic and manual (by human) approaches are possible. We process channels independently and the next discussion is about some selected channel image. The key idea is to extract grid node coordinates (x, y) and try to undistort signal using them.

We need to normalize brightness and contrast over all the axes of the image. It's necessary for the stable classification for background, grid and signal pixels. The classification task using K-Means could be performed successfully if it uses suitable cluster initialization: background is near to white color always, signal is black, grid has middle brightness.

The classificatio n task is done and now we need to detect every grid nodes. The solution is to bruteforce all possible line parameters (angles and offsets) in vertical and horizontal directions and convolve these lines with extracted grid image at classification step. The intersections of such lines gives node coordinates (x, y).

These coordinates allow to undistort the signal from image. We use signal pixels obtained by classification and transform them from distorted to undistorted space where the grid has all lines which are strong parallel and the each cell is square.

Results. Now we built prototype system. It accepts scanned pictures from patients, converts paper ECG to digital presentation, sends it to the doctor. The diagnosis will be sent to the patient back as soon as doctor finishes it.

Outcomes. It's a complex task with a lot of different cases in the algorithm and business logic. We need a high amount of ECG pictures to solve it much better using neural networks and now we are working in this direction.

048 ORGANIZATION OF THE SYSTEM OF CORRESPONDENCE CONSULTATIONS (CARDIO BUREAU) IN CARDIOLOGICAL AND CARDIOSURGICAL PRACTICE OF KHMAO-UGRA

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Remote technologies have been widely used in practical healthcare in the diagnosis and treatment of patients with cardiovascular diseases in KhMAO-Ugra since 2002.

The purpose of this work is to show the effectiveness of the organization of the system of correspondence consultations (cardio-bureau) in the cardiological and cardiosurgical practice of KhMAO-Ugra.

Methods. The chairperson of the cardio-bureau is the chief freelance cardiologist of the Department of Health of KhMAO-Ugra, the main specialist is the chief freelance cardiovascular surgeon of the Department of Health of KhMAO-Ugra, the members of the cardio bureau are leading experts in cardiology and cardiovascular surgeons. The tasks of the cardio bureau work includes: solving expert questions on the diagnosis and treatment of patients with cardiovascular diseases; selection of patients for referral to Federal centres of Russia; consulting pregnant women with congenital malformations of the fetus. Work with medical organizations of the district is carried out through the system of teleconsultations AMC-Doctor.Net; also consultations are conducted on-line via video conferencing. Commission of cardio-bureau works in 4 groups: congenital heart defects — children and pregnant; heart rhythm disturbances — adults and children; ICD, acquired heart defects (adults, including defects in pregnant women), vascular diseases that does not require surgical interventions (except children) and patients with cardiosurgical diseases. The sessions of the cardio-bureau are held daily for all groups; the commission may recommend further follow-up, pre-examination of the patient, correction of therapy, admission to a hospital for the provision of high-tech medical care, or referral to a consultation with the Federal Center.

Results. The introduction of remote technologies into clinical practice allowed to significantly increase the volume of consultations conducted in recent years and availability of this type of medical assistance (Table 1).

Table 1

Structure of the cardio bureau consultation and patients sent to the Federal Centers of the Russian Federation for 2015 - 2017

Index	2015	2016	2017	Dynamics 2017/2016, %
All patients were consulted, including:	937	986	1491	51,22
*** children with congenital heart disease**	200	182	327	79,67
*** pregnant women, including:**	399	436	448	2,75
- congenital malformation of the fetus	79	115	148	28,7
- concomitant pathology of the cardiovascular system	320	321	300	-6,54
*** other consultations (heart rhythm disturbances, ischemic heart disease, hypertension)**	338	368	716	94,57
Sent to the Federal Centers	129	97	95	-2,06

Comparative analysis of cardio-bureau groups showed that there was a significant increase in the number of consultations of patients with heart rhythm disorders (+35.9% in 2017) and cardiological pathology that does not require surgical intervention (+35.5% over the analysed period). In 2017, 95 patients were sent to the Federal Centres of the Russian Federation for surgical treatment, 43 of them were children. In general, cooperation is carried out with 12 Federal Centres of the Russian Federation.

Conclusions. The use of remote technologies-the application of the cardio-bureau system — increases the effectiveness and quality of medical care for patients with cardiovascular diseases. Application of the technology allows to improve the efficiency of specialists of remote areas of KhMAO-Ugra. Advising patients using remote technologies improves the timeliness of referring patients with circulatory diseases to district clinics and Federal Centres of the Russian Federation.

049 ORGANIZATION OF THE WORK OF CARDIOLOGICAL ON THE TERRITORY OF KHANTY-MANSI AUTONOMOUS DISTRICT — UGRA

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In the message to the Federal Assembly, the President of Russia called the widespread introduction and development of telemedicine one of the priorities in health care. Remote technologies have been widely used in practical healthcare in the diagnosis and treatment of patients with cardiovascular diseases in KhMAO-Ugra since 2002. The four leading institutions of the KhMAO-Ugra conducts more than 4,000 remote consultations annually, both in planned and in urgent order.

The purpose of this work is to show the effectiveness of the organization of the work of cardiological remote-consulting points in the territory of KhMAO-Ugra.

Methods. Cardiological remote-consulting point was opened on the "District cardiological dispensary "Center of diagnostics and cardiovascular surgery" (Surgut) in 2011 with the aim of optimizing the provision of medical care to patients with acute coronary syndrome. From 2011 to 2017 on the territory of KhMAO-Ugra 6 cardiological remote-consulting points were organized: for patients with acute coronary syndrome №1 and 2 ("District cardiological dispensary "Center of diagnostics and cardiovascular surgery", Surgut), №3 ("District Clinical Hospital", Khanty-Mansiysk), №4 ("District Clinical Hospital", Nyagan), №6 ("District Clinical Hospital", Nizhnevartovsk); for children with congenital heart defects — №5 ("District cardiological dispensary "Center of diagnostics and cardiovascular surgery", Surgut). Consultations are carried out round the clock, 7 days a week on-line. In the distantly territories, CardioJet complexes for ECG transmission using GCM operate.

Results. The introduction of remote technologies into clinical practice allowed to significantly increase the volume of consultations conducted in recent years and availability of this type of medical assistance. In 2017 the work of cardiological remote — consulting points has been optimized: the number of consulted patients with ACS has significantly increased. Since 2016 the registration of patients transferred to District cardiological dispensary according to the results of counselling is conducted. In 2017 a total of 1,692 consultations were held (cardiological remote — consulting points №1, 2 and 5), which is 43% more than in 2016; 1,231 patients transferred to District cardiological dispensary (73%), which is 21% more than in 2016 (Table 1).

Table 1

Indicators of work cardiological remote-consulting points №1, 2, 5 for 2015-2017

Index	2015	2016	2017	Dynamics 2017/2016
Consultations were held (№1)	53	251	773	more than 3 times
transferred to District cardiological dispensary on the results of consulting	29	124	349	more than 2.8 times
Consultations were held (№2)	150	773	910	18%
transferred to District cardiological dispensary on the results of consulting		861	880	2%
Consultations were held (№5)		10	9	-10%
transferred to District cardiological dispensary on the results of consulting		3	2	-33%
Total number of consultations		1183	1692	43%
transferred to District cardiological dispensary on the results of consulting		1016	1231	21%

Conclusions. The introduction of cardiological remote-consulting points in the territory of KhMAO-Ugra made it possible to increase the efficiency and quality of medical care for patients with cardiovascular diseases. Application of the technology allows to improve the efficiency of specialists of distantly areas of KhMAO-Ugra. The implementation of patient consultations using remote technologies improves the timeliness of sending patients with cardiovascular diseases to the district clinics to provide them with specialized, including high-tech, medical care.

050 MONITORING USING AMBIENT AND WEARABLE SENSORS FOR PREVENTION AND EARLY DETECTION OF SERIOUS HEALTH EVENTS IN ELDERLY PEOPLE

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Introduction. In our aging society, prolonged independent living is a question of individual preference in addition to an economical one. Recent studies have shown that increasing home care in comparison to institutionalization, may have a significant effect in lowering health-care cost projections. To realize this vision, major threats of healthy aging in the elderly have become a central challenge in recent research.

Monitoring technology provides new possibilities in providing preventive and proactive services to health-care professionals in real-time. These technologies could help in identifying potentially adverse changes in behavior or vital signs before a life-threatening event (e.g. fall or stroke) occurs. More recent ambient assisted living (AAL) technologies allow to unobtrusively and autonomously measure everyday physical activity and changes thereof. Monitoring physical activity, behavior and other vital signs could potentially help to accurately detect early signs of decline in overall health or track the course of an intervention or the effect of certain changes in prescribed medication. Existing systems that rely on single sensor-based detection fail to produce efficient and reliable results. Multimodal sensor-based technologies can provide an objective alternative to existing systems.

Methods. Thirty-four participants (age >70 years, living alone) have been recruited and are currently monitored for year, using a set of wearable and ambient sensors. Wearable sensors include a mobile ECG (Preventice Health-Guardian) and a Fitness Watch (FitBit) for 50% of the participants, while the other 50% of participants will be provided with an armband (Biovotion Everion) and an accelerometer (Axivity AC3). Ambient sensors include motion and door sensors (Domo-Safety System) as well as a piezoelectric bed sensor (EMFIT). Simultaneously, questionnaires and limb strength measures are recorded, while local care givers visit the participants twice a week to get information about lifestyle changes, accidents and other unforeseeable events.

Results. Physical activity and movement between rooms positively correlated with muscle-strength, where by movement between rooms showed strong correlation with hand-grip strength. Initial retrospective analysis of a single subject data prior to an heart failure showed that the subject's breathing rate and average motion during sleep increased significantly. These negative trends emerged several weeks before the actual event, showcasing the potential for early intervention.

Conclusions. Monitoring physical activity and vital signs using multi-modal sensor-based technologies can be a powerful tool for early detection of adverse events, provide accelerated response to events and reduce rescue times which are linked with reduced negative medical impacts.

051 MHEALTH TELEMONITORING IN ADULT PATIENTS WITH CONGENITAL HEART DISEASE

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Background. Previous telemonitoring studies showed conflicting results, with inadequate patient selection being an important factor. Adult patients with congenital heart disease (CHD) seem eligible for

telemonitoring, as they are young, symptomatic and require lifelong follow-up.

Purpose. The purpose of this study is to assess the effect of mHealth telemonitoring on the frequency of emergency department visits and hospitalizations in adult patients with CHD, in comparison with historical data.

Methods. Symptomatic adult patients with CHD were enrolled in a mHealth telemonitoring program, fully reimbursed by major insurance companies. In this program patients evaluate blood pressure (weekly), weight (weekly) and heart rhythm with single lead EKG (monthly, or times of symptoms) through mobile devices, digitally connected to their smartphones. In case of symptoms extra measurements could be performed. Individualized thresholds were determined at baseline. If data repeatedly exceeded thresholds, or in case of cardiac arrhythmias patients were contacted for treatment adjustments or reassurance.

Results. 108 symptomatic adult patients with CHD severity of mild (24), moderate (48) and severe (36) were included (mean age 44.1 years, 35.2% male). At baseline, 28 patients experienced heart failure symptoms (NYHA class⩾II), 93 had palpitations or cardiac arrhythmias and 15 hypertension. Median follow-up was 4.0 months (range 0-14), adherence was 92%. During follow-up there were 22 emergency hospitalizations, 15 for palpitations, in contrast to 36 emergency hospitalizations during a similar time period in historical data (figure 1), 26 for palpitations. More emergency presentations due to palpitations were adequate while using mHealth, as more patients with palpitations required ECV during follow-up (13,87%), compared to historical data (17,65% (P=0.52 McNemar)).

Conclusion. These preliminary results demonstrate a trend towards a reduction of emergency hospitalizations in adult patients with CHD using mHealth telemonitoring.

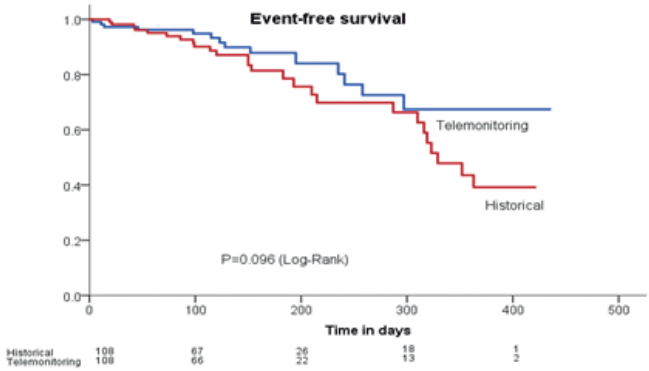

Figure 1. Event free survival.

052 TELEMEDICINE AMONG MEDICAL STUDENTS AND PATIENTS WITHOUT MEDICAL EDUCATION IN RUSSIA

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Background. For a long time, telemedicine in Russia was outside the legal field and it started to be regulated by the government only from 1th January, 2018. This state of affairs led to a negative attitude to telemedicine by both doctors and patients.

Purpose. The purpose of this study is to identify the awareness of medical students and patients without medical education about telemedicine and telemedicine technologies as well as using them in their practice. We chose medical students as they are adherent to new technologies and gadgets.

Methods. We developed a special questionnaire for this study. The survey was conducted on the Internet. 248 students of various Russian medical schools and universities and 217 patients took part in the survey. Statistical processing of data was conducted in Microsoft Excel 2010.

Results. The average age of respondents in the group of medical students was 22 ± 0,2 years, in the group of patients — 28 ± 1,3 years. 59% of medical students were aware of telemedicine and 13% had heard, but did not remember what it means. In this, 69% of them have already given medical recommendations to their relatives and friends with the help of telemedicine technologies (SMS, phone calls etc.). On the other hand only 32% of the patients are aware about telemedicine and 20% have heard about it.

More than half of the students of medical schools and patients believe that telemedicine is used for remote interaction with the patient (55% and 54%, respectively). 60% of students would like to consult on a special platform (site, mobile application), and 66% of patients are ready to use it. 63% of students would like to hold such consultations on a regular and paid basis, however only 44% of patients are ready to pay for them.

65% of medical students are ready to spend smaller part of their working time for remote consultations, and 58% of patients suppose that a doctor can devote smaller part of time to this. At the same time, 22% of students are not ready to spend their working hours on such consultations and 13% of patients believe that doctors should spend no time on them. Despite this, 58% of students and 51% of patients believe that only a doctor specialized in telemedicine should consult patients online.

Conclusions. The study showed a quite high awareness of telemedicine among medical students in Russia (59%), but only third of the interviewed patients knows what it is. Almost all students have already made medical recommendations with the help of telemedicine technologies. Since it is believed in all groups that a doctor can devote a smaller part of the time to telemedicine, it can only be part of a comprehensive examination and treatment with face-to-face visits. Because the proportion of patients willing to pay for such consultations is less than those who were originally ready to use it, the inclusion of telemedicine services in the Mandatory Medical Insurance system is an important step for the development of telemedicine in Russia.

053 TELEMEDICINE: OPPORTUNITIES AND POSSIBILITIES

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The Russian Federation has specific socio-demographic and geographic features that make it difficult to provide qualified medical assistance to a significant number of the population. One of the goals of the priority national project "Health" is to make expensive medical care available to as many citizens as possible, especially for residents of remote areas [Levanov V.M. et al., 2012]. The most realistic, economically justified and effective way to solve this problem is the introduction of modern information and communication technologies in the field of protecting public health. Telemedicine uses information and communication technologies to overcome geographical barriers and increase access to medical services for the population.

Before the advent of the Internet telemedicine was limited to isolated pilot projects and progressed only in countries with a developed communications infrastructure. In recent decades the interest in telemedicine has been steadily increasing among medical professionals due to the significant development and cheapening of information and communication technologies, as well as through the popularization of the Internet which has enriched the field of telemedicine using web applications and multimedia systems.

Now in Russia at the state level telemedicine services are gradually being introduced in the "doctor-patient" scheme. The main legal documents regulating medical activities within the framework of telemedicine in the Russian Federation are the following: Federal Law № 242 of July 29, 2017 "On Amending Certain Legislative

Acts of the Russian Federation on the Application of Information Technologies in the Sphere of Health Protection", the Government of the Russian Federation from April 12, 2018 № 447 "On approval of the Rules for the interaction of other information systems intended for the collection, storage, processing and provision of information relating to the activities of medical organizations and the services they provide, with health information systems and medical organizations", Order of the Ministry of Health of Russia of November 30, 2017 № 965n "On the approval of the order of organization and provision of medical assistance using telemedicine technology". However the issues of legal regulation of telemedicine care have not been fully resolved yet.

There are still a number of obstacles to further development of telemedicine. In some cases, wariness towards the use of telemedicine technologies is caused by insufficient computer literacy. In addition, when using telemedicine methods over long distances difficulties inevitably arise due to linguistic and cultural differences between the provider and the recipient of health services. Nevertheless, the development of telemedicine is predetermined by high demand for the opportunities it provides, and it is clear that the existing difficulties will be overcome soon.