I AM HEALTHY ANALYTICS (IAHA)

Automatic health analysis system

Marina **Stepanenko**

PROJECT FOUNDER

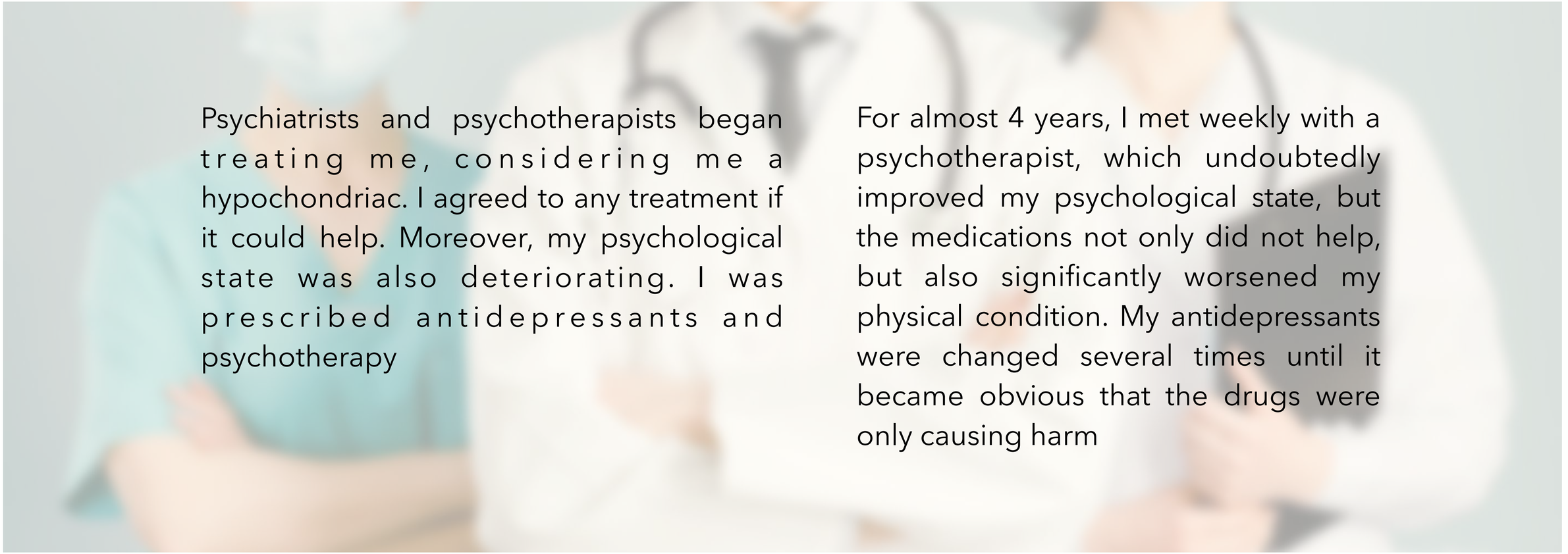
I'm 36, I'm from Moldova, my main activity is graphic design and volunteering to help animals

10 YEARS AGO I WAS FORCED TO STUDY A NARROW MEDICAL SPECIALIZATION

From the age of 8, I suffered from sudden dizziness and fainting conditions, but none of the doctors could diagnose and help me. It got worse every year. By the age of 25, my condition had deteriorated so much that I was unable to get out of bed on my own

Standard **tests and analyzes**

SHOWED THAT I WAS COMPLETELY HEALTHY



Psychiatrists and psychotherapists began treating me, considering me a hypochondriac. I agreed to any treatment if it could help. Moreover, my psychological state was also deteriorating. I was prescribed antidepressants and psychotherapy

For almost 4 years, I met weekly with a psychotherapist, which undoubtedly improved my psychological state, but the medications not only did not help, but also significantly worsened my physical condition. My antidepressants were changed several times until it became obvious that the drugs were only causing harm

In the end **I was lucky**

AND I MET A DOCTOR WHO SET THE DIRECTION FOR MY DIAGNOSIS

This doctor was a cardiologist with extensive knowledge in various fields of medicine. He determined that I suffer from paroxysmal tachycardia, which does not appear on a regular cardiogram, which is always performed at rest. That's how I learned that there is a narrow branch of cardiology - arrhythmology. And that my case is far from unique, and yet a huge number of people around the world cannot receive a diagnosis and appropriate surgical treatment. Such people suffer for decades, become disabled or die from sudden cardiac death

The occurrence of **supraventricular tachycardia (SVT)**

UNITED STATES STUDY

The most common type of PSVT is atrial fibrillation, with a prevalence rate of approximately 0.4% to 1% occurring in men and women equally; it is projected to affect as many as 7.5 million patients by 2050. The risk of developing PSVT was found to be twice in women compared to men in a population-based study, with the prevalence of the PSVT higher with age. Meta-analysis that summarized data from all available studies on the risk of ischemic stroke among patients with PSVT found 2-times higher risk of Ischemic stroke compared to individuals without PSVT.

570,000

individuals with SVT each year in U.S.

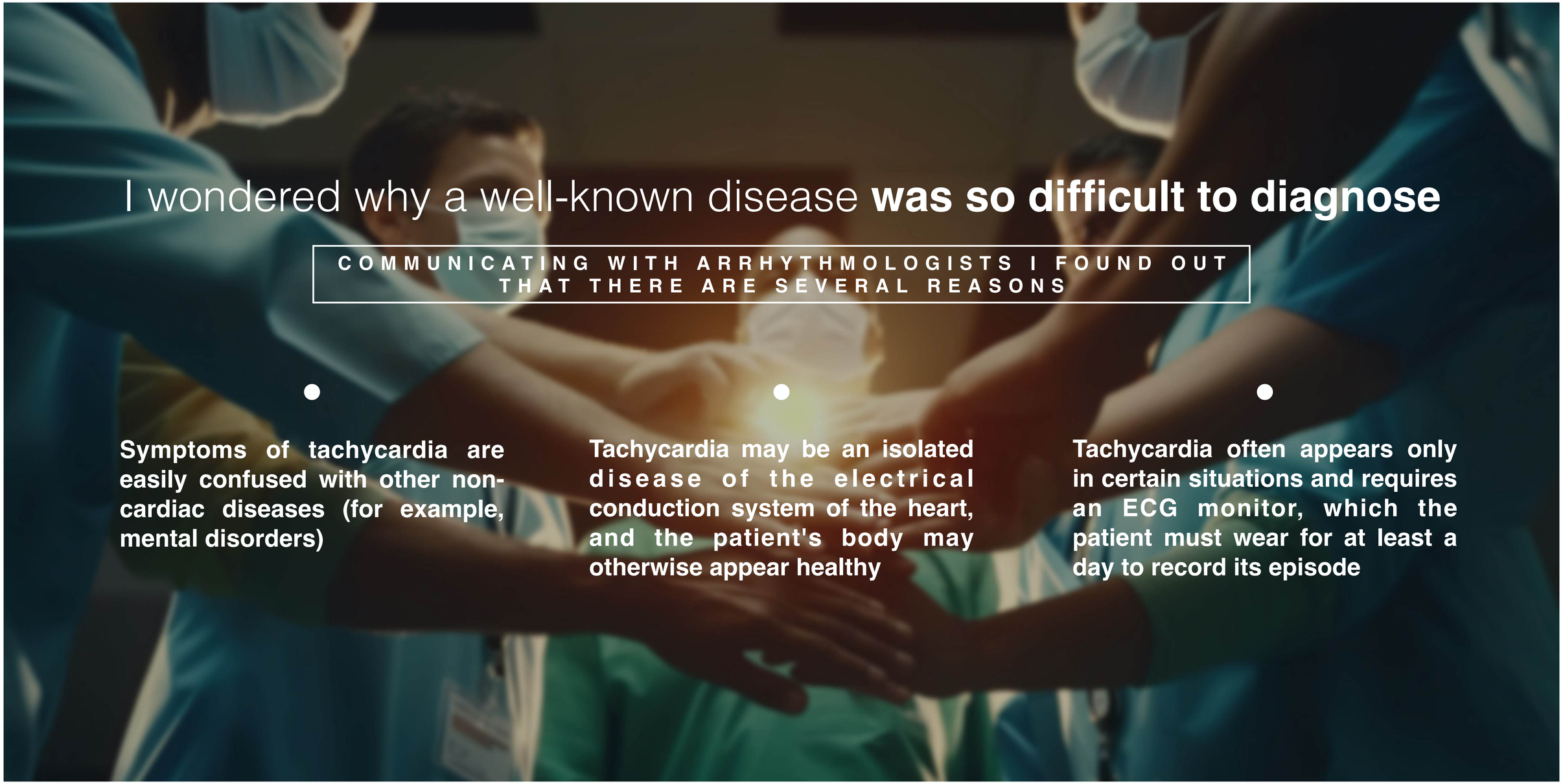
1,260,000

the prevalence of SVT in 2018 in U.S.

more than1,000,000

suffer from cardiac arrhythmias each year in the UK

Paroxysmal supraventricular tachycardia and risk of ischemic stroke: A systematic review and meta-analysis
Pongprueth Rujirachun MD, Phuuwadith Wattanachayakul MD, Arjbordin Winijkul MD, Patompong Ungprasert MD, MS X
First published: 14 May 2019 | https://doi.org/10.1002/joa3.12187 | Citations: 4



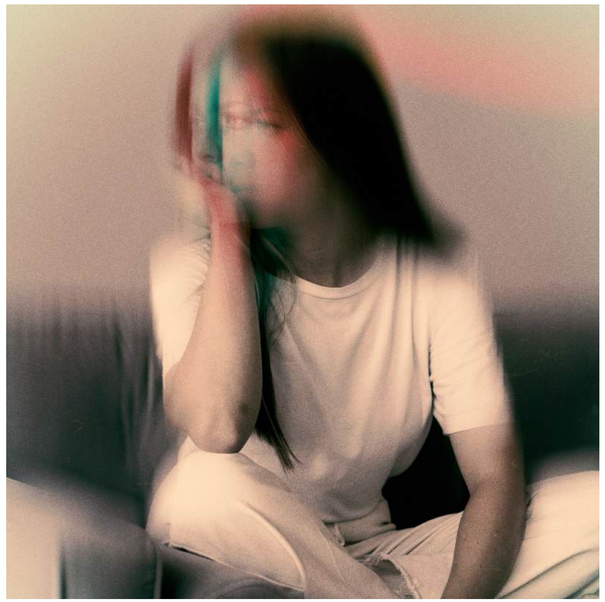
I wondered why a well-known disease **was so difficult to diagnose**

COMMUNICATING WITH ARRHYTHMOLOGISTS I FOUND OUT THAT THERE ARE SEVERAL REASONS

- **Symptoms of tachycardia are easily confused with other non-cardiac diseases (for example, mental disorders)**
- **Tachycardia may be an isolated disease of the electrical conduction system of the heart, and the patient's body may otherwise appear healthy**
- **Tachycardia often appears only in certain situations and requires an ECG monitor, which the patient must wear for at least a day to record its episode**

Thus, in order to diagnose **paroxysmal tachycardia**

IT IS NECESSARY TO INITIALLY ASSUME ITS PRESENCE, EVEN IF NOTHING INDICATES THIS



Patient who would benefit
from psychotherapy

undergoes useless tests and painful examinations which only aggravates his condition

And first of all, you need to be sure that the patient's complaints are caused precisely by physiological reasons, and are not somatic manifestations of psychological problems, such as depression or anxiety.

However, the medical approach in general involves conducting examinations aimed at clarifying the diagnosis, and not at determining physiological health

Patient in need of
an arthymologist

is forced to receive psychiatric treatment, which increases the risk of sudden cardiac death

HAVING EXPERIENCED ALL THE DIFFICULTIES AND SUFFERING

that befall people who find themselves in a similar situation, I involuntarily began to wonder whether there really were no ways to make an initial conclusion and prognosis for at least a short period of time that a person is cardiologically healthy in general

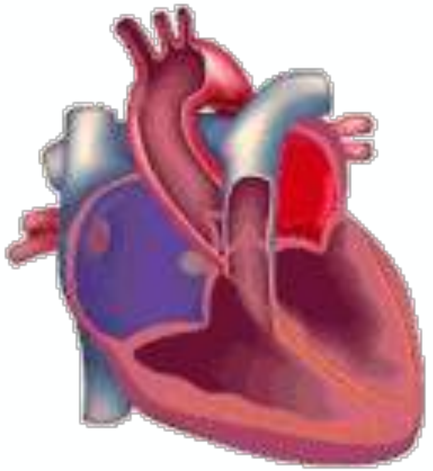
The most accessible **non-invasive method**

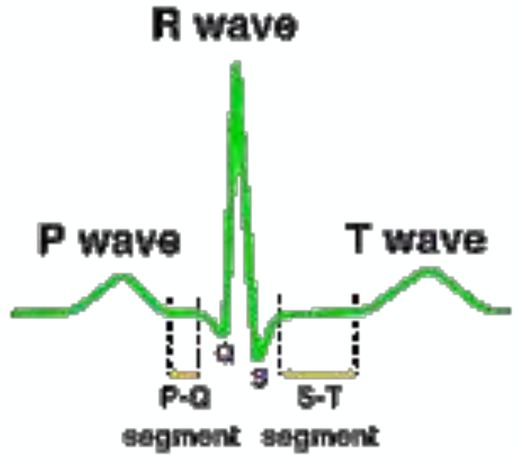
OF EXAMINING THE HEART REMAINS A CARDIOGRAM

The Electrocardiogram (ECG) is a recording of the electrical signals generated by the heart. It is a continuous record of voltage changes reflecting the cyclic electro-physiological events in the myocardium using electrodes placed on the skin.

These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat). There are three main components to an ECG: the P-wave, which represents depolarization of the atria; the QRS complex, which represents depolarization of the ventricles; and the T-wave, which represents repolarization of the ventricles.

Electrocardiography is the most widely used test in the world





Procedia Computer Science 151 (2019) 941–946 1877-0509 The 10th International Conference on Ambient Systems, Networks and Technologies (ANT) April 29 - May 2, 2019, Leuven, Belgium Automation algorithm to detect and quantify Electrocardiogram waves and intervals Rajani Akulaa , Hamdi M. Mohamedb aAssociate Professor,JNTUH College of Engineering,Hyderabad,500078,India bStudent, JNTUH College of Engineering,Hyderabad,500078, India

With the development **of technology**

AUTOMATED METHODS FOR DECIPHERING ELECTROCARDIOGRAM HAVE APPEARED

Which made it possible to detect indicators invisible to the human eye, but important for assessing the state of the cardiovascular system. One of these indicators is **Microvolt T-wave alternans (MTWA)**

T-wave alternans (TWA) is a periodic beat-to-beat variation in the amplitude or shape of the T wave in an electrocardiogram. TWA was first described in 1908. MTWA is a variant of TWA that detects signals as small as one-millionth of a volt

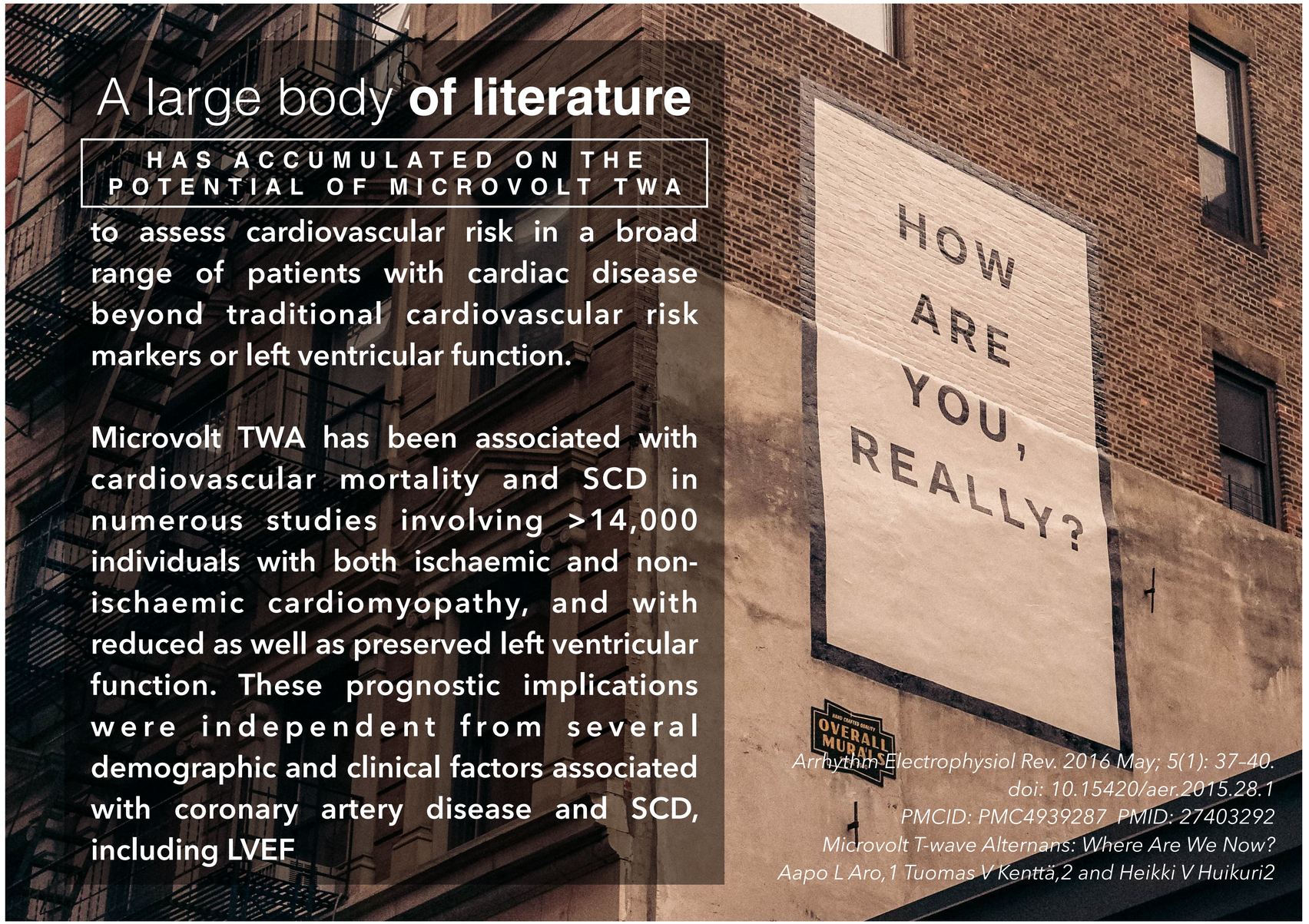
International Journal of Cardiology 109 (2006) 293 – 306 Review
*Microvolt T-wave alternans: A review of techniques, interpretation, utility, clinical studies, and future perspectives , Majid Haghjoo *, Arash Arya, Mohammad Ali Sadr-Ameli*
Department of Pacemaker and Electrophysiology, Rajaie Cardiovascular Medical and Research Center, School of Medicine, Iran University of Medical Sciences, Mellat Park, Vali-e-Asr Avenue, P.O. Box 15745-1341, Tehran 1996911151, Iran

A large body **of literature**

HAS ACCUMULATED ON THE POTENTIAL OF MICROVOLT TWA

to assess cardiovascular risk in a broad range of patients with cardiac disease beyond traditional cardiovascular risk markers or left ventricular function.

Microvolt TWA has been associated with cardiovascular mortality and SCD in numerous studies involving >14,000 individuals with both ischaemic and non-ischaemic cardiomyopathy, and with reduced as well as preserved left ventricular function. These prognostic implications were independent from several demographic and clinical factors associated with coronary artery disease and SCD, including LVEF

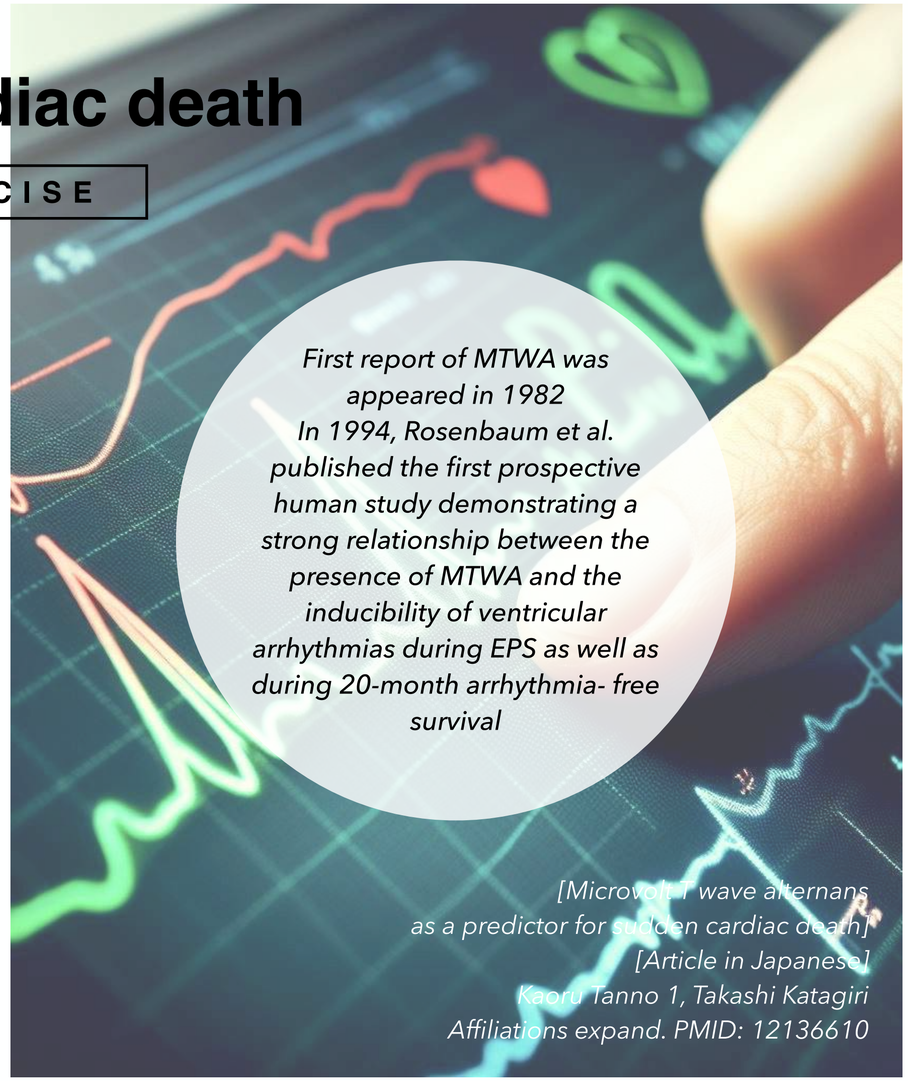


Arrhythm Electrophysiol Rev. 2016 May; 5(1): 37–40.
doi: 10.15420/aer.2015.28.1
PMCID: PMC4939287 PMID: 27403292
Microvolt T-wave Alternans: Where Are We Now?
Aapo L Aro,1 Tuomas V Kenttä,2 and Heikki V Huikuri2

For predicting **sudden cardiac death**

SENSITIVITY OF MTWA BY EXERCISE

was 92%, specificity 61%, positive predictive value 7%, negative predictive value 99%. High sensitivity and negative predictive value are suggested that MTWA could be a screening test for sudden cardiac death after myocardial infarction. In addition, it is reported that MTWA is useful for predicting sudden cardiac death in patients with DCM or impaired cardiac function. Although the development of ICD has provided the effectiveness of prevention of sudden cardiac death, it is difficult to identify the patients with malignant ventricular tachyarrhythmias for primary prevention. MTWA can increase referrals of appropriate patients for further electrophysiologic evaluation and therapy



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*Microvolt T-wave alternans: A review of techniques, interpretation, utility, clinical studies, and future perspectives , Majid Haghjoo *, Arash Arya, Mohammad Ali Sadr-Ameli*

Department of Pacemaker and Electrophysiology, Rajaie Cardiovascular Medical and Research Center, School of Medicine, Iran University of Medical Sciences, Mellat Park, Vali-e-Asr Avenue, P.O. Box 15745-1341, Tehran 1996911151, Iran

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PHARMACOLOGICAL THERAPY WITH B-BLOCKERS SIGNIFICANTLY REDUCES THE LEVEL OF MTWA

and can convert a positive test to negative in approximately in half of the cases. In a meta-analysis among patients with left ventricular dysfunction on continuous β-blocker therapy, abnormal MTWA testing was associated with a fivefold risk of ventricular arrhythmic events, whereas only weak association was noted in studies on which β-blocker therapy was withheld prior to screening.Consequently, any MTWA testing is suggested to be performed under continuous medical therapy.

Recent evidence suggests that MTWA may also detect influences of non-pharmacological interventions that are known to be associated with reduced mortality rates as well. In patients with stable coronary artery disease, exercise rehabilitation reduced MTWA levels both patients with and without diabetes, and during the 2-year follow-up a large proportion of the patients with positive MTWA converted to negative MTWA.Thus, MTWA seems to be a method that may capture and quantify influence of mainstream clinical interventions to arrhythmia susceptibility

The FDA has cleared **two methods of MTWA testing:**

CAMBRIDGE HEART'S SPECTRAL ANALYSIS (SA) METHOD AND GENERAL ELECTRIC'S MODIFIED MOVING AVERAGE (MMA) METHOD

Spectral analysis (SA) is a sensitive mathematical method of measuring and comparing time and the ECG signals. It requires specialized propriety electrodes to calculate minute T-wavevoltage changes. Software then analyzes these microvolt changes and produces a report to be interpreted by a physician

The Modified Moving Average (MMA) method uses a temporal domain in which T-wave alternans are assessed as a continuous variable along the complete ECG. The MMA method of MTWA testing is performed using standard ambulatory ECG equipment. This method does not require fixation of heart rate to determine TWA level accurately in freely moving subject

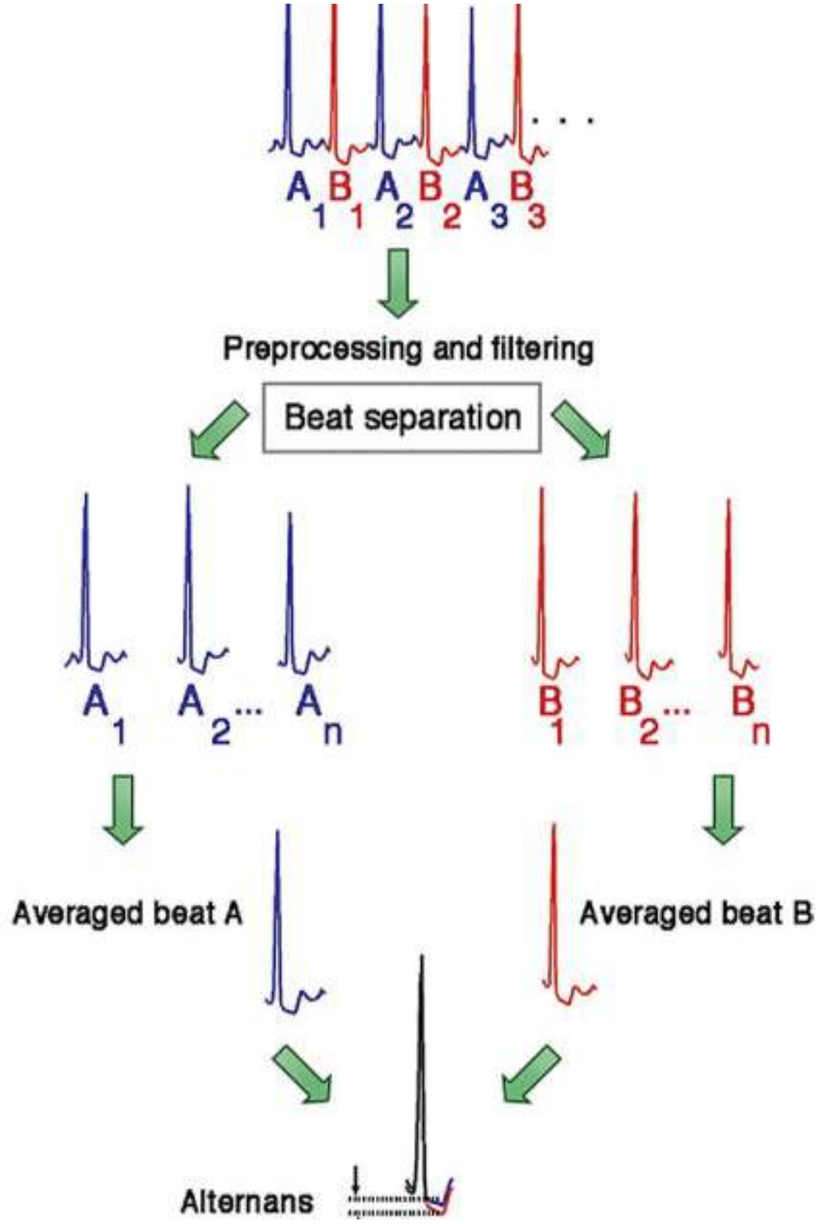
National Coverage Determination (NCD) Microvolt T-Wave Alternans (MTWA) Publication Number 100-3. Manual Section Number 20.30
Manual Section TitleMicrovolt T-Wave Alternans (MTWA)Version Number 3 Effective Date of this Version 01/13/2015 Implementation Date 06/23/2015

Modified moving average **method (MMA)**

OF MICROVOLT T-WAVE ALTERNANS ANALYSIS

In this technique, a stream of beats is divided into odd and even bins, and the morphology of the beats in each bin is averaged over a few beats successively to create a moving average complex. TWA is computed as the maximum difference in amplitude between the odd-beat and even-beat average complexes from the J point to the end of the T wave. TWA magnitude was determined for each 15 s of data.

MTWA levels >60 μV during routine exercise testing and ambulatory ECG monitoring indicate severely elevated risk for SCD and/or cardiovascular mortality. In patients during the early post- myocardial infarction (post-MI) phase with or without heart failure, an MTWA level >47 μV also predicted SCD. Each 20 μV of MTWA increases risk of cardiovascular and SCD by 55 and 58%, respectively



National Coverage Analysis (NCA) Decision Memo, Final Decision Memorandum: Microvolt T-wave Alternans CAG-00293R2, Tamara Syrek Jensen, JD, Director, Coverage and Analysis Group, Joseph Chin, MD, MS Acting Deputy Director, Coverage and Analysis Group, James Rollins, MD, PhD, Division Director Kim Long, BA, Lead Analyst, Joseph Dolph Hutter, MD, MA Medical Officer

Extensive **clinical evidence**

FROM SIX PROSPECTIVE FULL-COHORT STUDIES ENROLLING >3,800 PATIENTS

has been accumulated over the past five years demonstrating that MMA-based MTWA assessment is a sound methodology that has clinical utility in identifying patients at risk for SCD who may benefit from medical or device based therapy. In addition, two retrospective studies analyzed MMA's predictivity in existing cohorts that enrolled >2,100 patients using a nested case-control design, which allows statistical significance in large data sets to be tested from representative samples with relatively minor loss in statistical efficiency. Based on these investigations, the predictivity of this diagnostic algorithm appears to be at least comparable to that observed with the Spectral Method. Moreover, multivariate analyses indicated that MMA-based MTWA stratifies SCD risk independent of left ventricular ejection fraction, the current marker for insertion of ICDs, thus providing physicians with information in addition to left ventricular ejection fraction regarding potential benefit from ICD insertion.

Risk assessment with MMA-based MTWA is also independent of medications and is accurate in patients with depressed as well as preserved left ventricular ejection fraction. Furthermore, studies were published that reported MTWA levels for patients with various diseases known to increase risk for cardiovascular mortality. Mean MTWA levels were 58 μV in patients with myocardial infarction and diabetes, 71 μV in patients with renal disease requiring hemodialysis, and 51-65 μV in patients with sleep apnea, conditions that are relevant to the CMS population.

The utility of MMA and specific guidelines for its use are provided in a recent multi-society endorsed consensus guideline statement authored by experts in both the Spectral and MMA Methods, which describes and compares the methods. It concludes that the two methods are equivalent in prediction

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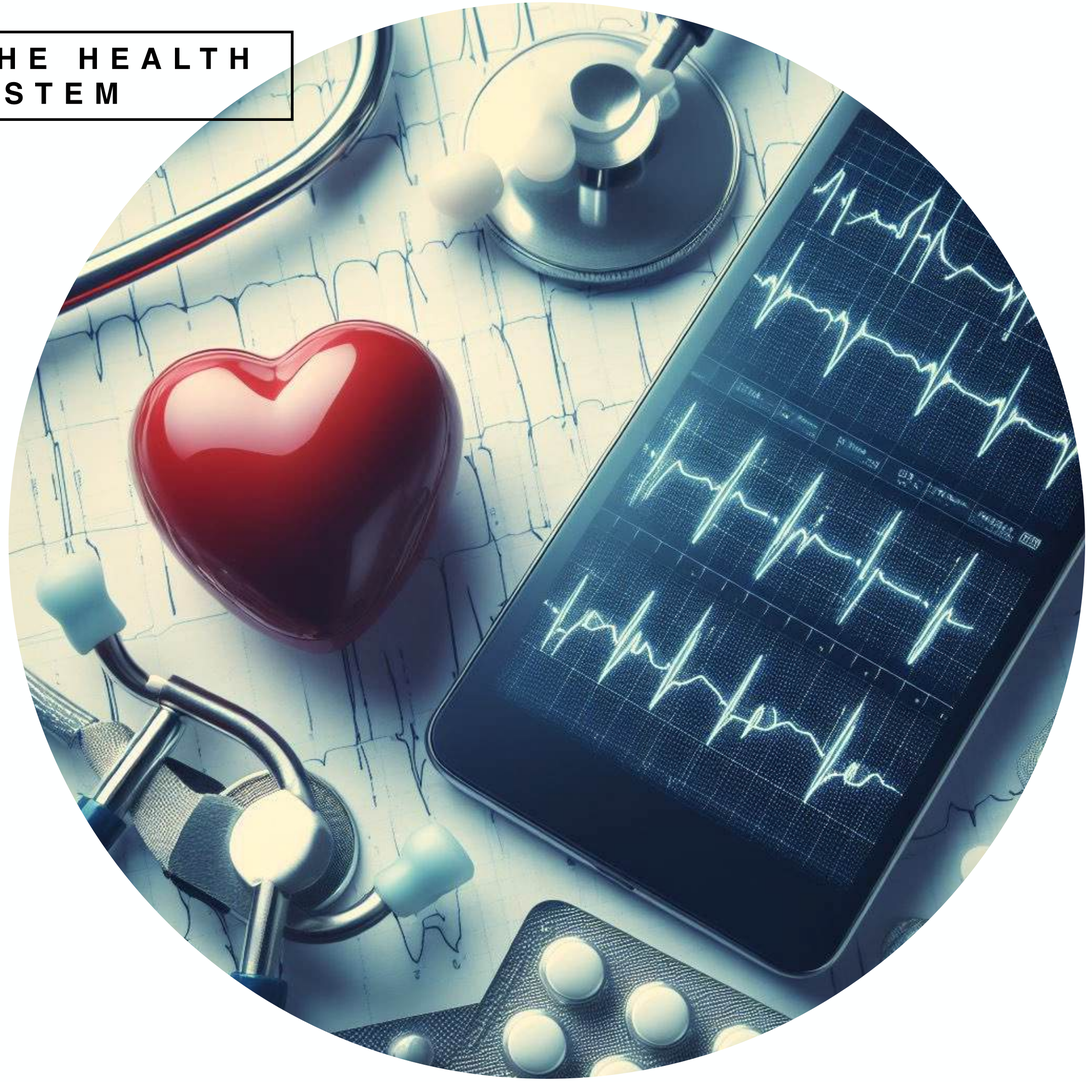
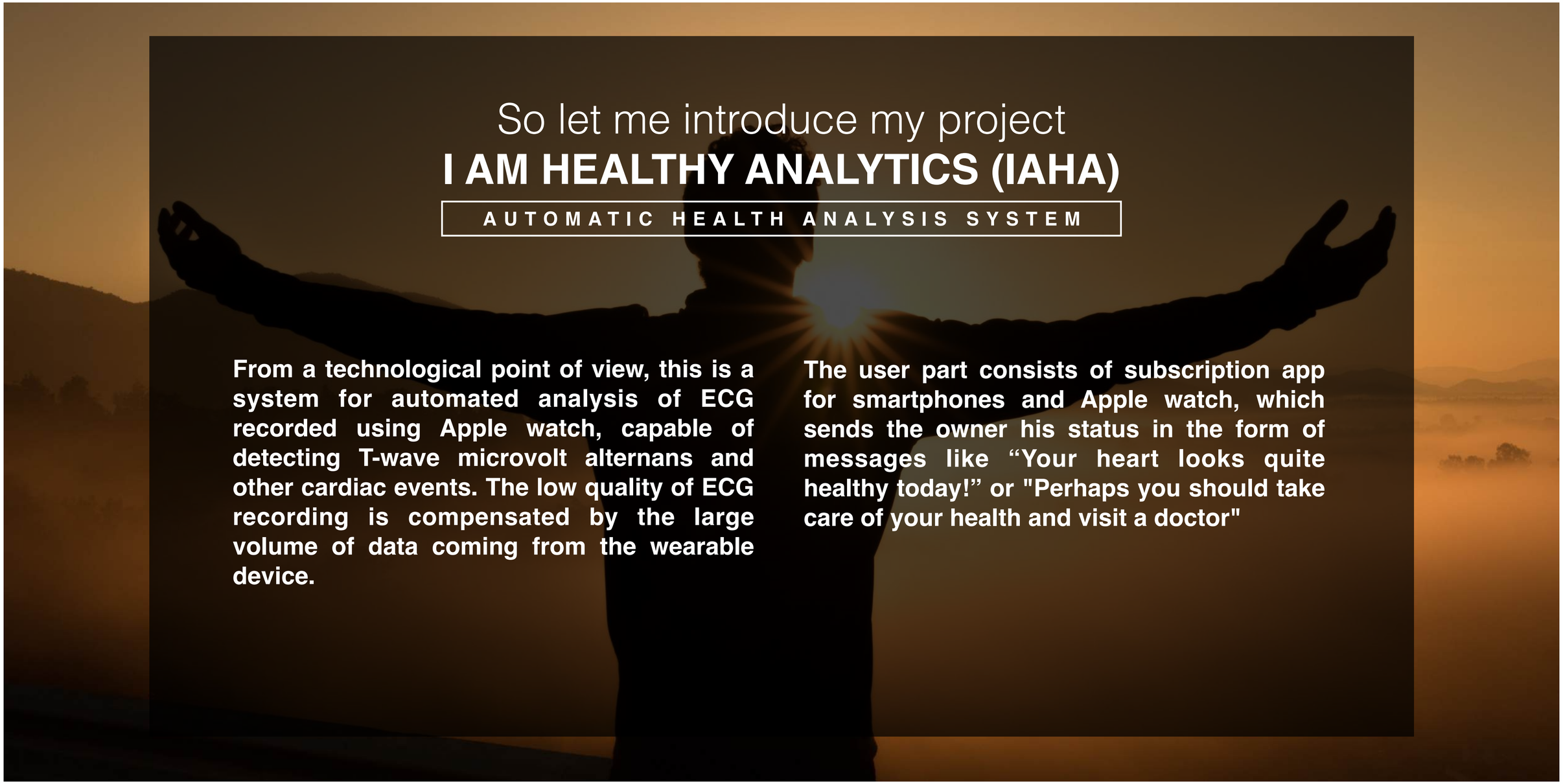
Thus, the absence of **microvolt alternans of the T-wave**

CAN BE A RELIABLE MARKER OF THE HEALTH OF THE CARDIOVASCULAR SYSTEM

The presence of MTWA in itself is not a diagnosis, but a reason to take care of your health and consult a doctor.

In addition, the features of the MMA analysis method make it possible to determine microvolt TWA even in cardiograms taken by non-medical devices, such as smart watches





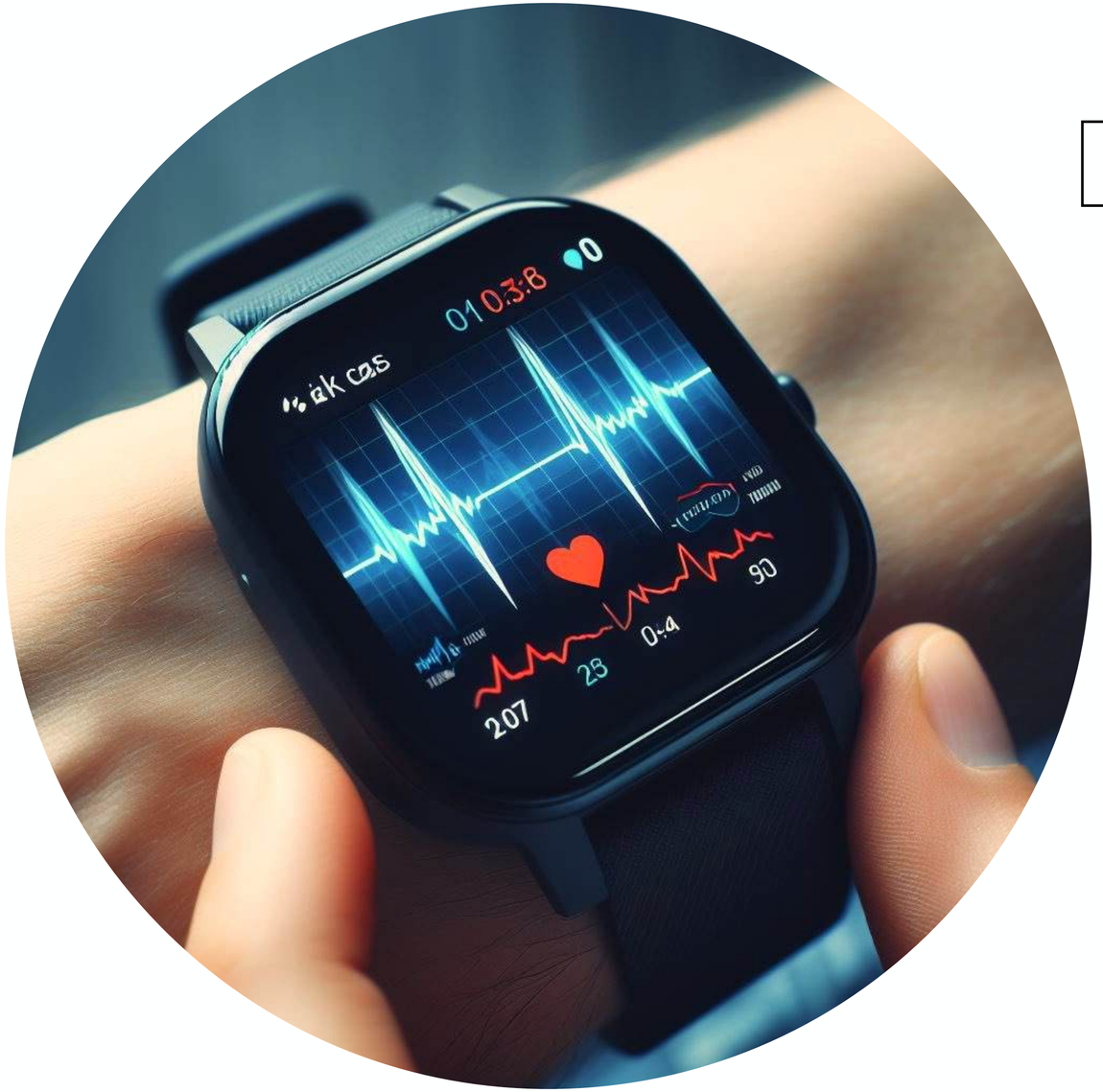
So let me introduce my project

I AM HEALTHY ANALYTICS (IAHA)

AUTOMATIC HEALTH ANALYSIS SYSTEM

From a technological point of view, this is a system for automated analysis of ECG recorded using Apple watch, capable of detecting T-wave microvolt alternans and other cardiac events. The low quality of ECG recording is compensated by the large volume of data coming from the wearable device.

The user part consists of subscription app for smartphones and Apple watch, which sends the owner his status in the form of messages like “Your heart looks quite healthy today!” or "Perhaps you should take care of your health and visit a doctor"



HAVING IDENTIFIED A SUSPICIOUS CARDIAC EVENT

the system saves the ECG section and a commentary on its automatic interpretation for subsequent analysis by the attending physician, who makes the final decision on further examination.

The application can also automatically send similar ECG sections to the smartphone to the attending physician and the user's relatives. Or even call an ambulance using the geolocation of the owner of the apple watch if you suspect an ischemic stroke, loss of consciousness and other emergency conditions displayed on the ECG

Who might be interested **in the application**

WHICH DOES NOT AIM TO MAKE A DIAGNOSIS OR CLARIFY IT

People with diagnosed cardiovascular diseases or at risk for cardiovascular diseases

people caring for elderly relatives

athletes monitoring their health

people concerned about their health in general

people suffering from poor health

young women with chest pain*

people suffering from paroxysmal arrhythmias

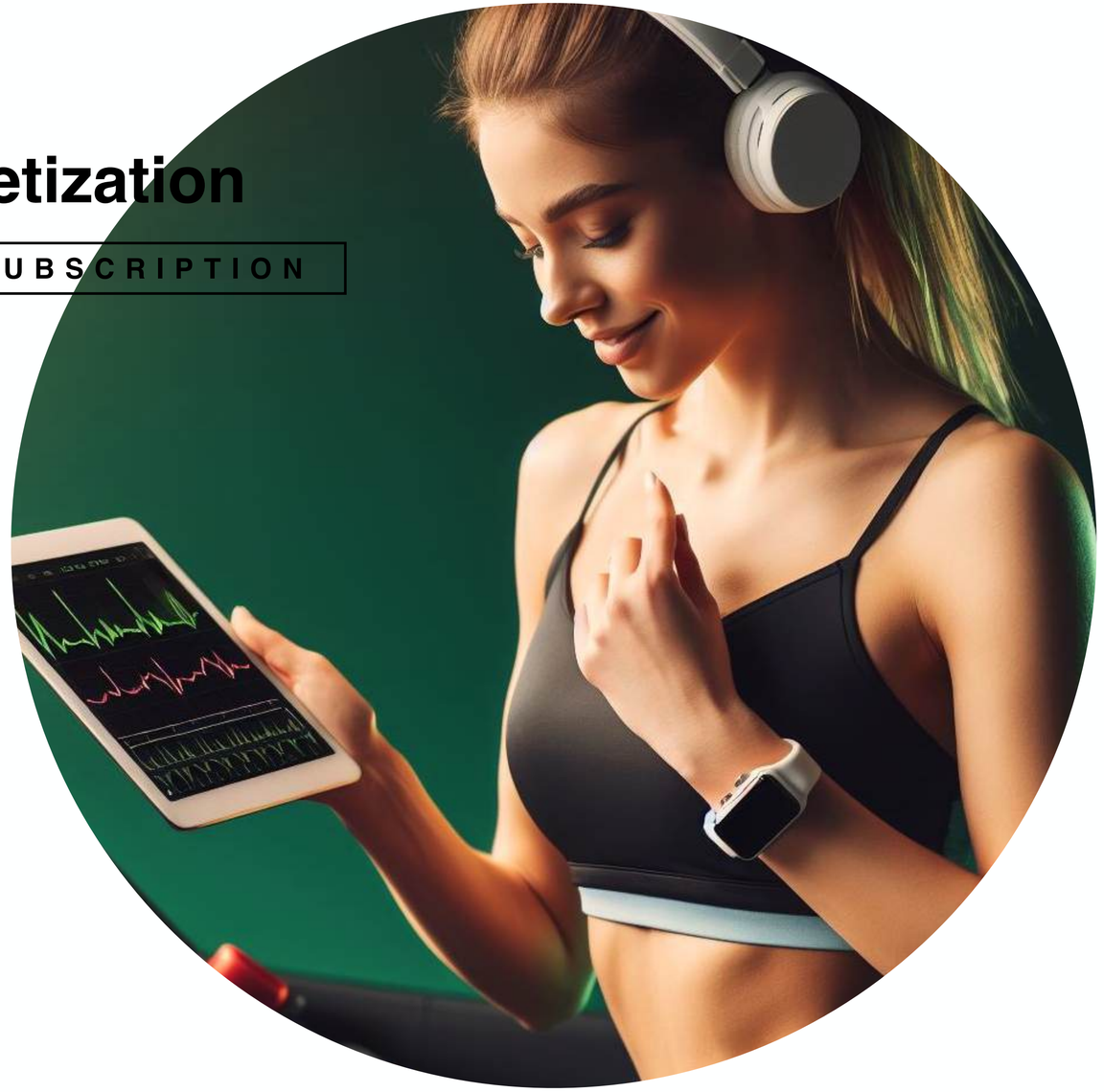
***According to he National Institute of Minority Health and Health Disparities Research analyzing 4152 records representing 29 730 145 Emergency department visits for adults aged 18 to 55 years, young women with cute myocardial infarctions (AMI) present with greater comorbidity and have higher rates of in-hospital mortality compared with young men. Chest pain (CP) is the most common symptom of AMI in men and women, but in the VIRGO (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients) study, it was less likely to be recognized as related to heart disease among women. On a population level, women are less likely than men to undergo cardiac testing when presenting with CP. Also women were independently less likely to be admitted when presenting with CP. Similar trends are seen by race. Black adults are less likely to undergo electrocardiography or cardiac enzyme testing when presenting with CP.**

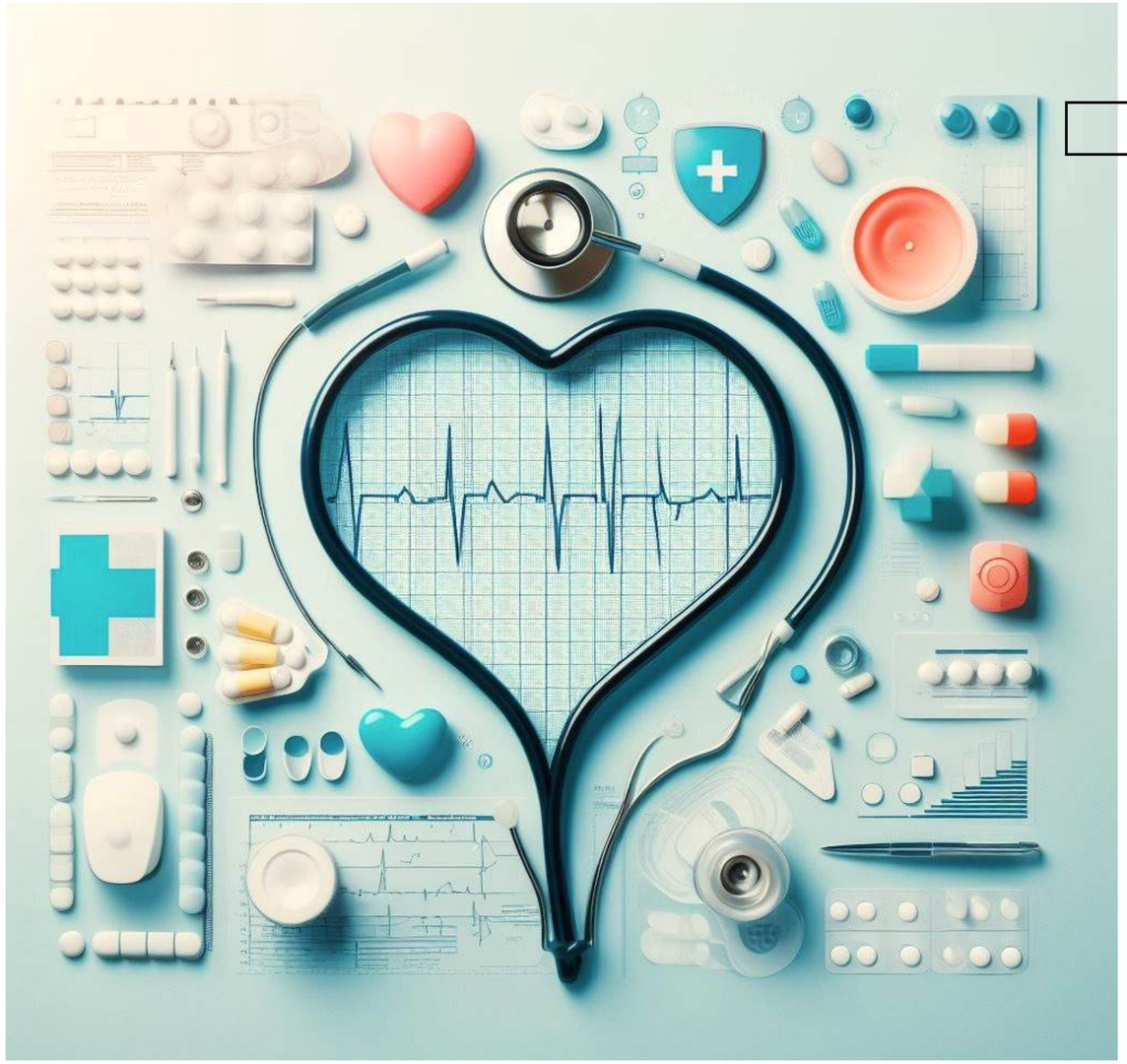
Sex and Race Differences in the Evaluation and Treatment of Young Adults Presenting to the Emergency Department With Chest PainED Management of Chest Pain in Young Adults by Sex Banco et al Darcy Banco, Jerway Chang, Nina Talmor, Priya Wadhera, Amrita Mukhopadhyay, Xinlin Lu, Siyuan Dong, Yukun Lu, Rebecca A. Betensky, Saul Blecker, Basmah Safdar and Harmony R. Reynolds Journal of the American Heart Association Volume 11, Issue 10 May 2022

Opportunities for **app monetization**

IN ADDITION TO THE MONTHLY SUBSCRIPTION

the project is great for advertising both commercial medical centers and third-party applications dedicated to healthy eating and exercise





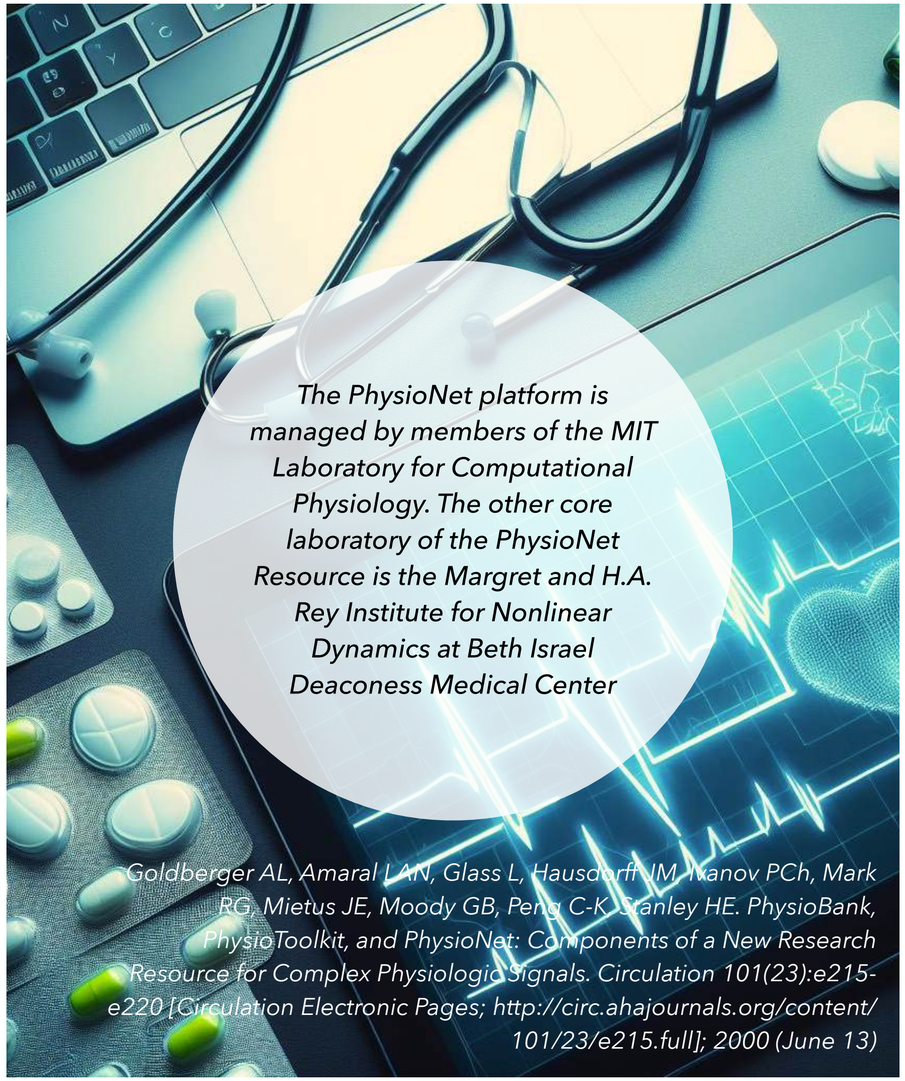
PROJECT DEVELOPMENT PROSPECTS

Since the system is capable of self-improvement thanks to machine learning, analyzing incoming ECG data, with each new user the accuracy of analyzing ECG events in general and determining microvoltage T-wave alternans in particular will only increase.

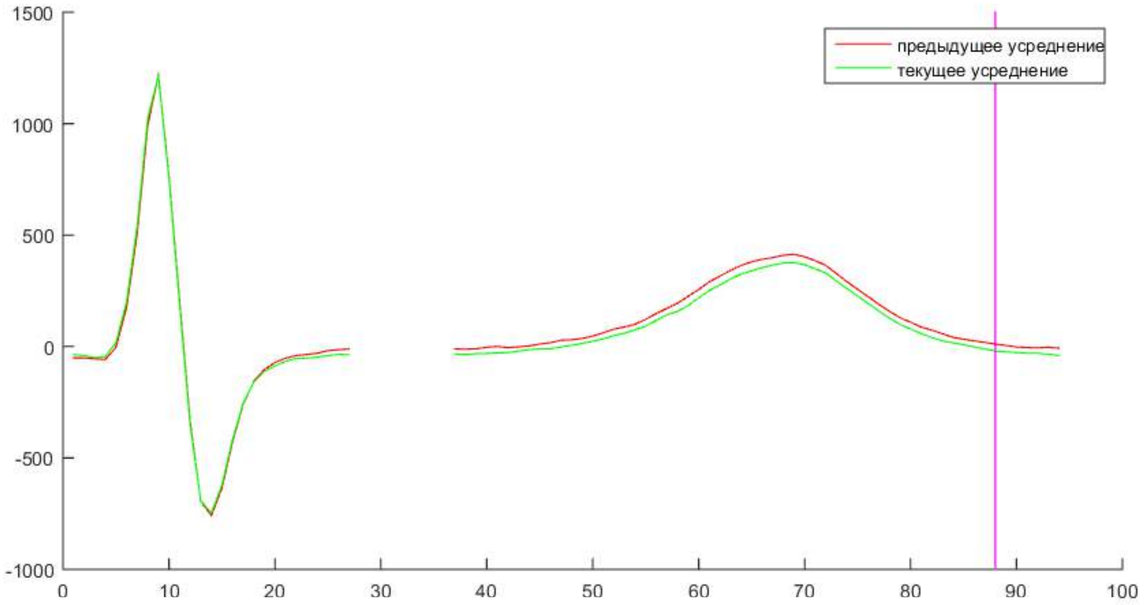
Moreover, in the future, big data analytics of users' ECGs, taking into account their health status and lifestyle (with the users' consent, of course), will make it possible, with the help of neural networks, to find completely new markers of health and longevity, providing medical organizations with material and direction for relevant scientific research

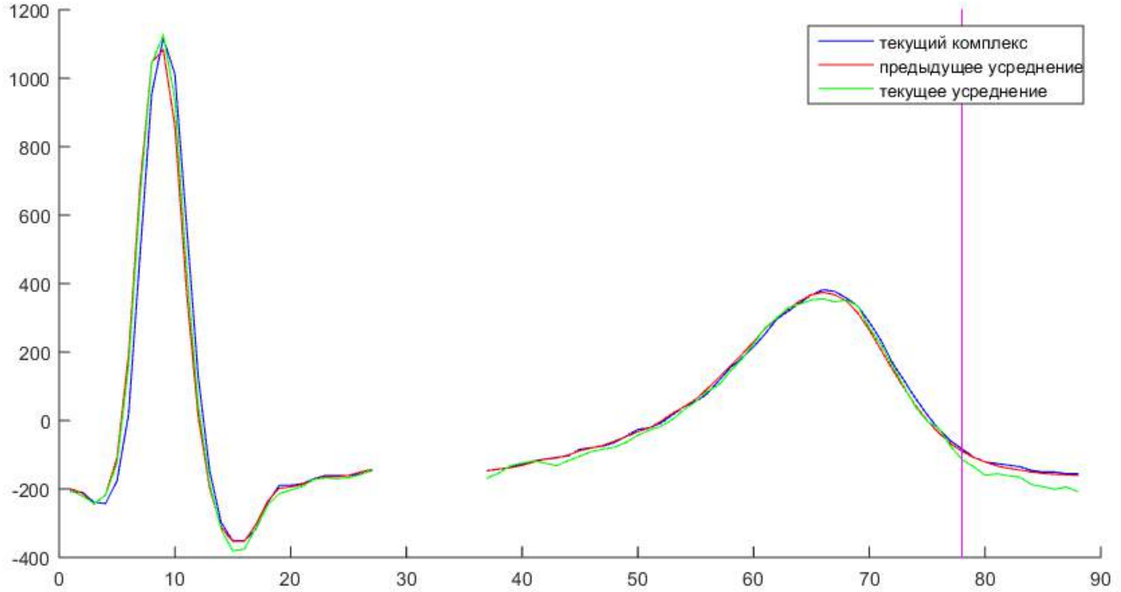
STAGE OF PROJECT IMPLEMENTATION TO DATE

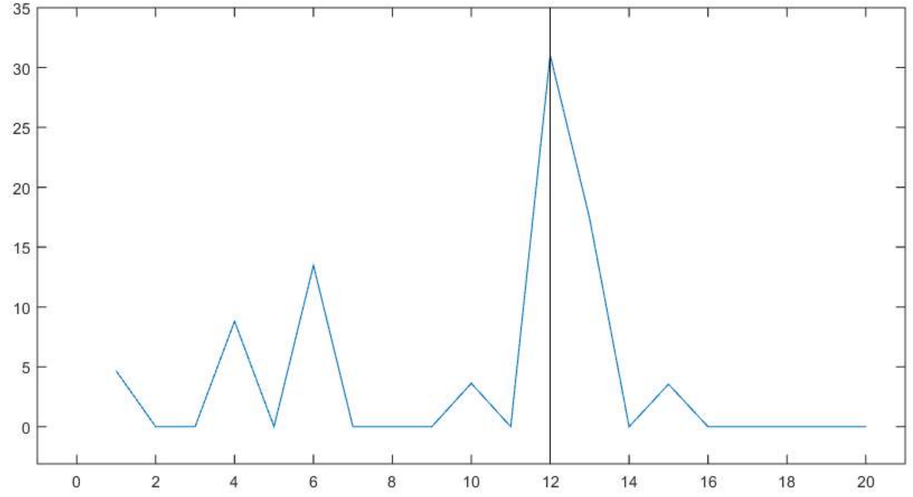
Using databases and elements of software products from the open resource PhysioNet, the leading technical specialist of the project created a web version of the system that automatically analyzes the downloaded ECG of a registered user and successfully identifies microvolt T-wave alternans using the MMA method

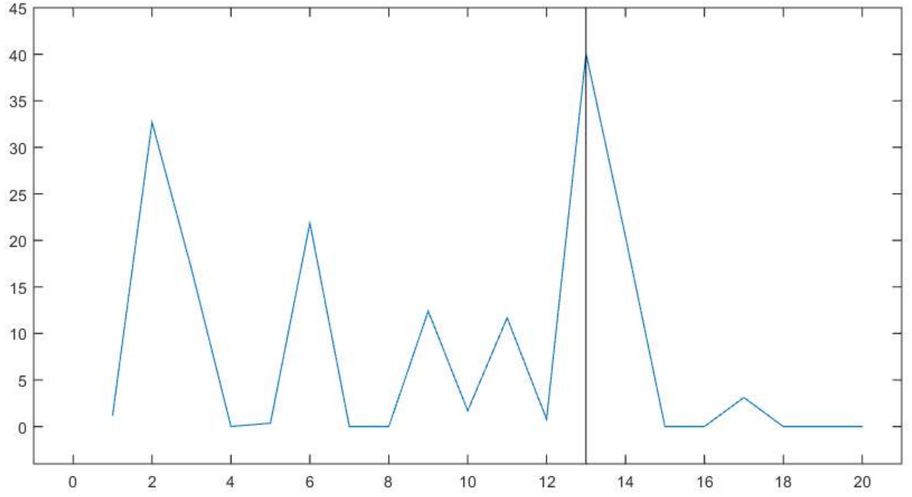


FRAGMENTS OF MMA ANALYSIS OF MTWA OF LOADED ECGS









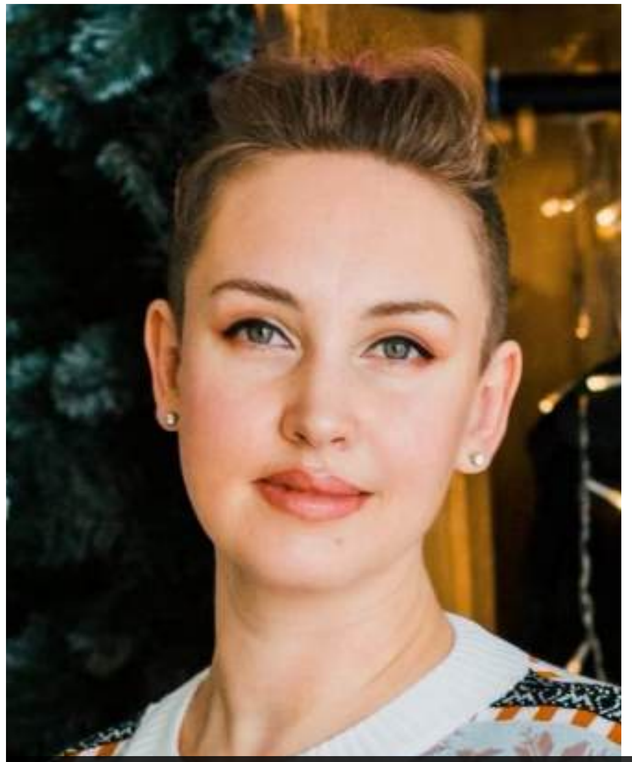
At the moment **the project is financed**

EXCLUSIVELY FROM MY PERSONAL FUNDS
WHICH ARE OBVIOUSLY NOT ENOUGH TO COMPLETE IT

Tasks that cannot be implemented without third-party funding:

- Development of an application for smartphones and Apple watch
- Providing significant computing power for storing and processing large amounts of data
- Expanding the team of technical specialists

OUR TEAM



Marina **Stepanenko**

Project founder

Andrey **Beletsky**

leading technical specialist

THANK YOU

FOR YOUR ATTENTION

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