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***Abstract*—The combination of pervasive sensing and multimedia understanding with the advances in communications makes it possible to conceive platforms of services for providing telehealth solutions responding to the current needs of society. The recent outbreak has indeed posed several concerns on the management of patients at home, urging to devise complex pathways to address the Severe Acute Respiratory Syndrome (SARS) in combination with the usual diseases of an increasingly elder population. In this paper, we present TiAssisto, a project aiming to design, develop, and validate an innovative and intelligent platform of services, having as its main objective to assist both Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) multi-pathological patients and healthcare professionals. This is achieved by researching and validating new methods to improve their lives and reduce avoidable hospitalisations. TiAssisto features telehealth and telemedicine solutions to enable high-quality standards treatments based on Information and Communication Technologies (ICT), Artificial Intelligence (AI) and Machine Learning (ML). Three hundred patients are involved in our study: one half using our telehealth platform, while the other half participate as a control group for a correct validation. The developed AI models and the Decision Support System assist General Practitioners (GPs) and other healthcare professionals in order to help them in their diagnosis, by providing suggestions and pointing out possible presence or absence of signs that can be related to pathologies. Deep learning techniques are also used to detect the absence or presence of specific signs in lung ultrasound images.**

***Index Terms*—Telemedicine, Multi-pathology and Multi-parametric Monitoring, Artificial Intelligence, Machine Learning, Decision Support System, Point-of-care devices**

I. Introduction

In early 2020 the pandemic hit northern Italy and henceforward the healthcare system is under review. The lack of improved methods and structures to deal with fast-spreading contagious pathogens, like Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), produced immediate issues with long-term unknown outcomes and is now leading to consequences that we could only understand in the long run. Recognised healthcare systems, such as the northern Italy ones, still struggle to quantify the impact of the pandemic on their structures. Minor and major inconveniences, like the decrease in hospitalisation or the lag in scheduled appointments [1], are rapidly adding up, and even if the situation is now under control, it is hard to quantify repercussions in the near future. Several organisations and public entities promoted different calls to investigate and respond to these new kinds of issues to help in the ongoing situation and to be better prepared and gain resilience to deal with future similar scenarios.

TiAssisto (an Italian juxtaposition that could be translated into IAssistYou) was conceived in response to the COVID19 call launched by the Tuscany Region in June 2020. This project has been designed to provide and test telehealth systems and methodologies with the ultimate goal of validating the help those could provide during emergencies and ordinary circumstances. The Consiglio Nazionale delle Ricerche (CNR) institutes Institute of Clinical Physiology (IFC) and Institute of Information Science and Technologies "A. Faedo" (ISTI), in collaboration with the Local Healthcare Company of North West Tuscany (ATNO), designed, developed and deployed the telehealth platform in order to assist physicians and patients during all the project phases.

A. Telehealth and public health

Telemedicine and telehealth projects cover a wide range of medical applications, one example is remote surgery with

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the long-distance use of telesurgery technology [2]. Means needed to develop this practice were initially confined to high-level applications, but with the fast advancement of the internet and computer technologies new possibilities arose. Telehealth has been in the spotlight worldwide [3] since the advent of 4G networks and access to fast and stable internet connection protocols, like Fiber to the Cabinet (FTTC) and Fiber to the Home (FTTH), but well-defined studies are only recently emerging. The amount of telehealth/telemedicine scientific papers from 2020 to date is more than half of the one produced in the previous time frame. Numerous works were conducted before 2020 on telemedicine's possible applications and benefits, in which adopted solutions [4] or guidelines [5] can be found. In the last two years, active studies are been showcased pointing the way forward outlining protocols, technologies and problems to deal with. Pandemic literature covers a big slice of these projects [6], [7], but even articles that showcase telehealth employment in usual care are growing in number [8], [9].

Although 5G investments will be delayed due to the current international situation, the pandemic has somewhat accelerated the Italian digital transition in order to offer the possibility of easily connecting the largest number of patients to their General Practitioner (GP) even beyond high-density urban centres. This new possibility can be used to design better tools to support physicians and test new telehealth/telemedicine projects. Recent studies [10], [11] show how access to consistent and reliable data can improve diagnosis and first aid response. The constant stream of newly available data can facilitate the integration of AI in medicine. ML and Deep Learning (DL) can particularly benefit from this

B. *TiAssisto/ IAssistYou*

Italy adopted in 2012 the legislation on Telemedicine, but the technical guidelines on data protection were only introduced in 2018, a hiatus that together with the slow development of the network could have contributed to creating a situation in which Italy's telemedicine infrastructures were not well-defined at the beginning of the Pandemic. The lost opportunity [12] deeply affects early simple telehealth projects, like contact tracing [13], [14]. Public knowledge of the argument was almost nonexistent and the reception was below expectation. A topical point in the TiAssisto project development is the involvement and training of the GPs that often are the first and trusted source of knowledge in cutting-edge healthcare. In TiAssisto we aim to design, implement and provide a new decision-enhancing system to better assist and connect health professionals, GPs and patients using a Web platform that serves the northern-west area of the Tuscany Region, integrating several models of care (Figure 1). TiAssisto helps collect and share medical information such as Lung UltraSound (LUS) images, vital signs and other health information, which not only will let us build algorithms that can help in classifying images or predicting patients' conditions, but will also be used to explore a way to personalise health care, thus resulting in a leap towards the 5.0 medicine of the future and its public acceptance.

Out of all the three hundred enrolled patients, one half (150) and the majority of the involved professionals use the TiAssisto telehealth Web platform: the records of their impressions and opinions are monitored during the whole duration of the experimentation in order to validate the platform and the proposed methodologies. Information and data gathered from all the sources are used to evaluate the benefits or disadvantages for both patients and healthcare professionals.

In this paper we investigate and define:

- a new protocol to develop and test telehealth projects;
- the design of a telehealth Web platform and intelligent services for continuous monitoring;
- the validation of the impact of telemedicine and ML solutions in the management of fragile subject;
- the integration of these services in nowadays care pathways.

The following Section II introduces the intermediate milestones of the project corresponding to the definition of the methods, data and population, key parts of the entire project; then, Section III describes the alpha version of the Web Platform and the logic behind its development. As last, Section IV proposes the possible AI integration in the healthcare process, while Section V describes a preliminary experiment. Discussion and conclusions are reported in Section VI.

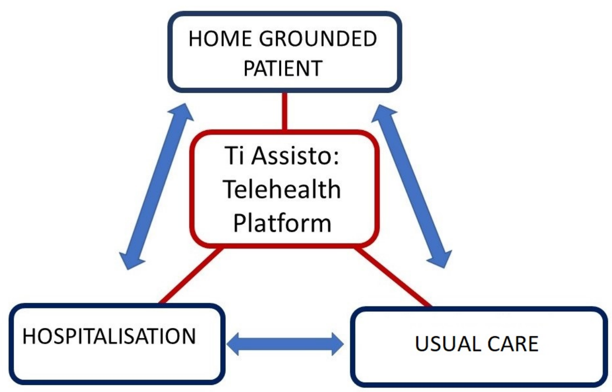

Fig. 1. Medicine 5.0 proposed access in which patients and physicians have a new way to interact through Web platform and monitor devices

II. Materials and Methods

In order to validate our telemedicine solutions, a specific plan for extended experimentation has been devised, including all the actors, professionals and stakeholders. GPs have the main role of suggesting eligible patients that have an internet connection and a mobile phone or a tablet or a personal computer and are willing to actively participate in the trial.

A. *Population in TiAssisto*

IFC and ATNO started the project enrolling thirty GPs — and others will join ongoing — interested in testing the developed Web application and experiencing the possible benefits of telehealth themselves. The project recruited three hundred patients with the help of the involved physicians and ATNO. Patients considered to be enrolled in the trial can have different medical histories, but, due to the nature of the project, particular attention was used to choose who to contact for participating in the study, prioritising:

1) SARS-CoV-2 home care patients;
2) SARS-CoV-2 hospitalised patients;
3) patients living in Nursing Home (NH);
4) other patients, fragile subjects affected by diabetes (I and II) and/or heart failure are slightly prioritised; these conditions seem to be among the ones that have most affected the mortality rate and thus need to be checked with greater attention [15].

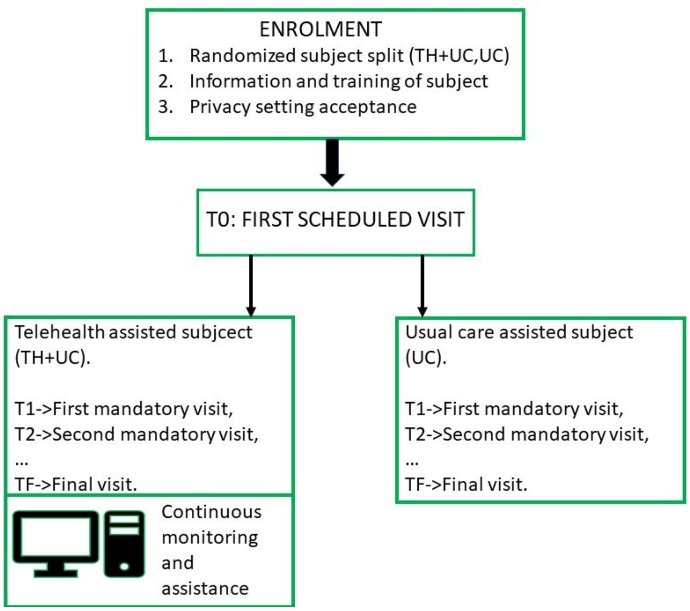

Fig. 2. Enrolment strategies and subsequent follow-up of subjects, in the TH + UC and in the UC groups.

At the beginning of the trial, part of the development team (CNR and ATNO), healthcare professionals and computer scientists are assigned to assist participants in the TeleHealth and Usual Care (TH+UC) cohort with the associated task: collecting data, using the assigned easy-to-use devices (weight scale, pulse oximeter, glucose meter, blood pressure meter, thermometer, heart rate monitor), connecting to the platform and even with home screening if needed[1].

Pandemics showed the need for an emergency unit on the territory to provide first assistance even for people quarantined. Special Continuity Care Units (SCCUs) are special teams whose purpose is the continuity of the care for any patients, in case no other ordinary unit is able to attend. Enrolled patients can receive assistance at home from these teams, that is the reason why it has been required the participation of SCCUs in the project.

[1]After training the users, the support team acts only whenever the condition of patients and their safety require an intervention.

B. The TiAssisto's Method

A Random Controlled Trial (RCT) protocol is used to select the participants. The selected ones are divided into two groups, so that one half is followed with the mixed method consisting in TeleHealth and Usual Care (TH + UC), while the other half are assisted only on with Usual Care (UC), obtaining two groups of 150 people each. Four control visits, defined as T0, T1, T2 and TF, are scheduled corresponding to the months 0, 1, 3 and 6 since enrolment of the patients (see Figure 2).

T0 represents the starting point for each patient: the GP or another health professional belonging to the SCCUs and the Extended Care Units (ECUs) accesses a dedicated Web platform. Patients or their caregivers fill in a standardised entry questionnaire and enter their medical history; only the subjects involved in the experimental group will use the platform to complete these steps. The collected data is accessible to the researchers and personnel of the project. To avoid violation of privacy, only a few selected users are allowed to know the relation between sensible and private users' information.

In addition to scheduled visits, as normally happens, other more or less urgent visits may be requested by the patients to the GPs. These can be performed using the teleconference system integrated into the platform, also accessible by quarantined people. The SCCU members joining the ongoing trial, collect data similarly to GPs and also receive a timed access to the platform as specified by the GP, during which they can contact the patient's GP with the integrated telehealth video system. At the end of their usage of the platform, they are prompted to fill out a standardised questionnaire to record their experience with the TiAssisto platform.

TF denotes the final visit and it is scheduled six months later the start of the trial. As a possibility, it is considered an early exit from the project (in case of death, personal reasons or otherwise): in this specific circumstance, patients are asked to complete the final questionnaires for collecting their views on the time they spent using the Web platform.

The assistance provided by the development group is aimed at reducing excessive workload for both the enrolled patients and the healthcare professionals participating in the project. The TiAssisto team follows the subjects for at least two months after the end of the project, to assess and diminish any issue that could be due to the transition to the standard assistance of the patient or an increased workload for the healthcare professionals, especially for GPs.

C. Data in TiAssisto

1) Patients' data.: Standardised questionnaires are administered in the defined phases, i.e. T0, T1, T2 and TF. They are used to determine the opinion and health status of the subject at the beginning, throughout and at the end. Questionnaires include:

1) Dass-21: mental health survey;
2) Kansas City: Heart Failure survey on quality of life;

3) DIMS; Diabetes standard survey to monitor the quality of life;
4) Other supporting questionnaires.

On the customized area of the Web Platform, the patients insert a set of periodical information as requested by their GP. Some of these are health status questions that can be simply answered with a YES/NO. Vitals measurements are acquired using devices provided to patients. Information flows are always available for the related physician that can assert personally if this kind of pattern could help deliver better care.

Patients' data is used to compute multiple scores to support the GP: scores used are standardised and can also be used to assist physicians to detect when and if the patients need to receive medical assistance or to be visited.

At the end of the project, a few final questionnaires are administered to record the last impression on the use of telemedicine and health status.

TABLE I
AN EXCERPT EXAMPLE FROM THE DATASET: BODY TEMPERATURE, SYSTOLIC BLOOD PRESSURE (SBP), DIASTOLIC BLOOD PRESSURE (DBP), OXYGEN SATURATION AND DYSPNEA VALUES ARE SHOWN FOR SHORT

Subject	Temperature	SBP	DBP	Oxymetry	Date	Dyspnea
1	37.5°C	91 mmHg	130 mmHg	96%	02/01 9.30	Yes
1	42°C	91 mmHg	130 mmHg	94%	02/02 10.00	Yes
...						
300	36°C	81 mmHg	120 mmHg	98%	02/27 11.30	No

2) Healthcare specialists' data.: At T0 and TF the Healthcare professionals, which actively participate in TiAssisto, answer the Telemedicine Service Acceptance (TSA), a 25-item questionnaire with a five-level Likert scale. Similarly, professionals joining the project ongoing fill out a revised version of the TSA to evaluate their experience. Data acquired is used to see if there are going to be any changes in opinion about telehealth and can help future projects to improve these new healthcare practices.

The GPs, and the other physicians collect records on the platform of their visits by inserting data into a customised Web area.

In Table I, a very small subset of the data that physicians could acquire is shown. Data that can be recorded is in fact more extended and various.

Data collected spans from basic physiology in order to assess the basic health status of the patients, to cutting-edge new significant parameters like pulse oximetry, which due to SARS-CoV-2 has raised in importance, to Electrocardiography (ECG), to blood gas analysis and ultrasound images. To this end, GPs and physicians are equipped with portable ECG machines, ultrasound devices and blood gas analysers.

III. THE PLATFORM

A telehealth system identifies a wide range of electronic and digital devices whose purpose is to remotely guarantee health assistance. TiAssisto proposes a Web platform accessible via Internet from any browser, using tablets, mobile devices or personal computers [16].

TiAssisto is a server-based platform of services developed by CNR; all the TiAssisto modules have been self-produced. Logic and UI design follow the Model View Controller pattern (MVC), approach. MVC is an already established pattern that has several advantages: among these, the independence of the various components (input logic, business logic and user interface logic)) allows easier work for the various work groups involved in the development, and the controller separated from the rest of the application makes planning easier and allows to focus on the logic of operation. *PostgreSQL*, *Java EE* and *Java Server Faces* are the primary bricks of the system.

A. Privacy

TiAssisto ethical committee as well as the legislation require that all sensitive data is treated respecting the privacy policies. Selected personnel from ATNO using our Web platform will record in the database all the personal information of the subjects. This information is encrypted using *pgcrypto*, a built-in module for *PostgreSQL* enhanced with an ad-hoc built system. The encryption algorithm and the used key are declared outside the database and the telehealth platform to minimise possible damages in case of hacking.

Privacy is furthermore guaranteed with data anonymization: each user has associated an anonymous id that can be used to map all the relations inside the platform. This is also a standard practice in medical studies to ensure subject anonymity. Only the chosen members of the project are allowed to identify the subject and visualise their private data, and clinicians will be allowed to visualise only their own patients.

B. GUI development

Each web page developed in TiAssisto was realised by the developing team in collaboration with the users. A beta test was first conducted with a subset of users: User-Centred Design (UCD) seems to be the most reliable way to build telehealth projects [17]. The research nature of the platform does not exclude the possibility of making adjustments to the GUI at run-time [16].

Proposed GUIs are personalised for user groups. Usage for Patients must be as simple as possible to avoid errors or any stressful situations. As requested by physicians, we designed a quick and intuitive graphical interface to simplify and speed up their work avoiding over generalise data so that they do not perceive the platform as too much oversimplified and not effective as a helping diagnostic tool (Figure 3).

Graphics showing the recent health history of the patients, scores and suggestions are provided by means of AI modules, to help physicians and consolidate the trust in this new branch of medical assisting devices (Figure 4).

IV. ARTIFICIAL INTELLIGENCE IN TIASSISTO

As stated, the main task of the Web platform is to validate the telehealth benefits over a vast territory. Integration of an AI that can help health professionals in real-time could be a major

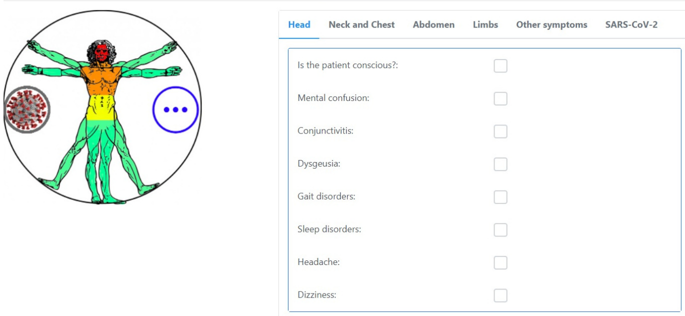

Fig. 3. The stylised version of the "uomo vitruviano (Vitruvian Man)" by Leonardo da Vinci, implemented as a map area, is an easy-to-understand tool used to provide an alternative option to quickly access the information to be recorded during visits.

Fig. 4. Summary page for the dummy patient "Mario Rossi": section of the recent health measures history that a physician can visualize.

benefit for the project other than a powerful new mechanism to further quicken and help physicians in their diagnosis. In medicine and in other scientific fields, the term AI is sometimes only used for machine learning-based approaches. However, inductive analysis is not the only strategy to develop intelligent systems. Indeed, decision support systems, based on deductive reasoning, have been deployed long before ML ones. The knowledge-based AI used in hospitals can contain a vast set of rules to ensure surveillance and faster decision-making in real life.

In Tiassisto, intelligent services are based on the combination and synergy between the various AI approaches. Rules employed in hospitals are refined so that can be better applied in a domestic setting or in General Practice. Image classification and object detection are tasks better entrusted to the DL algorithms instead [18], the focus on TiAssisto is on ultrasound interpretation, due to the setting of the project [19]. Finally, machine learning algorithms are presented as a way to predict the health status of the patients using both the periodic data recorded in the platform and the one coming from the scheduled visit. The set of data used to train and test this result varies from patient to patient and it is based on their health conditions.

A. Lung ultrasound

In the last few years, ultrasound images have been used as an important and trusty tool for monitoring health status. The presence or absence of particular signs in the images can lead to the discovery of different pathologies. Ultrasound is a versatile and affordable examination tool. This technology is also portable and usable outside hospitals or healthcare centres, even if less sophisticated than point-of-care exams like computed tomography scans (CT) and Magnetic resonance imaging (MRI), its diagnostic power is high and can be augmented with the help of AI. These factors made it possible to use it even during the pandemic, when home quarantined patients could not benefit from hospitalisation.

Experiences during the pandemic were reported [20], in which physicians and lab staff used LUS to find out if the patients were developing pneumonia due to SARS-CoV-2 and thus to further check their status during the ongoing disease and in the immediate follow-up.

Health-care specialists seem to recognise in the LUS structural evidence of SARS-CoV-2 [21], [22] pneumonia or its resolution. In our project the ultrasound data is collected by professionals, thus no excessive manipulation is needed to train a Deep learning algorithm. A fraction of this data is analysed and annotated by sonographers and is used as a training set for a acDL model whose envisaged task is to automatically detect particular structures in the images (Figure 5).

The second and different DL algorithm categorises the lung ultrasound images and is used to assist in the identification of a wide range of signs that can support physicians to diagnose lung diseases: starting from pneumonia[2], but not omitting other important diseases, e.g. pulmonary oedema, pneumothorax and cancer.

The DL network architecture modelled to investigate and used to solve this task is an ensemble of EfficientNet. The ISTI team is trying to adapt previous work [23] on image classification optimisation from generic tasks [24], [25] to the field of medical image classification. The deep learning algorithm is being developed with *Python* and the *PyTorch* library; the graphic processing unit, GPU, used is an NVIDIA QUADRO RTX 5000, owned by ISTI.

B. Patients health score evaluation parameters through AI

Modern technology with the capability of integrating small sensors from a multitude of devices has made really easy to obtain a vast set of health data to help monitor patients' status. Physicians have always used vital measures and other parameters individually or together to monitor and evaluate patients' conditions. In the majority of situations outside the hospital [26] or clinic, where vital signs are constantly monitored by a professional team, there are few methods to assess the health status of the patients. Self-monitoring like the one presented in TiAssisto, and in the near-future automatic monitoring, represents a methodology to explore.

The different parameters gathered in TiAssisto are steadily updated and presented to the referenced physicians and the development team in a standardised manner. The stream of

[2]SARS-CoV-2 primary health treat starts from severe pneumonia even if the variants seem to attack other organs.

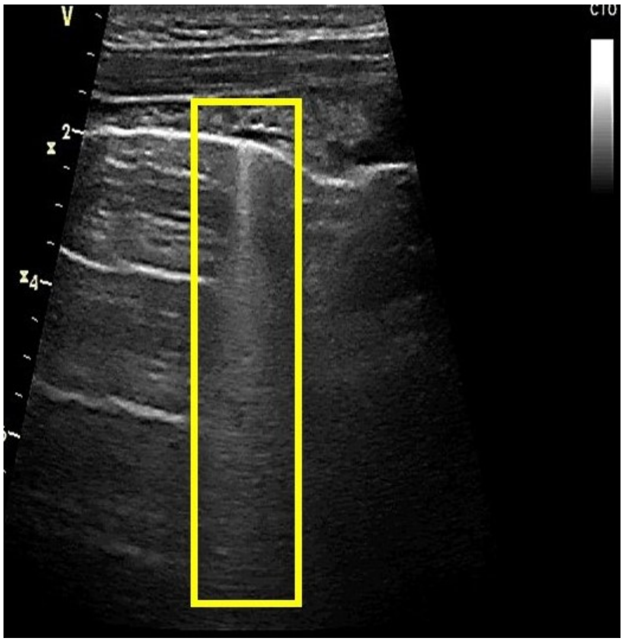

Fig. 5. A lung ultrasound: once uploaded to the TiAssisto platform, it is processed and specific signs are classified by AI algorithms, like the comet-tail B-lines highlighted in the yellow rectangle.

data interacts with a strong AI integrated into the platform. A strong AI is generally depicted as a decision tool that uses a defined set of rules and equations to autonomously solve a problem; the set of rules that are used has been designed with the help of IFC. This partnership between the medical and computer science teams has made it possible to build a simple AI, that can express through scores or sentences the patients' health trends and other diagnostic advice.

This system can be further expanded, capturing one step at a time what it is the complex decision process that physicians use to make a diagnosis; so it can be seen as the first approach of a future AI system that can assist prospective healthcare professionals. These new patterns aim to check if the telehealth system may have a major role in identifying and quickening medical examination or hospitalisation to patients well being.

This modernisation of standard health monitors is also partnered with weak AI machine learning techniques to assert patients' conditions. This particular task is going to be used to implement an ethical machine learning tool, to see if classical-based ML could achieve reasonable performance against the new deep learning technique, that could have a more demanding electric consumption on comparable size [27].

V. Experiment

One of the project aims is to build a dataset containing enough samples (n), which is possible to work in the condition where predictors (p) are far lesser than the sample size, i.e. $p \ll n$, an ideal start to implement ML algorithm.

At this stage of the project, we lack a database of this size, with few patients' data and the physicians' help it anyway was possible to develop an experimental dataset. Based on plausible physiological ranges of each feature and few real data, a random function was used to generate an experimental dataset of vital signs: continual measures (glycemia, blood pressure, ...) and categorical constructs (i.e. Edema?: Yes/No).

A function can have difficulties to represent a vital measures trend during the day, measures that are usually defined in a range that can be deeply affected by condition and activity, but a random approach can be used to predict a single status for a patient during a check-up or self-monitoring.

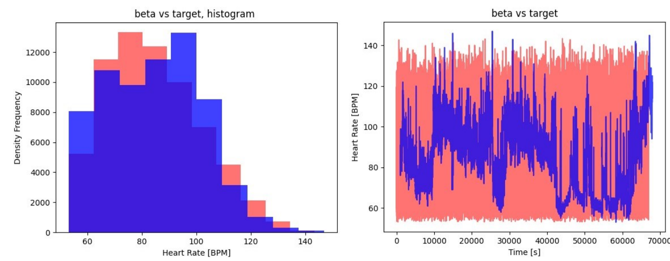

Fig. 6. Heart rate trend during the day (blue) of a subject obtained by an actigraph against a simulated Heart rate (red), the distribution is not conceivable for a human being, but a single element of distribution can be an example of standard or particular activities.

The available data was used to test which probability distribution fits the best features used in the experiment. The python packages used to analyse available data are *disfit*, *scipy* [28] and *numpy* [29]. The *disfit* package helped to identify the best distribution and the parameter that best fits the probabilistic distribution of the data, with the help of this information, the *scipy* package was used to implement a random distribution with the same characteristics and it is used to generate examples that are then inserted in the experiment dataset.

With this assumption, we can recreate a variable with a similar frequency distribution, but its application is limited, since we assume that the fitted data is randomly correlated, while vital measures samples are actually highly correlated between themselves (Figure 6).

The complete dataset, obtained through data augmentation, is then inserted in the pipeline of TiAssisto as 100 different test subjects. For every set of features, the AI in TiAssisto will automatically generate a related set of scores, one numerical and one chromatic. The numerical score is computed by the AI integrated into the platform, then the same AI compares the score with the precedent available data and generates a coloured flag that expresses if the subject is stable, worsened or improved. This score, discretized, is used as a target outcome to train different machine learning models, such as XGBoost ad it's implementation [30].

The split ratio chosen for training and testing is 70% / 30%, which means that 70 patients are used as a training set while the remaining are used as the test set (Table II).

The set of ML algorithms is tested, with two mandatory clauses: non-random shuffle on cross-validation set and not back- or forward-propagation between data of different patients. The validation set defined is based on the subject group fold. Even if data was randomly generated, we implemented a simulated model designed to be as much accurate as possible.

TABLE II
GRADIENT BOOSTING CLASSIFIER EXAMPLE: THE DATASET USED IS MOSTLY FORMED BY AUGMENTED DATA, THAT CAN EXPLAIN THE HIGH ACCURACY OBTAINED

	Precision	Recall	F1-Score	Support
worsening	1.00	1.00	1.00	471
stable	1.00	1.00	1.00	489
improving	1.00	1.00	1.00	440
accuracy			1.00	1400
macro avg	1.00	1.00	1.00	1400
weighted avg	1.00	1.00	1.00	1400

The accuracy obtained on the test set is oddly high due to the data generation process used: with a gradient boosting tree algorithm a 100% prediction capacity was obtained. This occurrence will be investigated throughout the project to see if it can be replicated in real-time monitoring. This concept will be further explored with the development of a patient-based algorithm.

VI. DISCUSSION AND CONCLUSION

The process illustrated in this paper described all the basic information that is needed to start the integration of healthcare services and telemedicine. It is clear that the initial involvement of major stakeholders in the healthcare systems is mandatory. Their trust in this kind of project is reflected in the involved population and helps the development of the active trial and its fair success.

The mutual collaboration of physicians, computer scientists and healthcare specialists made it possible the remote monitoring of the subjects' health status with the least invasive influence on their life. This collaboration also facilitated the implementation of the alpha version of the platform since it was designed with a team that had previous experience in how the healthcare system work. Early design of AI, especially for machine learning that needs properly data to work, can be a difficult task, but the information gathered in the development and training can strengthen the final result. Plausible generated medical data is an important topic to address for this matter; since could be used to early test theory if data is not immediately accessible.

A the end of the project, the size and quality of the gathered database will show how involved subjects perceived their first telemedicine and telehealth experience. This will lead to further research on the possibility to increase or lower the set of data chosen, not only for self-monitoring but for periodic check-ups. The choice to use a restricted set of vital measures and information in self-daily monitoring could show the benefit of this kind of procedure, but could also highlight healthcare patterns not easily detectable in the periodic check-up. Weak and strong AI designs are going to change according to the needs of the platform. It is important to state that the potential of a system that uses both problem-solving techniques in medical applications is high. Improving the system in early detection of plausible pathological signs could lead to better illness control and prevention, improving patient healthcare and potentially lowering healthcare expenses.

The development of a platform aimed to be used by a vast array of people is not an easy task. Especially in a situation where privacy and security must be implemented at a higher level. The amount of data needed to develop an AI algorithm urges for an implementation of a national research data set to test early-stage projects.

The general public and professionals seem to not still find reliable AI tools, even now that their usage and popularity are growing. Studies like ours, must take charge and not only prove the potential of AI as an assistance tool for specialist medicine and home care, but to show the general public that an ethical way to evolve this science branch is possible and should not be feared.

Explainable machine learning approaches are going to play a pivotal role in future AI medical platforms. Tools that can help identify the entire learning process of automatic algorithms are going to strengthen knowledge on AI evolution. Moreover, systems that are able to validate their statements are usually more accepted and can help the integration process of AI in modern society. At the state of the art, the explainable approach is considered at its early stage and the use in medicine is still uncertain [31], though is still an important step towards trustworthy AI [32].

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