Project presentation

Asclepius Oncology

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Many recent analyses and studies show that there is an increase in oncological incidents, while the life expectancy of an oncological patient is increased due to new, advanced therapies [1]. These facts, together with the technological developments, have as a result a rapid increase in the volume of medical data [2]. These data, if properly utilized, can provide significant benefits to both the patient as well as the treating physician.
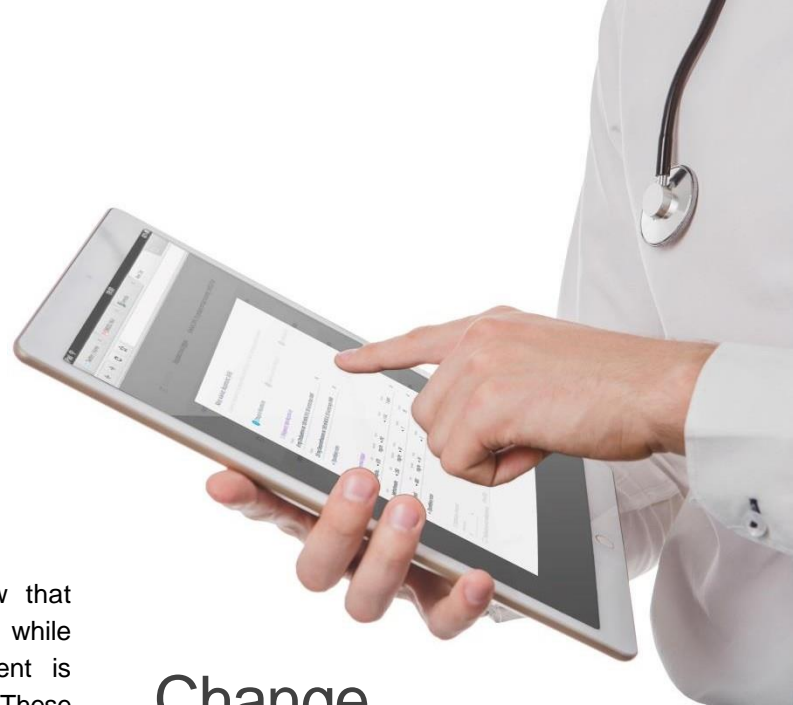
Change the way you manage patients' data

1. System description

The aim of this project is to create an innovative and secure network between oncological patients and oncologists, based on a patient-centered infrastructure. On top of this infrastructure, a suite of oncological data management applications will be developed. These applications aim to address both the treating physician and the patient. The system is complemented by the development of a set of smart and innovative applications on the oncology data.

#Important

One of the main goals is to provide new, technologically advanced digital tools, which will be able to facilitate the import of medical data and significantly reduce the time usually spent for these procedures.

2. System infrastructure

The infrastructure is designed to offer complete anonymity to the patient's entity, even from the side of the system (patient-agnostic system). The above design complies fully with the General Data Protection Regulation (GDPR) [3] and, in combination with a multiple key encryption and authentication system, provides a secure environment for the imported data. At the same time, it is possible for the patient to adjust the privileges on his/her data management (custom data policies).

2.1 Patient-centered architecture

The medical data are imported to the system by an oncologist chosen from the patient, but they belong to the patient entity. The patient has the ability to adjust and transfer the oncological data directly to any oncologist who is a registered user in the system. To utilize the patient-centered infrastructure, an oncological patient card is suggested to be given to all cancer patients. This card will display a unique identifier (ID and QR code) that represents each patient. The use of the oncological card facilitates both the patient import and management from the treating physician, while maintaining patient anonymity in the system's infrastructure.

To further evolve the patient-centered infrastructure, the use of blockchain technology [4] is among the future plans to be implemented. Blockchain has proven to be a useful tool for the creation of decentralized networks, and its use in medical data management projects has shown a lot of promise.
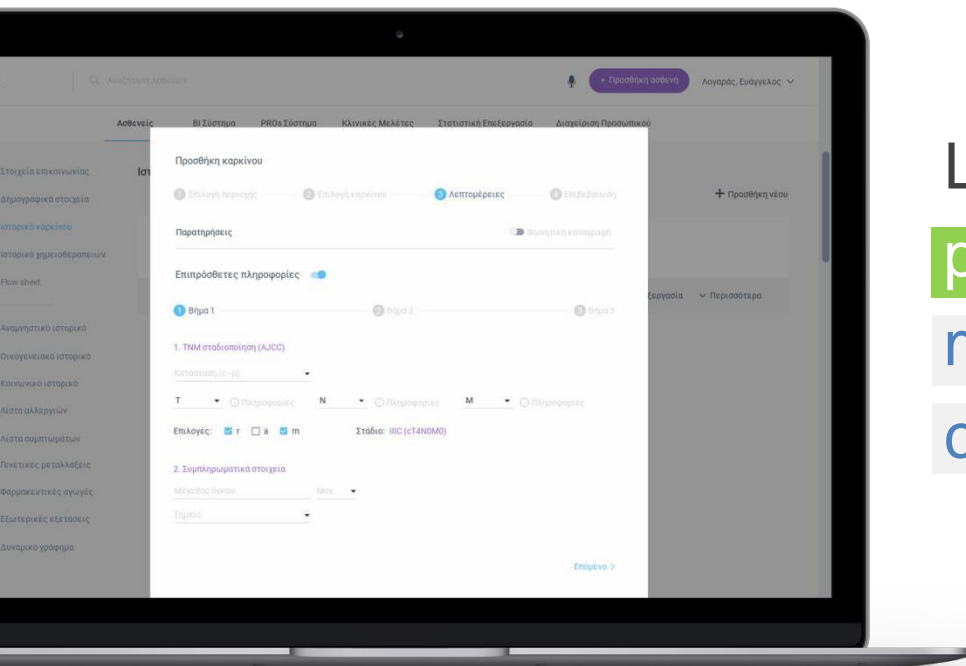

Less paperwork, more patient care

3. Presentation of the application

3.1 Common oncological template

The main body of the application is an oncological data management system, which consists of a set of tabs, shared between all the oncologists who are registered users of the system. These tabs are specifically designed based on oncologists needs. Each patient's data is only accessible to oncologists who have been safely connected to that patient, with the aforementioned process. The tabs of the oncology standard are listed below:

- Past medical history (PMH): Automated tree list of choices for companion diseases the patient may already have.

- Social history (SocHx): Automated cells and lists of choices related to the patient's everyday life and habits such as work, education, smoking, drug use, alcohol consumption, etc.

- Allergy List: Automated allergy selection list for the patient. It includes the allergies during admission, as well as the list of allergies that occurred during the treatment, which are automatically filled in through the Flow Sheet tab.

- Family history: Contains information such as: patient characteristics (twin, adopted), a number of blood relatives, relatives who have developed cancer (type, age, outcome).

- Symptom list: Automated tree list of options for symptoms that the patient has expressed. It includes the ability to record symptoms during patient admission to the system, as well as a list of symptoms (toxicity) that occur during treatment, which are automatically filled in through the Flow Sheet tab.

- Cancer history: Recording of the type / types of cancer the patient has, as well as other information, depending on each type (histological type, ICD10 code, anatomy, TNM staging, prognostic factors in accordance with AJCC, histologic grade, LVI, residual tumor, schematic visualization).

- Medicinal treatments: Ability of adding concurrent medication received by the patient.

- Flow sheet: It is the basic patient tracking record. This tab provides additional options such as: treatment plan, medical image, surgery and radiotherapy. When a new treatment plan is added, the system automatically displays the proposed therapies using an existing database of oncology guidelines (HeSMO, NCCN, etc.) and also utilizing the data imported through the Cancer history tab.
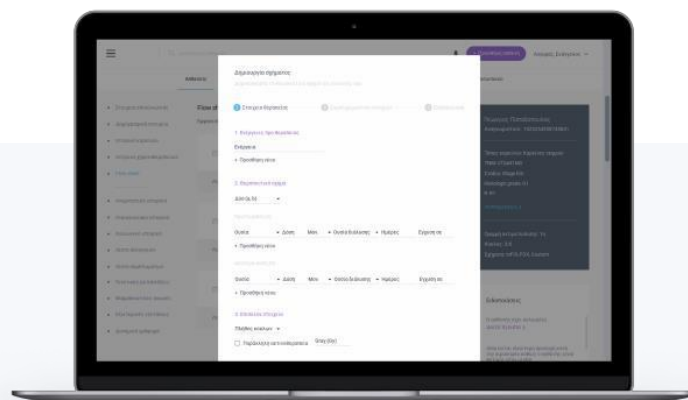
3.2 Customizable patient templates

Along with the oncology data template, the oncologist has also the ability to create new tabs, based on his/her personal needs. A variety of input fields are provided, in order to create custom, personal tabs. These tabs belong to the user himself/herself and are not visible to any other oncologist.
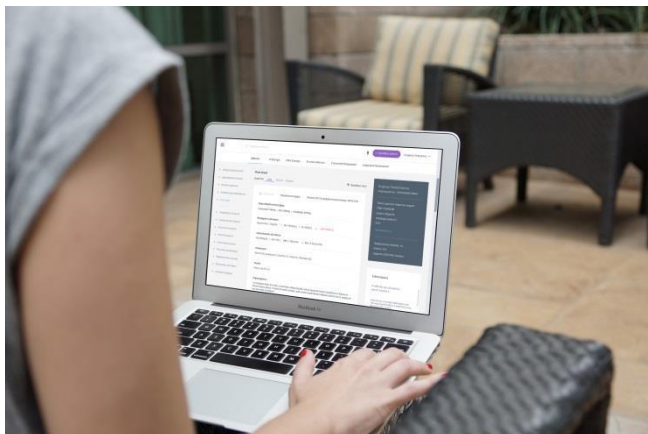
Cancer
Data
Management

3.3 Option to add analysis results from microbiological laboratories

The system provides the ability to upload to the patient profile, various medical analysis results from potential collaborating microbiological laboratories across the country, through a secure procedure. At the same time, it will be possible for the patient to add the medical results himself/herself. A system for conversion of medical exam data into digital and editable form for known analysis results template, and automatic import in the application database through an Optical Character Recognition (OCR) system will be provided, with the only requirement for human interaction being the confirmation of the data validity. External medical exam data is stored and visualized through a separate tab, and it is graphically accessible.

3.4 DICOM viewer

The application includes an online medical imaging system (MRI, CT, X-ray). The main features of the system are:

✓ Easy and immediate visualization of medical images using a drag-n-drop input method.

✓ The ability to save a certain number of individual slides from the medical image files to the patient's profile.

✓ The ability to add notes on top of the image, such as text, arrows, distance measurement, etc.

Part of the future plans is to incorporate to the system various Artificial Intelligence (AI) methods such as deep learning, in order to analyze patient images and identify conditions like tumors, even at a very small scale. Such research has already been done and is proven to work with a very good percentage of accuracy. Tools for image analysis, like the suggested, will comprise the Diagnosis Support Tools (DST) system that will be developed on the long term, as medical data continues to gather, in order to help the oncologist not only to decide the best treatment plan for the patient (Decision Support System - DSS), but furthermore to help significantly with the diagnosis.

3.5 Speech recognition

To further avoid unnecessary text typing, the application has embedded the ability of speech recognition and automatic data import capabilities for specific variables. The system is based on Google's Speech API [5], which through artificial intelligence algorithms adapts to the subject of the text, providing higher accuracy. It also offers a very high level of word recognition even in environments with significant white noise. It recognizes 110 languages globally, and can also provide speech recognition for previously recorded audio files.

To further increase the automation of data import, a tool with Natural Language Processing (NLP) capabilities will be incorporated to the system in the future. The purpose of this tool will be to produce meaningful data through analyzing a plaintext, which the oncologist imports to the system through speech recognition. Thus, the oncologist will be able to just talk to the system about each patient's condition, and the system will digitalize the imported information, transforming the plaintext to variables and values, ready to be saved in patient's profile.

3.6 Extra tools

In addition to the above, oncologists will also be provided with tools such as a patient follow-up reminder via SMS or email, an automated reporting system, ability to export all desired tabs in .xls or .csv format in order to provide data in forms that are easier to import to a statistical processing program (Excel, SPSS, Matlab, etc.), a social network among oncologists with messaging capabilities, etc.

A similar set of tools will be provided to the patient. Notifications and reminders related to the patient's illness, additional information regarding the disease that he/she might need, and personalized advice based on information extracted from the patient's medical data, are some of the proposed tools to enable the patient to comply with the physician's instructions in order to get better results, and in general to cope with his/her illness easier.

Innovation
through collaboration

4. Advanced applications

The main goal of these proposed applications is to facilitate the work of oncologists by developing new tools, as well as to support medical research, by using new and innovative technologies as well as Artificial Intelligence (AI)algorithms.

4.1 Patient-reported outcomes

The application will provide the patient with a patient-reported outcomes system (PROs system). The system will allow the oncologist to create questionnaires (different for each type of cancer) related to the symptoms of the disease, the quality of life of the oncology patient, the side effects such as toxicity in the treatment plans, patient's pain, etc. The utilization of these data will have a positive effect first of all on the oncological patient himself/herself, while providing new data to the treating physicians.

Using AI to support oncologists

4.2 Decision support system (DSS)

One of the main goals of this project is the development of a Decision Support System (DSS), which will be able, by using Artificial Intelligence (AI) techniques, such as pattern recognition, machine learning, etc., to analyze the existing anonymous central database and provide the user-doctor with additionalinformation.

4.3 Oncological registries

Simultaneously, the purpose of the imported data is, anonymously, always respecting medical confidentiality, to act as a registry of oncological patients in the country. Through this logic, each oncologist is individually facilitated by the abovementioned advantages, while a registry is created without the need for external registers.

4.4 Data analysis

The Hellenic Society of Medical Oncology (HeSMO), using this tool, will be able to statistically process the anonymous data and extract important information upon request. The statistical analysis tool is also proposed to be given to all the registered members of the Hellenic Society of Medical Oncology (HeSMO) individually, with the only difference being that they will only have access to the data of their own patients.

5. References

[1] American Cancer Society: Global Cancer Facts and Figures, Second Edition, cancer.gov

[2] University of Iowa, Carver College of Medicine, 2014

[3] EU General Data Protection Regulation, www.eugdpr.org

[4] www.blockchain.com

[5] cloud.google.com/speech