HOSMARTAI

AI for the smart hospital of the future

The HosmartAI Hub (HHub) will provide an environment where healthcare stakeholders will be able to design, develop or deploy AI-enabled solutions via multifaceted lasting functionalities.

The HHub presents a Dashboard as sole entry point to the HosmartAI ecosystem for all stakeholders. In the Co-creation space, technology developers can become aware of needs of healthcare stakeholders as well as select tools, devices, components, data sources etc. to solve those needs. By means of this co-creation methodology, the HHub platform will continuously involve stakeholders to develop a healthcare system accepted by end-users.

Further key components are the Marketplace as a one-stop-shop for AI-based solutions and the unique Benchmarking Framework for the monitoring of the general performance of hospitals and healthcare services.

www.hosmartai.eu HosmartAI HosmartAI

HosmartAI

"Hospital Smart development based on AI" aims to promote an effective and efficient healthcare system transformation. To this end, it will create a common open integration platform with the necessary tools to facilitate and measure the benefits of integrating robotics and AI technologies for healthcare professionals, patients, information system managers and health organisation administrations.

In parallel to the platform, HosmartAI is developing and implementing eight large-scale pilots focussed on Diagnosis, Logistic Efficiencies, Surgical Support, Treatment Improvement and Assistive Care.

Clinical domains include: Cancer Treatment, Gastrointestinal and Thoracic Disorders, Cardiovascular and Neurological Diseases, Elderly Care and Neuro-psychological Rehabilitation, Foetal Growth Restriction and Prematurity.

Pilot#1:

Supporting and optimizing clinical decision making

HOSMARTAI LEAD: **AHEPA Hospital & Hippokrateion (Greece),**
CONTRIBUTOR: **Aristotelio Panepistimio Thessalonikis**

This pilot is designing an AI-driven, clinician-interpretable computer-aided diagnostics/detection suite (ICADx/ICADe) to support the decision making related to timely diagnosis, early symptom screening and patient risk stratification providing guidance for optimized treatment options.

Application scenarios and HosmartAI's approach:

Cardiology: **Evaluation of the efficiency of AI-assisted diagnosis using echocardiograms, and measurement of LVEF and LVGLS.**

Gastroenterology: **Evaluation of an AI-based tool for an automatic, more accurate identification and characterization of small bowel abnormalities in video capsule endoscopy.**

Angiology: **Development of an AI-based tool to indicate the presence of coronary artery stenosis of 50% or above that will provide with guidance for the decision on the need of further testing as well as optimal personalized treatment**

Obstetrics: **Development of AI-based predictive models integrated into a web application that will indicate whether each case is threatened by preterm labor or fetal growth restriction.**

Pilot#2:

Optimizing radiotherapy outcomes by tackling Multi-Appointment Scheduling Problems in Hospitals (MASPHs)

HOSMARTAI LEAD: **Centre Hospitalier Universitaire de Liège (Belgium),**
CONTRIBUTORS: **Fundación Instituto Tecnológico de Castilla y León, Telematic Medical Applications, Univerza v Mariboru**

The number of parameters influencing the radiotherapy outcomes of a given patient is overwhelming. Factors like tumour type, aggressivity, size and location, the patient's physical condition and psychosocial context as well as parallel oncological treatments are only a few examples. The availability of machines and of human resources together with the patient's travel possibilities to the Radiotherapy Unit as well as machine maintenance or room availability also need to be taken into account.

An AI algorithm will optimize patient scheduling in a context of patient-centred planning. Computational modelling will help better identify dysfunctions and problems encountered during scheduling. Subsequently, simulations will assess the model performance by testing model predictions in situations where variable weighting and resource availability may change.

The AI system will consider all variables in the electronic health record; electronic forms completed by the consulting radiation oncologists; treatment machine characteristics and scheduling of other patients as present in the patient management system used by the radiotherapy department.

In addition, the AI algorithms will work together with a conversational robot (chatbot) allowing communication between patients and the hospital. The chatbot will inform patients when a rescheduling in the radiotherapy plan is validated. Based on patient answers the chatbot can urge the patient to go to the hospital or the department to contact the patient for medical or organisational support.

Pilot#3:

Improving treatment with innovative technologies and robotics in the rehabilitation process

HOSMARTAI LEAD: IRCCS Rehabilitation Center (Italy),
CONTRIBUTORS: Vimar SpA, Aristotelio Panepistimio Thessalonikis

Motor impairment is widespread in people suffering neurological diseases. This reduces the level of autonomy in activities of daily living.

In recent years, spontaneous motor recovery in neurological diseases has been modelled by several "Proportional Recovery Rule(s)" (PRR). These allow to predict expected outcomes underpinned by spontaneous biological mechanisms of functional reorganisation, but 20-30% of patients are not predicted accurately. Technological-based solutions and AI applied to rehabilitation settings may provide new possibilities to predict and enhance patient motor recovery.

In this pilot, the combination of VIMAR's domotic application and rehabilitation devices, already used in the Laboratory of Rehabilitation Technologies in San Camillo IRCCS hospital, will allow to monitor the patient's activities and improve the prediction of expected outcomes, as well as actively control the environment before, during and after the motor treatment. This is particularly important as San Camillo hospital is situated in a hard-to-reach area where the monitoring of the environment and of the patients is difficult. An ultra-wide band sensor will also be tested to extend the monitoring capacity in other rehabilitation settings (e.g., home-based treatment). Additionally, the cooperation with AUTH will add an app-based service to measure the degree of similarity of the movements performed by the patient compared with the normal reference movement allowing to track patients' motor recovery improvement.

Pilot#4:

Mapping and ablation of cardiac arrhythmias with Robotic Navigation

HOSMARTAI LEAD: **SERMAS Hospital (Spain),**
CONTRIBUTORS: **Eidgenössische Technische Hochschule Zürich, Ninety One GmbH**

According to the European Society of Cardiology, 2019 statistics, more than 6 million cases of cardiovascular diseases were diagnosed in European Union. Some statistics show that the cardiovascular specialist workforce will need to double between 2000 and 2050 to keep up with factors such as the aging population.

Remote magnetic navigation (RMN) and the use of soft magnetic catheters has been able to demonstrate an improvement over manual ablation by reducing major complications by 72%, improved short term & long term efficacy by 6-8%, and reduce the radiation exposure for the patient by 36%. The next milestone is to demonstrate that RMN can also reduce the procedure allowing the electrophysiologist to operate more patients per day and reduce the number of not-treated patients due to the lack of skilled specialists.

This pilot will use AI to control the navigation of a magnetic catheter. In parallel, it will integrate data set across different models and device types from various companies that record ECG signals or have developed tools to map the electrical activity of the heart, contributing to the standardization of all medical data recorded in the Electrophysiology (EP) lab.

Mathematical modelling and AI methods will help use these tools to further create tailored treatment by disease type, progression of disease, and / or patient cohort – potentially specifying it down to an individual patient level. The data will then be forwarded to a RMN system to automate the catheter navigation. The pilot will demonstrate that the combination of RMN and AI can reduce the time to create an EP map as well as the time to reach multiple ablation sites. It will also archive data recorded during the EP procedure to create a database.

Pilot#5:

Robotic Nurse for Assistive Care in Hospitals

HOSMARTAI LEAD: **UKCM Hospital (Slovenia),**
CONTRIBUTORS: **Univerza v Mariboru, Green Communications SAS, Fundación Instituto Tecnológico de Castilla y León**

While hospitals are facing population and workforce aging, the WHO estimates that the world will need an additional 6 million nurses and midwives by the year 2030 (source: State of the World's Nursing 2020). The overworking of staff, partially due to repetitive tasks, leads to human errors and less than optimal outcomes.

This pilot's goal is to to evaluate a Social Robotic System (SRS) that supports and improves the quality of nursing care. The SRS will assume communicative functions such as assistance (providing medical information, reminding patients to take medication, etc.) and collect patient data using hardware and software sensors. By 'outsourcing' schematic and recurring communication components nurses will have more time for more in-depth interaction with patients.

Moreover, as data is queried at the time of its formation, objective assessment via AIs will significantly improve pitfalls associated with PROMs. The SRS in HoSmartAI will: interconnect with medical grade wearables to measure vital signs; motivate patients to carry out exercises and provide companion features through an empathic conversational AI.

Patients and healthcare professionals will evaluate the effects, usability and acceptance of gamified nursing delivered by the SRS. The pilot will also assess the acceptance and utility of a clinical decision support system delivered by the SRS during Grand Rounds.

Pilot#6:

Virtual Assistant for a continuity of care in Neuropsychological Rehabilitation and Elderly Care

HOSMARTAI LEAD: **INTRAS Care Centre (Spain),**
CONTRIBUTORS: **Fundación Instituto Tecnológico de Castilla y León, Green Communications SAS, Aristotelio Panepistimio Thessalonikis, Telematic Medical Applications, Univerza v Mariboru**

The ageing of the population comes hand in hand with physical and cognitive deterioration together with. In Europe, 31% of older people live alone or isolated facing a double threat: living alone and subjective loneliness experienced as a set of negative feelings, with serious repercussions on their health. Affordable solutions are required to address these concerns while favouring opportunities for ageing-in-place of older adults as far as self-sufficient.

This pilot makes use of existing health and social integration platforms and services for health and wellness. It aims at:

1. Empowering and assisting patients through interventions and recovery services by means of a comprehensive, interacting and cross-linked ICT based solution.

2. Increasing support of independent living for older people and their caregivers to improve and maintain their independence, functional capacity, health status as well as preserving their physical, cognitive, psychological and social well-being.

3. Providing a low intensity follow-up that allows for the early detection of a worsening of health status and appropriate reaction to it.

4. Assisting healthcare professionals (e.g. neuropsychologists, psychologists, other therapists) by providing remote prevention or therapeutic intervention modalities.

This approach allows to obtain real-world patient data and respective recovery plans, enabling it to train its AI modules and test the remote treatment procedures and infrastructure. Moreover, it improves the connection between care services and the personalization level of care.

Pilot#7:

Smart Cathlab (Catheterization Laboratory) Assistance: AI-based automatic X-ray image analysis to support clinical decision and facilitate reporting during cardiac procedures

HOSMARTAI LEAD: **UZ Brussel (Belgium),**
CONTRIBUTORS: **Philips Medical Systems Nederland BV, Vrije Universiteit Brussel**

Image-guided interventions like X-ray imaging with contrast injection (or coronary angiography) have become the treatment of choice for a broad range of diagnoses and treatments. Recently, other data sources providing additional functional information (like pressures, Functional flow reserve, iFR) along with new imaging modalities (like Intravascular Ultrasound and Optical Coherence Tomography) have been integrated in the CathLab and are becoming the standard of care in European guidelines. All this information aims at supporting the clinician during the clinical procedure and to improve treatment outcomes. However, many clinicians complain about the large amount of highly complex data they acquire daily, the time it takes to co-register them with the current angiographic data and the difficulty in deriving meaningful insights from all. In particular, administrative work is widely recognized as a major source of professional burnout in healthcare, specially for invasive cardiologists, having to dedicate significant amounts of time on post-procedural reporting.

With AI, tools to start automating this process are now available. AI can automatically guide and track steps of a procedure, logging relevant events and actions, and then auto-populate reports with images and measurements acquired during the procedure. The clinician would only have to supervise, complete, and sign off the pre-populated report at the end of procedure.

In the context of Pilot 7 an AI application will be developed that automatically detects key events in X-ray images during interventional cardiology procedures, which are input to the post-procedure report.

Pilot#8:

Prognosis of cancer patients and their response to treatment combining multi-omics data

HOSMARTAI LEAD: **UZ Brussel (Belgium),**
CONTRIBUTOR: **Vrije Universiteit Brussel**

The availability of advanced diagnostic tests and the emergence of personalised medicine have made oncological care increasingly complex and data dependent. Medical imaging has become an integral part of the care process, and is used extensively at diagnosis, treatment planning and during follow-up. The rapid technological progress in Next Generation Sequencing is enabling the collection of novel medically relevant data at the molecular level.

The aim of this pilot is to develop a digital health research platform that integrates multimodal data and advanced analytics for the examination of Glioma, which account for the majority of malignant primary tumours of the brain. Currently, image and genetic data for Glioma is analysed separately to strategize the treatment for a patient. The unique expertise at the VUB and patient data at the UZ Brussels will be leveraged to create a general framework to store and analyse pseudo anonymized medical data -both at the image and genetic level-, their clinical behaviour and response to therapies. The platform offers an integrated view on the patient data for research, while conforming to GDPR and patient legislation, thus enabling AI-driven extraction of new information on such tumours. We will perform AI based analysis on image and genetic data separately as well as integrate the data (image and genetic) to develop AI-based tools for clinical decision support for clinicians.

WINNERS OF HOSMARTAI'S OPEN CALL FOR TECH

To encourage the integration of further innovative tech solutions into the HosmartAI framework and its overall application into new healthcare facilities, the project has launched two Open Calls. The 4 winner SMEs of the first call entered a six-month programme that funded the Design, Development and Integration of their AI technologies within the HosmartAI ecosystem.

FHIR De-Identification and Pseudonymization Tool

De-Identification and Pseudonymization of FHIR (Fast Healthcare Interoperability Resources) data made easy

COMPANY: Docunque SRL

www.docunque.it

FHIR-DIET offers added value for the secondary use of data while meeting legislative requirements of Personal Health Records. It proposes a set of default rules and the ability to add custom rules. Default rules consider HIPAA Safe Harbor De-Identification as starting point to remove Protected Health Information from FHIR data. When these are not enough, custom rules allow simple personalization according to the specific privacy-utility tradeoff needs and to cope with GDPR.

The service will be accessed through three simple APIs documented with OpenAPI: De-Identification, Pseudonymization and De-Pseudonymization. The tool will be provided as a Docker container ready to be integrated into microservice architectures.

SEGTNAN - Secure Establishment of Group Testing Network Across Nations

An Open-Source Java-based Federated Database System on an FHIR Server to Securely Connect Healthcare Centers across Europe

COMPANY: Synaptic ApS

www.segtnan.io

SEGTNAN aims to establish a science-based platform for the smart pooling of medical tests that can be used by any healthcare centre across Europe. The solution connects data points, secures data safety and shares results in a sensible, user-friendly manner. As part of the data collection and connection to the federated network, SEGTNAN will also make use of data warehouse intermediate servers and services to aggregate dynamic data from multiple sources.

With sources coming and going, some being simple static data and others being data warehouses with pre-processed data from other sub-sources outside of the network, SEGTNAN creates a dialogue between what healthcare scientists know and what they are searching to answer.

SmartMap SNOMED

AI-powered application that automates the time-consuming and error-prone process of data mapping

COMPANY: Medicalvalues GmbH
www.medicalvalues.de

The increasing shortage of specialists is leading to overloaded medical staff. This results in over- or undertreatment, incorrect therapy or wrong diagnoses. Manual documentation and initiation of processes are error-prone and quite time-consuming for the staff.

Medicalvalues provides physicians with diagnostic decision support through an AI-based application that takes symptoms, pre-diseases, lab results and imaging data into account. Integrative diagnostics for hospitals and large laboratories are the key focus. We see an increasing interest in Germany regarding mapping that has also been triggered by Covid LOINC Mapping. The mapping will be provided using the FHIR standard.

EMMA – Emergency Clinical Support

EMMA minimizes physicians' burnout in Emergency Departments by providing optimized patients' triage and monitoring

COMPANY: VIDAVO S.A.
www.vidavo.eu

The overcrowding of the Emergency Department (ED) is directly responsible for patient harm and health system dysfunction.

The wearable device EMMA enables real-time recording of blood oxygen saturation, body temperature, respiration and heart rate using edge computing, ensuring data privacy while minimizing latency. Combined with Vidavo's Vida24© solution for chronic disease management, EMMA assists ED personnel to triage incoming patients more effectively. It informs clinicians on the probabilities of a patient´s need for hospitalization and admission to the ICU, creating a critical patient stratification. It is a support algorithm that, simply put, saves lives. In addition, the system estimates the duration of hospitalization needed per patient which allows for more efficient hospital resource management.

CONSORTIUM

The HosmartAI consortium consists of European technology stakeholders including SMEs, Industry, Hospitals, Research Centres, Digital Hubs and Universities.

CONTACT:
info@hosmartai.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101016834