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eHealth
Success Stories

euHeart

Patient Specific Virtual Heart Models

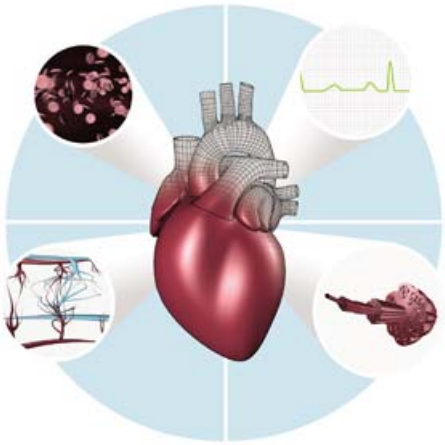
European Commission
Information Society and Media

Integrative computer models to support improved therapy selection and optimisation of treatment outcome for individual patients affected by cardiovascular disease

Jim M. is a 60 year old man who, despite surviving a recent severe heart attack, has now a large area of scar tissue in his heart that is disrupting its electrical rhythm and mechanical contraction. Unfortunately, despite drug therapy, his symptoms keep on deteriorating. One of the few effective treatment options for Jim's cardiologist is the implantation of a pacemaker to restore synchronised electrical rhythm and efficient pump function. However, this procedure is expensive and, while highly effective in specific patients, large multicenter trials have shown that at least one third of patients will not respond. The optimal treatment for Jim is thus unclear. **The novel ICT technology provided by the euHeart project is focused on assisting this decision-making process by embedding the wide range of anatomical and functional data collected during Jim's clinical examinations in a personalised computational model.** In Jim's specific case his virtual heart model predicts that he will respond well to the implantation. It also proposes an optimal treatment plan indicating where to position the pacemaker leads in the heart and how to operate them. Finally, this plan is combined with interventional data to guide the cardiologist during his manipulations.

euHeart focuses on bridging the gap between academia and industry and to provide a better quality of cardiac care in the EU clinics

The euHeart consortium, combining 16 industrial, clinical and academic partners, aims to develop advanced computer models of the human heart that can be personalised to patient-specific conditions using clinical data from various sources - such as imaging, measurements of blood flow, blood pressure, and Electrocardiograms (ECGs). These computer models integrate the behaviour of the heart and the aorta at molecular, cellular, tissue and organ-level. They also incorporate clinical knowledge about how cardiovascular disease disturbs the correct function of the heart at these levels. As a result, it may be possible to develop simulation tools that doctors can use to predict the outcome of different types of therapy. Because the models are personalised to individual patients, the therapy can be equally personalised. The euHeart consortium works also on the integration of the multi-disciplinary achievements into prototype systems for use in clinical settings. The validation studies carried out on cohorts of patients at clinical sites will facilitate the collection of evidence of clinical benefit and the quantification of potential impact.



The vision of the euHeart consortium is that **the long-term outcome of the project** will be a consistent, biophysically-based framework for quantitative data integration, interpretation, and knowledge extraction using the new tools developed. The expectation is that euHeart will provide insight into the origin and progression of specific cardiovascular disease patterns. The project will support a paradigm shift from straightforward clinical guidelines that determine treatment options towards the **true personalisation of care based on specific individual physiology**.

Needs & challenges addressed

Cardiovascular disease is a highly relevant and epidemiologically significant contributor to loss of quality and quantity of life within Europe, with a considerable impact on its economy. **It causes over 1.9 million deaths in the EU every year (42% of all deaths) with a total estimated cost of EUR 169 billion.**

Major benefits for patients and society

- Improvement of treatment through personalisation of care (vs. straightforward clinical guidelines)
- Increased safety of care through higher confidence in decisions due to consistent integration of the fragmented and inhomogeneous data acquired throughout the cardiac care cycle
- Reduction of medical costs and treatment duration

Commercial exploitation

- *Imaging industry* – improved analysis software moving from purely descriptive data interpretation towards biophysically-based disease quantification and prediction of disease progression. Computer-based therapy optimisation
- *Device industry* – personalisation of implantable devices through patient-specific simulations optimising treatment outcome

Progress beyond the state-of-the-art

- Generation of tools & concepts for the *personalisation* of models using clinical data, i.e. making computer models reflect the specific patient's conditions
- Development of clinical *prototypes* integrating multi-disciplinary tools and complementary expertise available across Europe
- Focus on *validation* and demonstration of clinical benefit

Implementation status

During the first half of the project, most efforts have been dedicated to preparing the clinical studies and to building the technical elements needed to achieve the project objectives. The focus of the third year will be to bring the pieces of the puzzle together and to start the clinical validations, whose results will be collected, exploited and disseminated during the last year of the project.

euHeart

Personalised & Integrated Cardiac Care: Patient-specific Cardiovascular Modelling and Simulation for In Silico Disease Understanding & Management and for Medical Device Evaluation & Optimization

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Timetable: from 06/08 – to 05/12

Total cost: € 19.053.465

EC funding: € 13.900.000