October, 2011

eHealth
Monthly Focus

euHeart

In-silico simulation of the patient's heart for selecting the best therapy and optimizing its outcome

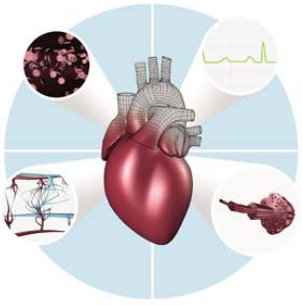
European Commission
Information Society and Media

Relevance and need

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

The **diversity and quantity of available data in current clinical workflow present a significant opportunity to improve clinical care of CVD**. At the same time, the clinical practice of using population-based metrics derived from disparate diagnostic tools, imaging devices and physiological measurement systems can indicate contradictory treatments plans due to inter-individual variability in pathophysiology.

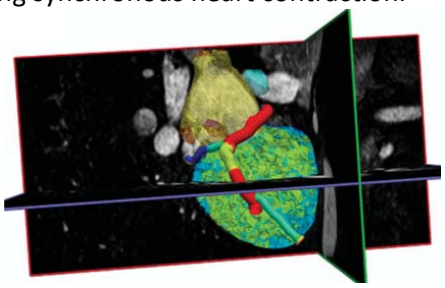
The euHeart project is working on the In-silico simulation of the patient's heart to address these issues and to provide the best assistive decision-making tool.



How far is euHeart?

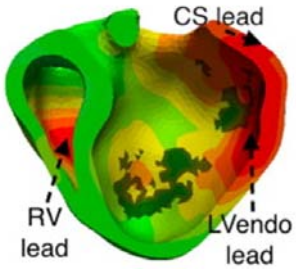
To support development and validation of the simulation tools, new acquisition protocols of cardiac magnetic resonance (MR) have been developed, comprehensive acquisition protocols have been defined, patients have been recruited, and data have been acquired. Automatic or semi-automatic tools for extracting the patient's heart morphology including the heart chambers, the coronary sinus and tissue viability have been developed.

On the basis of this anatomical framework, quantitative analysis tools of the heart motion / deformation provide dyssynchrony information, which is particularly relevant for cardiac resynchronization therapy (CRT) given the aims of restoring synchronous heart contraction.



In addition, algorithms for the quantitative analysis of the septal flash, a marker that has demonstrated a strong relation with a positive response of CRT, have been developed.

Combining the methods for extracting the patient's anatomy with methods for personalizing the electrophysiology, the kinematics and the mechanics, the acute effects of pacing on pressure development were simulated for several pacing conditions on two patients. The results showed good agreement with invasive hemodynamic measurements.



The overall results look promising and euHeart made huge steps forward. Still the results need further confirmation by applying the tools to a large number of patient cases and validating the results.

Objectives and approach of euHeart

The euHeart project aims to **improve diagnosis, planning and treatment of CVD by developing ICT tools for simulating the patient's heart**. The 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 at these levels. The simulations are personalized using clinical data, images, blood pressure, ECGs, etc.

euHeart focuses on five areas of CVD and associated therapies:

- heart failure through CRT,
- heart failure through congenital cardiac surgery and left ventricular assist devices,
- cardiac rhythm disorder through radiofrequency ablation,
- coronary artery disease through revascularization using coronary stents,
- diagnosis and treatment of valvular and aortic diseases.

For the application areas, prototypes addressing specific clinical questions are being developed and validation on small patient cohorts is planned. In addition, one pilot trial, including approximately 120 patients, will be performed to demonstrate the clinical benefit in determining the optimal lead placement and pacing sequence in CRT.

Case story: Jim

Jim M. is a 60 year old man who, despite surviving a recent severe heart attack, now has a large area of scar tissue in his heart that is disrupting its electrical rhythm and mechanical contraction.

Unfortunately, despite drug therapy, his symptoms are continuing to deteriorate. 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 exactly this decision-making process by embedding the wide range of anatomical and functional data collected during Jim's medical 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.

Timetable:	from 06/2008 – to 05/2012
Total cost:	€ 19.053.465
EC funding:	€ 13.900.000
Instrument:	IP
Project Identifier:	FP7-2008-IST-224495

Partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), INRIA, French National Research Institute in Informatics and Mathematics (FR), King's College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP).

Important Links:

Project website: http://www.euheart.eu

European Commission - ICT for Health: http://ec.europa.eu/eHealth

For further information:

Project Coordinator: Jürgen Weese

Tel: +49 40 5078 1466 ; Fax: +49 40 5078 2510

Email: juergen.weese@philips.com