

The **Health-e-Child (HeC)** project started in early 2006 with the aim of **developing a Grid-based healthcare platform for European paediatrics**, providing seamless integration of traditional and emerging sources of biomedical information; the long-term goal being to deliver uninhibited access to universal biomedical knowledge repositories for personalised and preventive healthcare, large-scale biomedical research and training, and informed policy making.

In particular, the project is focusing on individualised diagnosis, therapy and follow-up of paediatric heart diseases, inflammatory diseases, and brain tumours for which it is developing innovative software tools. In order to overcome the fragmented nature of the information available, HeC allows handling all relevant medical data, information and knowledge ranging from genetics to imaging and clinical by synthesising those in a cohesive unified whole. This harmonised view of the data forms the basis of personalised treatment, comparison, and identification of different individuals' classes based on biomedical profiles. Inner sophisticated disease models are thus parameterized by the collected data for individual patients to give further insights on the nature and progression of the disease.

As one of the biggest European FP6-funded projects and with fourteen partners, HeC brings together three different communities, which can be considered as equally important project's cornerstones: healthcare professionals - with the concrete involvement of leading clinical centres in Europe, medical imaging and clinical data analysis experts - with market driving industry participants coordinating the integration process, and Grid computing specialists - harnessing the distributed infrastructure to solve emerging clinical questions.

The realisation of these goals however requires a powerful infrastructure that is highly responsive and reliable. Therefore, the state-of-the-art Grid technology is used to interconnect clinical centres and to allow the integration, analysis and seamless flow of information between institutions, while preserving patients' privacy. Further to this, the platform enables healthcare workers and clinicians to navigate a large international repository of (anonymised) patient data, to share relevant information and to discover novel knowledge. Thanks to the Grid, the system provides advanced facilities to search for similar patient cases supporting clinical decision making and personalised treatment, to validate arbitrary hypothesis over the entire population, and to further extend medical records with extracting new meaningful features, e.g. through the construction of 3D models of the heart, useful for better decision making on follow-ups and intervention with congenital heart diseases.

This new cutting-edge research platform and its main use cases are what the partners propose to demonstrate at the **eHealth Week 2010 exhibition**. Two concrete and revolutionary usages of the data are planned to be performed in a visual, interactive and pedagogical way, where HeC's underlying large European Grid infrastructure, made of eight physical sites at the time of writing, is accessed and challenged live to supply physicians with timely and relevant information.

### Demonstration:

The proposed **demonstration illustrates how Grid-based (bio)medical research** can be turned translational and made meaningful to both medical practitioners and patients, **ultimately supporting tomorrow's healthcare needs in personalised medicine**.

Our **user-friendly demonstration is highly visual**, with live and seamless accesses to the distributed Grid infrastructure and multiple displays using advanced visualisation techniques (such as treemaps, neighbourhood graphs, dynamic user interfaces and innovative medical image viewers). The platform includes state-of-the-art graphical tools for distributed patient data exploration and personalised decision support.

Attendees are invited to connect to the system using a plain USB key,

which includes major authentication, data management and decision support facilities. Once logged in, all interactions are supported with their graphical representation under the form of workflows of tasks being performed, and animated presentations providing simple explanations.

**The demonstration at the eHealth week 2010** on 15/03 (EC stand 801) **is based on anonymised samples of real-life patient data, and invites attendees to challenge the system to identify interesting similarities**. The focus is on cardiology (i.e. Tetralogy of Fallot) and brain tumour (i.e. juvenile pilocytic astrocytoma) patients. All samples and examinations are accompanied with simplified clinical explanations allowing visitors to quickly understand their findings.

The demonstrator sheds light on HeC's novelty through a series of clinical workflows manipulating real data in remote clinical centres. By means of a large patient database and with a true Tetralogy of Fallot case - a rather common congenital heart disease, two attracting software demonstrations are given.

**(1) Clinical Data Exploration**. The first relates to patients classification according to selected similarity criteria. It illustrates how the Grid is used to process large amounts of data on-the-fly and to graphically represent the population distribution. Thus, users can rapidly identify similar cases, reveal correlations and refine their search until obtaining a set of reference individuals and associated treatments information for comparison.

**(2) Medical Imaging: 3D Volumes**. In the second use case, the user downloads the Magnetic Resonance Imaging (MRI) scan of a child's heart. The functioning heart is displayed on the clinician's screen; on top of which the system dynamically highlights 3D contours of the right ventricle. This model provides important information such as the blood pumping and ejection volumes, the dimensions of the ventricle, supporting the clinician in timely decision making, e.g. as to when to operate the patient in case of valve replacement.

The multi-level and multi-centre Grid database is therefore explored live to discover similarities over a large population and to assist professionals in providing better treatment to their patients, children.

The central element of decision support in HeC is a Case-Based Reasoning (CBR) system called CaseReasoner; an application for personalised, patient-centric, decision support based on similarity search and case retrieval over the Grid, which may help in reducing medical errors and in increasing healthcare quality and efficiency.

CaseReasoner implements advanced data visualisation techniques, never used in the field, with the major objective of improving transparency and explanation in medical CBR. While analogous systems usually work with single data modalities such as separately imaging or genomics, a clinician using CaseReasoner is able to specify complex inter-patient similarity on all kinds of biomedical data being shared between centres.

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### Keywords:

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