

Sharing for Healthcare - A Research Environment

The use of complex mathematical modelling in medicine is improving diagnoses and treatments for patients, giving decision-support to healthcare professionals, and enabling new interventions to be developed in clinic and by industry. As the Virtual Physiological Human discipline matures, so its researchers need to collaborate on tools, models, data and best practice; **VPH-Share** is providing the environment in which such collaborations will be routine.

Objectives of the project

The treatment of disease is a continuing quest for improved understanding, from which come new measures of disease severity and new mechanisms of intervention. The latest mathematical models of disease use highly personalised representations of anatomy and physiology to derive new measures that are unique to each patient, enabling therapy to be customised to the individual. Such models are developed by researchers working in the Virtual Physiological Human initiative (the 'VPH') who share common methodologies, and who increasingly should be benefitting from collaborative working.

There is currently no pan-European computer system that allows these researchers readily to share their resources, meaning that similar tools are wastefully developed multiple times by different groups, data is expensively collected then used only once, and large-scale automated systems to facilitate model-building have not become available.

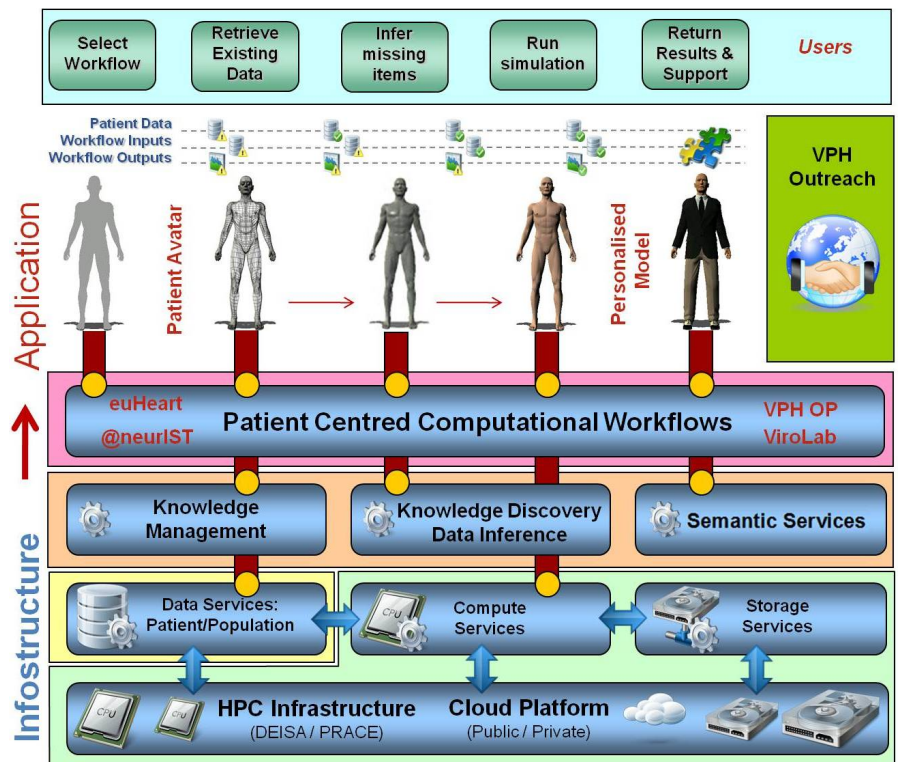
VPH-Share is providing the collaborative environment in which VPH researchers will be able to maximise their efficiency, knowing that these barriers to sharing resources have been removed.

The key aims of the project are to:

- Expose and share data and knowledge;
- Develop multiscale models for the composition of new VPH workflows;
- Facilitate collaboration within the VPH community.

The project will also create specific facilities to:

- Conduct simulations in the Cloud and the Grid;
- Link content using semantic inference;
- Allow researchers to examine uncertainty, and variation in model parameters;
- Encourage industrial collaboration and uptake;
- Enable easy interaction via tailored interfaces



Project Description

VPH-Share will meet the need for shared facilities by developing the organisational fabric (the *infostructure*) required to unite researchers, and integrating carefully-optimised services to share data, develop models and facilitate collaborations.

VPH-Share will meet the need for shared facilities... it focuses on a key bottleneck – the interface between research and clinical practice.

CASE STUDY - VPH-SHARE HELPS RESEARCHERS DEVELOP NEW STROKE INTERVENTIONS

A VPH research team is collaborating with neuro-radiologists to help them predict the likelihood of cerebral aneurysm rupture, a complex condition in which intervention can sometimes be as risky as taking no action. The VPH aneurysm modelling team uses VPH-Share in six ways...

1. They obtain the image-processing tools to build an automatic image-to-model workflow;
2. They have access to a library of anonymised patient images to help refine their models;
3. They use VPH-Share's parameter-flexing systems to check the stability of their models;
4. They use VPH-Share's cloud computing systems to run their analyses many times faster than locally;
5. They collaborate with device designers to select and simulate a range of medical interventions;
6. Finally, they add anonymised data from their own patients back into the library, for others to re-use

Data within the VPH is usually in the form of clinical data from individual patients: medical images, biomedical signals and sometimes additional population-based information. The operations range from secure access and storage through annotation, data inference and assimilation, to complex image processing and physics-based mathematical modelling, to data reduction and representation. The project focuses on a key bottleneck – the interface with the wealth of data from medical research infrastructures and from clinical processes.

Continuously evaluating the effectiveness and fitness-for-purpose of the infostructure and building a thorough exploitation strategy are key activities, creating confidence in the communities. The consortium, through its optimal mix of medical, mathematical, engineering, software & hardware and industrial knowledge and expertise from the EU and internationally, will make this effort a success, delivering to European citizens clinically useful outcomes that will benefit society.

To validate the facilities established by the project, four flagship workflows (from existing FP6 and FP7 projects @neurIST, euHeart, VPHOP, Virolab) are being harnessed to provide data, tools and models, to engage with the services developed by VPH-Share, to drive the further development of the infostructure, and to pilot its applications.

Expected Results & Impacts & Preliminary results

The ambition of VPH-Share is to meet the emerging needs of the VPH research community for streamlined developments, facilitated resource-sharing and the enabling of improved model development into clinical practice.

The results will include ...

- Secure Cloud facilities for the sharing and computation of medical data and simulations;
- Sophisticated data-sharing management including scalable federation of resources;
- Interfaces with Public Health Records;
- An architecture that includes semantic interoperability;
- A patient avatar definition for VPH workflows;
- A workflow composition management system;
- Four example 'VPH-Shared' FP6/7 workflows;
- Systems for uncertainty and variation implemented in markup language;

The impact of VPH-Share activities will extend across many aspects of European society and industry, to the benefit of business and citizens:

- **Strategic impact** on cooperative working and the formalisation of health knowledge;
- **Clinical and Societal impact** by enabling federation of medical databases and re-use of clinical data and EHR content;
- **Industrial impact** by giving competitive advantage to those using the infostructure;
- **Economic impact** by marshalling resources across multiple disciplines to speed time-to-market and the growth of
- **Impact on knowledge** by the practical implementation of facilities for 'Integrative Research', a key concept of the VPH, within a sound ethical and legal environment;
- **eHealth impact** from extending individualised predictive healthcare, accelerating medical knowledge implementation, and developing interoperability;
- **European impact** by employing the leading experts to extend the state-of-the-art approaches to secure infrastructure, unrestricted by member-state borders;
- **International impact** via the extension of reach to US institutions and the NIH, and to Asia via the Osaka Accord;
- **Impact on ICT 'Challenge 5'** – ICT environments for sustainable personalised healthcare, disease prevention and chronic disease management.



VPH-Share

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KEYWORDS

Virtual Physiological Human, Modelling, Infrastructure, Physiology, Clinical, Workflow, eHealth, Community, Data Exposure, Multiscale, Uncertainty, Cloud, Avatar, Knowledge.