



Computational Oncology

Norbert Graf

Medicine is undergoing a paradigm shift, which gradually transforms the nature of healthcare from *reactive to preventive*. The changes are catalyzed by a new approach to disease that has triggered the emergence of personalized medicine focusing on integrated diagnosis, treatment and prevention of disease in individual patients. The pre-requisites for this are the convergence of systems approaches to disease, new measurement, modeling and visualization technologies, and new computational and mathematical tools¹.

While the goal is clear, the path to it has been fraught with roadblocks in terms of technical, scientific, and sociological challenges. The first step to facilitate the gradual translation from current medical practices to personalized medicine is to bring together internationally recognised leaders in their fields to create an innovative computational, service-oriented IT infrastructure. The emphasis must be to provide an open, modular architectural framework for tools, models and services:

- to share and handle efficiently the enormous personalized data sets
 - coming from clinical trials and
 - hospital information systems (HIS)
- to ensure that policies for privacy, non-discrimination, and access to data, services, tools and models are implemented to maximize data protection and data security
- to enable demanding Virtual Physiological Human (VPH) simulations
 - for which standardization and semantic data interoperability is a major issue
- to integrate models from system biology with VPH models
- to build and standardize tools and models
 - such as the VPH Toolkit² for explicit reuse of tools and services
 - to guarantee that tools, services and models are clinically driven and do enhance decision support
- to provide tools for large-scale, privacy-preserving data mining, and literature mining
- to enhance patient empowerment

¹ <http://www.cra.org/ccc/initiatives>

² <http://www.vph-noe.eu/wp3>

The design and development of such a modular architectural framework is technologically challenging. In addition all tools, models and services need to be evaluated and validated by end-users. Usability of these tools is a major issue and is essential for starting a certification process. Feedback loops to developers for continuous improvements have to be integrated. Such an innovative architecture should promote the principle of open source. All tools, models and services have to be tested in concrete advanced clinical research projects and clinical trials that target urgent topics of the medical research community, a key area of societal importance. Maintenance and further developments of the framework need to be addressed from the beginning. To sustain such a self-supporting infrastructure realistic use cases have to offer tangible results for end-users in their daily practice. Teaching and educational programs for end-users have to be implemented to facilitate the access to the platform and the use of tools, models and services.