The Virtual Physiological Human – a 'digital twin' for patients

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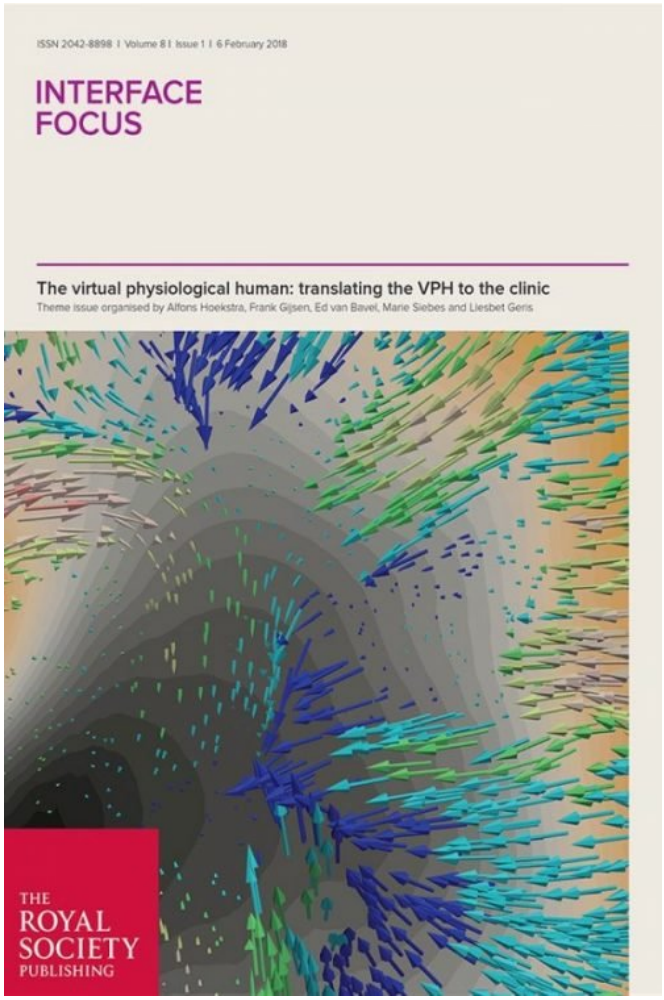

Credit: The Royal Society

Today, *Interface Focus* published a themed issue about the Virtual Physiological Human (VPH) – your 'digital twin' which could model your physiology and pathologies. The issue focuses on translating the VPH to the clinic, and demonstrates the impact of VPH applications on medicine. We spoke with the organiser, Alfons Hoekstra, about the VPH project to learn more.

What is the Virtual Physiological Human?

VPH is a big, world-wide community that aims to create validated in-silico models of human health and disease. These models are usually multiscale, and they involve processes at the tissue or organ levels coupled with processes at the cellular levels. For instance models of the heart, where models of individual cells are coupled to mechanical models of heart tissue. The VPH is also about delivering computational and data infrastructure to facilitate VPH modelling, taking into account all the intricacies of dealing with medical data. The long-term goal of the VPH is to create your 'digital twin', a personalised in-silico model of yourself, which should be able to model your physiology or pathologies.

What is the VPH Interface Focus issue specifically focusing on?

The final goal of the VPH is to create your digital twin that can be used by doctors, or could be used in virtual populations for in-silico trials, or by yourself to manage your health. This special issue is a selection of papers that were presented during the VPH2016 conference in Amsterdam. The theme of the conference was 'translating the VPH to the clinic', and in this special issue we have included a number of papers that demonstrate the kind of impact VPH applications could have on medical practice in the (near) future. At the same time, developments are moving very fast, and for the latest development in VPH research I suggest to visit the website of the VPH institute.

Why is the VPH important for medicine?

In-silico models of physiology or pathology can contribute to medicine in several ways. First, if models can be personalised, they could help doctors to predict for instance the progression of a disease of their patient (e.g. what would be the probability of rupture of a cerebral aneurysm?) or

predict the outcome of a treatment. Such predictions could then play a role in decision support scenarios. The in-silico models could also be used on the population level in in-silico clinical trials. They could then predict, for instance, the performance of a new device or a new drug, and as such contribute in designing better and more targeted clinical trials, or help in reducing the use of laboratory animals in first screening of devices. This special issue features papers that cover both applications of the VPH. Finally, the models could also be given to the general public, thus helping us manage our own health and disease.

What are the difficulties facing the VPH?

The vision of the VPH is very ambitious, and the stakes are high. As you can imagine, there are many difficulties – let's call them challenges. We need to carry out more fundamental research into modelling health and disease, which are highly complex systems. We also need to translate VPH to real clinical applications, to validate the models against sufficiently large cohorts of patient data, to dress our models with uncertainty quantification, and to push selected models into pre-clinical trials. To do so, we need continued support for research, both from national science foundations and from the EU. We need to build ever stronger public-private partnerships to further develop VPH, together with pharma, medical device industry, and software and services providers.

How are you yourself involved with the VPH project?

My main interest is in developing in-silico models for vascular diseases, so my goal would be to help contributing to the Virtual Artery, one virtual organ that constitutes the VPH. Moreover, where possible I contribute in helping the VPH community forward, for instance by organising the VPH2016 conference, or serving the VPH institute.

More information: Alfons G. Hoekstra et al. Virtual physiological human 2016: translating the virtual physiological human to the clinic, *Interface Focus* (2017). DOI: 10.1098/rsfs.2017.0067