Detailed digital human models could hold key to future clinical research

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Delegates at this year's Insigneo Showcase (May 5, 2016 at The Octagon Centre in Sheffield) will hear how in silico medicine—computer simulations of the human body and its disease processes—can help improve diagnosis and prognosis for conditions like Parkinson's and pulmonary vascular disease. Although ultimately destined for the clinic, the technology looks likely to move quickly into use within clinical trials, as it can enable more effective monitoring of the impact of new drugs and treatments.

The University of Sheffield's Insigneo Institute is Europe's largest research centre dedicated to this innovative approach to medicine. The Insigneo Institute hosts an annual showcase bringing together some of the world's leading in silico experts, with clinical translation as the theme of this year's event.

At this year's Showcase, Dr Andy Swift, Insigneo Senior Clinical Research fellow, will present his work to develop a model of pulmonary arterial hypertension (PAH) using MRI technology. Currently the condition is diagnosed by inserting a catheter into the patient, often in the neck or groin to test the pressure in the pulmonary artery. It's an invasive test that can be distressing to the patient.

Dr Swift and his team have developed a non-invasive test that uses MRI scan data to quantify changes that occur in the heart and provide an equivalent pressure reading. His model combines data on hypertrophy (the thickening of the heart muscle of the right ventricle), distortion of

the septum (the wall which separates the right and left ventricles), distortion of the artery and the forward and backward flow waves in the pulmonary artery.

In a recent study of data from 450 patients, researchers were able to use the model to diagnose PAH accurately.

"Two-thirds of the patients we assessed could be correctly diagnosed with PAH using our model, which meant only those patients where diagnosis was unclear would have had to have the catheter test if this was in full clinical use," said Dr Swift. "Many clinical trials in pulmonary hypertension also use the catheter test as an outcome measure, but it could provide a significant advantage to be able to replace it with a less invasive MRI scan, as our model also provides more detailed information on physical changes to the heart itself."

At the showcase, Dr Swift will discuss the role of modelling data from MRI in patients treated at Sheffield Teaching Hospitals NHS Foundation Trust.

Neurological disorders such as Parkinson's disease, where there are no objective measures of disease progression, is another area where in silico medicine could be used in a trial setting to test the effectiveness of new treatments.

Insigneo Senior Clinical Fellow Dr Alisdair McNeill will present his work on the use of gait analysis to develop a model able to assess disease progression in neurological disorders. He is working initially with patients with 22q11 deletion syndrome (a chromosomal defect), who are at high risk of developing Parkinson's disease.

"There are known to be changes to gait that are linked to Parkinson's disease, such as shortening of step length," said Dr McNeill. "Our model

will use data including walking speed, step length and rhythm of walking plus other parameters to see if we can pick up changes as the disease progresses or at risk individuals develop Parkinsonism. Although this type of analysis is less likely to be easily translated to the clinic, it could be very effective for clinical trials, as so many of the current tests for progression of Parkinson's disease and impact of treatments are very subjective and not sensitive to changes in clinical state."

In addition to presentations on the latest research from the Insigneo Institute, the Showcase will also feature presentations and debates involving some of the most prestigious names in in silico medicine from across the world, including Frederic Turquier (Director, Research and Development, Surgical Innovations, Medtronic); Norbert Graf (Professor in Paediatric Oncology, University of Saarland, Germany); and Peter Varga, (Director, National Center for Spinal Disorders, Budapest, Hungary).

Marco Viceconti, Executive Director at the Insigneo Institute said: "At the Insigneo Institute, our work aims to use the speed and accuracy of digital modelling to bring substantial benefits, both to clinical care and clinical trials."

The Insigneo Institute is at the forefront of clinical translation—ensuring that the developments in the laboratory benefit patients as quickly as possible.

"In the future, such detailed digital models of diseases and the structure of organs could be used to help diagnose conditions, understand the impact of surgical interventions and even run digital drug trials. The presentations and debates at this year's Insigneo Showcase show how both research and industry are moving closer towards this goal." Marco added.