

IN SILICO MEDICINE. *in silico* is an expression coined in 1989 to mean “performed on a computer or via computer simulation.” It is analogous to the Latin phrases *in vivo*, *in vitro*, and *in situ*, commonly used in biology to refer to experiments carried out in living organisms, in the laboratory, and where they occur in nature, respectively.

INSIGNEO

will realise the scientific ambition behind the Virtual Physiological Human, producing a transformational impact on healthcare

VIRTUAL PHYSIOLOGICAL HUMAN. The Virtual Physiological Human is a methodological and technological framework that, once established, will enable the collaborative investigation of the human body as a single complex system. The collective framework will make it possible to share resources and observations formed by institutions and organisations creating disparate, but integrated computer models of the mechanical, physical and biochemical functions of a living human body.

THE DIGITAL PATIENT. The Digital Patient is a hyper-sophisticated computer program that will be capable of generating a virtual version of each living person. When this is achieved it will be possible to run simulations of health and disease processes on a virtual or digital individual producing results to make predictions about their future health. It will also be possible to determine the best treatment specifically for that person. This individualised approach is termed “PERSONALISED MEDICINE” and is the future of healthcare.

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Insigneo

The Insigneo Institute for *in silico* Medicine is a collaborative initiative between the University of Sheffield and Sheffield Teaching Hospitals NHS Foundation Trust. Multi-disciplinary in structure, the Institute involves over 130 academics and clinicians who collaborate to develop computer simulations of the human body and its disease processes, which can be used directly in clinical practice to improve diagnosis and treatment. This is almost certainly the most sophisticated application of computing technology in healthcare, and Sheffield has become the UK's principal centre for this work.

Insigneo performs cutting-edge research in areas of fundamental and applied biomedical modelling, imaging and informatics, as it pursues the research agenda of the Virtual Physiological Human initiative. In the first five years its focus is on the Digital Patient, *in silico* Clinical Trials and Personal Health Forecasting. The Institute's work will bring about a transformational change in healthcare through multidisciplinary collaborations across many strategic areas, including personalised diagnosis, treatment and improvements in independent, active and healthy ageing.



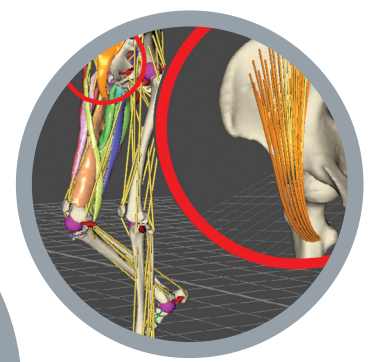
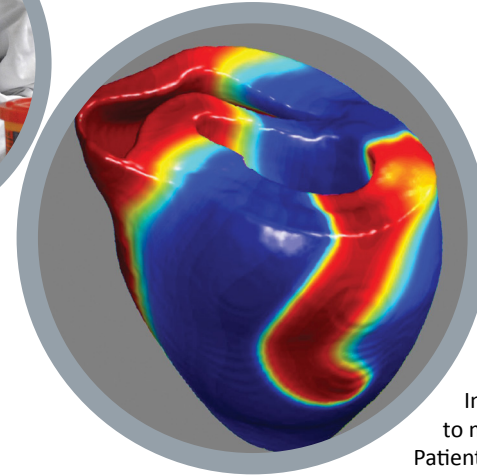
In Silico Medicine

In silico methods are transforming our understanding of the human body. They give us the power to re-integrate our knowledge of human physiology and pathology. Insigneo is applying these methods to aid clinicians and benefit patients by bringing together researchers and clinicians, with specialist skills and knowledge, from across the University of Sheffield and Sheffield Teaching Hospitals NHS Foundation Trust.

In silico methods of diagnosis and treatment are revolutionary because they give us a way to understand the processes and interactions within the body as a whole, rather than in many, disparate parts. They allow us to integrate detailed information, across many spatial and temporal scales, to create a more holistic understanding of our physiology. It is now possible to create sophisticated, personalised computer models, which are able to replicate, as closely as possible, the physiology and anatomy of individual patients. These models can then be used to predict the outcomes of different treatment options and optimise the selection of drugs or devices for each patient. The development of networks of powerful computers, with sufficient power and memory to store and manipulate the tools and data required for these models, has been key to their development. Insigneo works with partners across the globe (academic, clinical and industrial) to make sure that models, created and refined by developers and researchers, are delivered to clinical practice, maximising the benefits for patients.

"I am excited by the potential of these innovative applications of cutting-edge science."

Earl Howe, *Parliamentary Undersecretary of State for Quality*, speaking at the Insigneo Launch, 2013



The Digital Patient

We are increasingly used to the idea of an avatar - a digital version of ourselves - in games, on websites and in forums.

Insigneo is introducing this concept to medicine to create the Digital Patient - individualised models of patients, generated from their data, which can be used to prescribe personalised treatment. The Digital Patient can be used to predict risk factors and demonstrate how alternative life-styles or treatments could affect their health in the future.

Healthy Active Ageing

Insigneo is addressing the clinical challenge of improving quality of life in an ageing population. *In silico* techniques enable a holistic view of ageing and allow us to develop technologies to better understand and improve outcomes in age-related disorders. Insigneo researchers have created predictive models able to calculate an individual's risk of osteoporotic fractures; by calculating the strength of a patient's bones, how this strength is likely to change over time, and the probability that patients may overload their bones during daily life. Making it possible to evaluate the risk of bone fracture more accurately than is possible using current clinical methods.

In Silico Clinical Trials

Insigneo is at the forefront of the development of *in silico* Clinical Trials. ISCT's are a new way of approaching the once rigid clinical trial process, a process which will allow researchers to target the best option more quickly and cheaply. *In silico* clinical trials introduce the potential for: targeted drugs; a reduced development cycle; reduction of animal testing; identifying problematic side effects; creating tailored treatments and identifying new applications. Through its Avicenna initiative, Insigneo is bringing together key stakeholders, to ensure that *in silico* Clinical Trials are driven by real industrial needs, reducing the time to market and cost of development.

