

Success Stories: The Osteoporotic Virtual Physiological Human

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Osteoporosis is becoming one of the most serious diseases for the European ageing population: nearly four million osteoporotic bone fractures cost the European health system more than €30 billion per year, and kill 250,000 elders for related complications; this figure could double by 2050. Today a woman has the same probability to die of a hip fracture than of breast cancer. The aim of VPHOP project is to develop a novel multiscale modelling technology that could fight osteoporosis by predicting the bone risk of fracture more effectively than the current Standard of Care. With VPHOP, the European Virtual Physiological Human Initiative exhibits the potential to address today's socio-economic challenges and gain technologically competitive advantages for Europe.

In the last two years 50,000 individuals were forced to walk, stair climb, jump, trip, and fall while a groups of researchers observed, measured, probed and poked them as they fractured their hips, their bones and spine. Sounds immoral? It is not; it is virtual! This huge simulation required a truly powerful computer, an IBM PLX supercomputer with the power of 2290 personal computers. After two days of intense calculations the supercomputer predicted that every year in the general population of Italian we should expect two spontaneous fractures for each thousand citizens; this is a very accurate prediction, according to the recent epidemiological data study that analysed the incidence of spontaneous fracture in the general Italian population. This is already a success story in itself and for the Virtual Physiological Human initiative at large. It proves that is possible to build computer models that account for very many different processes that form a disease all together, and that can be personalised with the data of each individual to make accurate predictions that can be used to diagnose the disease and plan its most appropriate personalised treatment. The heart of the VPHOP hypermodel beats in Bologna (IT) where researchers at the Rizzoli Orthopaedic Institute and at Super Computing Solutions centre developed the first prototype of what will become the VPHOP hypermodel. In this first prototype the single models are not directly integrated, but each model is run separately, and the various results are combined using a probabilistic model of the disease.

The whole body models developed at Charité Universitätsmedizin Berlin (DE) for 90 patients that were examined in depth using some of the most advanced imaging and neuromotor analysis technologies available worldwide developed at provided a database of loads acting on the skeleton during various daily activities, for a wide range of body weights, heights, ages, life styles, etc.

Researchers at the Technische Universiteit Eindhoven (Netherlands), in collaboration with Philips Medical Systems Nederland (NL), used high resolution images of the bone tissue to build a computer model capable of predicting for each patient the strength of the tissue that form each bone of the skeleton.

The team at Eidgenössische Technische Hochschule Zuerich (CH) developed a computer model capable of predicting how the bone tissue will change over time due to the progression of the disease, and how this progression can be modified by different pharmacological treatment, whereas the Universitaet Bern (CH) are exploring the effect of other type of treatment for patients at very high risk.

Societal and economic Impact

The VPHOP Clinical Decision-Support Model already started demonstrating how, for the first time, a highly sensitive bone-fractureprediction is realisable, i.e. personalised, predictive medicine

at its best. This will change fundamentally the clinical approach to diagnosing and treating osteoporotic fracture and, respectively, establish a highly innovative global benchmark process for clinical practice in this medical domain. To substantiate these expectations, based on an innovative evaluation methodology, the likely impact of the new clinical intervention on the real-life clinical setting has been assessed, guaranteeing early application in the hospital environment, thereby also early industrial exploitation and sustainable business models.

For further information, please visit:

<http://www.vphop.eu>

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About the Osteoporotic Virtual Physiological Human (VPHOP)

VPHOP is a Collaborative Integrated Project that is developing simulation-based technology to predict the risk of bone fracture in osteoporosis patients. Co-funded by the European Commission as part of the Seventh Framework Program. The project runs for four years starting from September 2008. Coordinated by Rizzoli Orthopaedic Institute, the Project Consortium gathers 19 European Organisations based in Italy, The Netherlands, Germany, Switzerland, Belgium, France, United Kingdom, Sweden, and Iceland.

