The Perioperative Human Digital Twin

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The current approach of applying one-size-fits-all consensus guidelines over an entire patient population arose from the application of statistics to medicine in the 20th century. This has been highly successful, but the advent of machine learning and the availability of new sources of patient data is leading the shift towards precision medicine, promising medical treatment personalized to the individual. Early precision medicine has seen success in oncology with genomic testing to identify the BRCA gene and HER-2 receptor leading to biomarker-specific treatments. The near-future potential of precision medicine expands well beyond genomics, facilitating a more holistic assessment of a patient. An area of active research is that of digital biomarkers- electronically collected and processed measures of physiology and behavior. Future physicians will require to capture extensive multimodal data about individual patients, to view it in a clinically useful manner and to have evidence-based treatment plans based on this information.

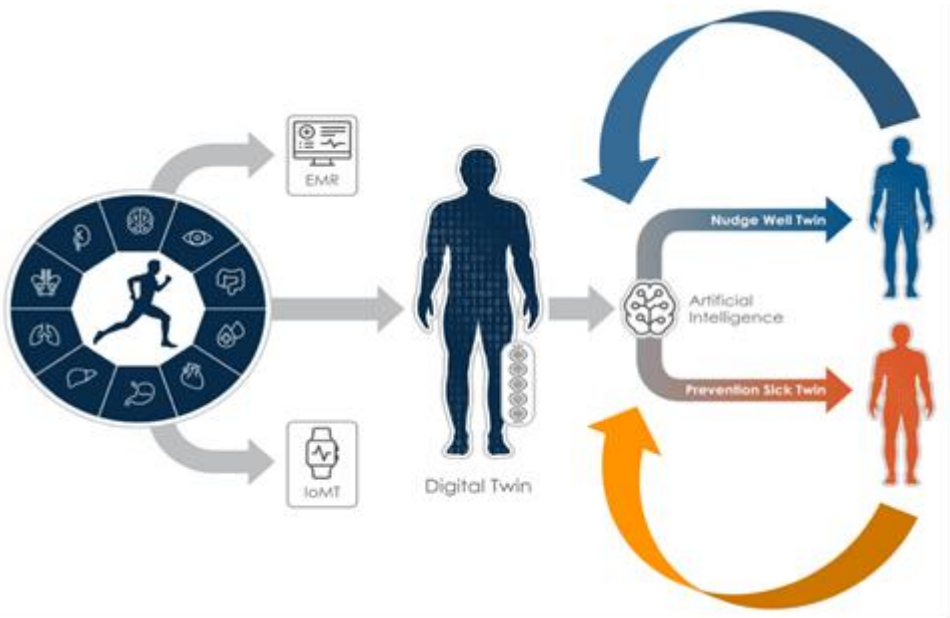
We introduce the concept of the Human Digital Twin (HDT). A digital twin is a mathematical model of a system constructed from all available information. The HDT allows for *in silico* analysis, assessment, and testing, without the need for direct perturbation of the patient's physiology. It can effectively expand precision medicine beyond genomics and other limited data sources to incorporate *all* biomarkers- digital, radiological, biochemical, exposomic, etc. A clinical picture is created using advanced analytics and AI, giving a holistic view of an individual. The HDT evolves in line with the person and their unique personal state with the addition of data over a lifetime.

A group of HDTs can be used with predictive modelling to compare the patient's current status with a personalized estimated trajectory. We can simulate the effects of possible therapies before they are given, so patients and physicians can select an option that will most effectively balance risk and benefit. This can both guide the decision to start treatment, and also be used for treatment effect monitoring. Any deviation in the patient from their HDT trajectory prompts reassessment and a search for unrecognized complicating factors. Furthermore, the HDT could guide patient recruitment for clinical trials by selecting those patients with biomarkers suggesting that they are most likely to see clinical benefit.

We are currently running HDT trials on:
Peri-operative patients: spine surgery and heart surgery
Sickle cell
Obesity
Concussion
Professionals in the peri-operative domain

During the presentation I will discuss how to plan, implement, and collect data for optimization of patient care.

Happy to give this as a core lecture during your symposium.



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