

Patient-Specific Digital Twins in Healthcare

Participants (6): Milaan Patel, Timothy Greenshaw, William Butcher, Benjamin Hind, Yifan Zhou, Narender Kumar.

The session began with Milaan providing a brief introduction highlighting the increasing prominence of Digital Twin (DT) in healthcare research using a framing slide showcasing publication trend over the past eight years, emphasizing the growing interest in both general and Health Industries.

Key Discussion Points

1. Defining a Digital Twin vs. Traditional Simulation or AI Models

Tim shared an example from his research involving a simplified digital twin used in cancer treatment planning. He noted that while such systems can assist to identify effective treatment plan, constructing a fully functional digital twin that mirrors all physiological processes within human body is extremely complex due to the biological intricacies.

This led to a broader discussion about what constitutes a digital twin versus a traditional computational model. A consensus emerged that the defining feature of a digital twin is the bidirectional data connection between the virtual and physical patient, which allows for dynamic updates of simulation models through real-time feedback to be then used to predict patient specific scenario. However, it was also noted that simpler models representing general behaviours can be effective and that a full digital twin may not always be necessary.

2. Use Cases: Neuroprosthetics and Wearables

Participants explored potential use cases in neuroprosthetics, particularly scenarios where AI/ML algorithms analyze sensor data from wearable devices to predict a user's intended motion. This prediction could then trigger neuromodulation devices or exoskeletons to assist movement with appropriate force and timing. While promising, it was debated whether such systems fully qualify as patient specific digital twins, given that such augmentation can be generalised and the only personalization aspect of it would be patient specific configuration.

3. Patient-Specific Prescriptions and Ethical Oversight

A key topic was the use of digital twins to support personalized prescribing, potentially offering recommendations tailored to an individual's health profile backed by the static evidence from disease-specific prescribing patterns. While participants agreed this could significantly reduce prescribing errors, challenges were raised about how to personalize these recommendations accurately. The idea of patient-led self-diagnosis was briefly discussed, but concerns were raised about misinterpretation and confirmation bias, where patients might wrongly believe they have certain conditions. Concerns were raised around ethical implications and algorithmic used for decision-making and it was agreed that human oversight remains essential to maintain trust and safety.

4. Data Privacy and Security Risks

The discussion also focused on the risks associated with storing personalized health data. Participants noted that the misuse or unauthorized sale of such data could have serious consequences, such as discrimination by insurers. There was general agreement that data used for training digital twin systems should be stored securely and managed by trusted public or non-profit organizations like the NHS, which have minimal incentives for data commercialization.

5. Bias in Model Training vs the Need for Tailored Care

Participants discussed that some treatments are unique to patient's specific demographics and the models used for providing tailored treatment recommendation must account that. However, it was also acknowledged that there is a risk of increasing disparities or giving unfair advantages if the models are not trained carefully. The group agreed this is a complex issue that needs careful oversight.