

PERSONALIZING HEALTHCARE



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The current one-size-fits-all approach to healthcare fails to recognize significant differences in the physical size, shape and behavior of different patients. This creates inefficiencies and cost overruns in both new medical equipment design and patient treatment systems and, more significantly, affects the quality of care provided. By personalizing a specific treatment to each patient, efficiencies will make healthcare more affordable for patients and more profitable for providers. Personalized healthcare still requires a significant paradigm shift for those in the healthcare business, as well as a new technology toolkit to collect data via devices and wearables so that treatments can be customized. While this medical digital twin concept might seem like science fiction, advanced technology is poised to improve quality of life for people around the world.

Applying big (medical) data to P4 medicine (participatory, personalized, predictive and preventive) is expected to save millions of lives in the near future and improve billions of others through early diagnosis and continuous monitoring of vital signs. Healthcare suppliers expect that this medical Internet of Things (IoT) revolution will not be possible without a technology shift. This shift must include the adoption of engineering simulation, also known as *in silico* healthcare. Designing and obtaining approval for new wearables employed by those willing to continuously monitor their health is greatly accelerated through simulation. Predicting the evolution of a pathology for a given patient and adjusting the treatment to achieve a better outcome (outcome-based medicine) requires predictive simulation tools (see the article “A Healthy Future”).

Wearables

The proliferation of safe and reliable wearable electronics is crucial to personalized healthcare and to make patients more autonomous. The medical IoT is leveraging the emergence of 5G wireless communication and its increased bandwidth to safely and reliably transmit medical data to healthcare professionals. The impact is already being felt. Oticon, a leading hearing

aid supplier, increases patient comfort by employing multiphysics simulation that takes into account the individual’s head and torso shape (personalization) to improve directional performance of the hearing aid (read the article “Hearing Gain”). Personalized medicine has also reached the veterinary field in the form of an IoT-enabled halter that communicates with horse owners when colic strikes. The halter could mean the difference between life and death for horses (view “Horse Sense”).

Medical Digital Twin

In the future, a medical digital twin comprising a computer model for each of us will gather the big data collected by wearables. The first implementations of medical digital twins already combine patient-specific geometry with patient-realistic material properties and operating conditions/ pathologies. Sim&Cure uses a localized digital twin to help surgeons treat patients suffering from cerebral aneurysms (see “Brain Trust for Aneurysm Treatment”). CBBL at Oklahoma State University leverages a human digital twin to assist the pharmaceutical industry in more efficiently targeting cancerous lung tumors (read the article “Targeting a Tumor”).

Additive Manufacturing

As medicine and orthopedic surgery become personalized, the

one-size-fits-all orthopedic implant will no longer satisfy the patient and the clinical staff. To preserve patient bone capital while extracting a tumor or fixing a major trauma, surgeons must customize the implant to each patient. OMX uses a combination of simulation and additive manufacturing to more quickly design and test implants for maxillofacial surgery (see “Personalized Implants Restore Smiles”).

Patient Adjusted Surgery

Staying abreast of progress in engineering simulation, innovative surgeons are eager to collaborate closely with local engineering groups. The University of Shanghai works with local hospitals to assess pediatric and newborn heart surgery scenarios. Using accurate simulation in conjunction with skilled surgery will increase the effectiveness of these procedures and provide the young patients with better quality of life (read the article “Hearts Content”).

Customized Medicine

As the healthcare world begins to collaborate on personalized medicine, the pharmaceutical industry must adjust to reduce medication and personalize drug doses. The drug manufacturing process is often modified to cost-effectively produce smaller quantities of a drug or to design single-use equipment. A manufacturer of single-use biopharmaceutical mixing equipment leveraged simulation to save hundreds of thousands of dollars by significantly reducing the need to build and test prototypes (view “The Right Mix” article).

Leveraging simulation for healthcare can improve treatment, reduce costs and improve the well-being of people worldwide. The stories in this special issue of ANSYS *Advantage* reveal just a small part of what entrepreneurs, hospitals, clinicians, and medical device and pharmaceutical companies are doing to incorporate simulation into their product development plans to save time, money and — most importantly — lives. **A**