

National Institute of Biomedical Imaging and Bioengineering

ENGINEERING THE FUTURE OF HEALTH

The National Institute of Biomedical Imaging and Bioengineering's (NIBIB) mission is to transform, through engineering, the understanding of disease and its prevention, detection, diagnosis, and treatment. For nearly two decades, NIBIB-supported research has pioneered cutting-edge technologies that are essential to extending health span, personalizing diagnosis and treatment, and significantly improving quality of life. As the NIH hub for developing novel technologies for all diseases and disorders, NIBIB support is driving research to benefit patients and healthcare professionals and accelerate biomedical discovery. I appreciate the opportunity to share examples of the groundbreaking research that NIBIB supports to engineer the future of health.

CONTINUOUS MONITORING FOR BETTER HEALTH

Heart rate and motion sensors in smart watches and other wearable devices are examples of consumer technologies that can provide continuous feedback to help people improve their health with exercise and diet. However, most information used to make decisions in current medical practice is collected at a specific moment in time, such as taking blood pressure or measuring blood chemistry. This gives a limited view of our health and disease risk because it doesn't account for the many changes that occur in our bodies on a continuous basis. Using principles employed in microchips for consumer devices, bioengineers are redesigning state-of-the-art wearable and implantable sensors with revolutionary capabilities. For example, researchers are developing a novel biomolecular sensor built into a custom fabricated microchip to report dynamic changes in glucose and insulin levels in the pancreas. This technology could make blood tests obsolete, and lead to personalized interventions for diabetes such as stimulation of the nerves in the pancreas to maintain healthy levels of glucose and insulin.

Another approach to create monitoring technologies that are easily accessible is to leverage the advances in the cell phones we all use. In one specific example, researchers developed an app that uses computational method to assess anemia using a picture of the fingernail taken with a phone's camera. The app uses sophisticated mathematical models to determine blood hemoglobin levels based on the coloration of the fingernail bed. This fast, pain-free screening to measure hemoglobin levels is particularly useful for people with blood disorders and patients receiving medications that put them at risk for developing anemia.

BRINGING CARE CLOSER TO THE PATIENT

Imaging technologies such as magnetic resonance imaging (MRI) have revolutionized medicine, making procedures such as exploratory surgery a practice of the past. However, MRI scanners cannot be used in places such as intensive care units,

ambulances, and most hospital emergency rooms because of their large size and high cost. NIBIB-supported researchers are working on revolutionary new ways to improve upon these technologies to make them smaller, more accessible, and less expensive. For example, researchers are developing a head-only portable MRI to rapidly assess brain function and injury. This simplified MRI scanner is made of lightweight materials and does not require helium gas to cool the magnets. It could be used to bring the many benefits of MRI to low-resource settings, clinics, and even ambulances in order to provide more rapid, cost-effective assessment at the point-of-care.

MODELS THAT MIMIC HEALTH AND DISEASE

The creation of miniaturized models of human tissues have helped researchers understand the biology and function of organs, cells, and individual components of cells. Researchers are now going a step further to create models that mimic disease in an environment similar to the human body. In one example, scientists have created a novel 3D brain tissue system that better mimics the tumor environment in patients. This type of system can show how tumors interact with other cells and tissues in the surrounding environment in order to grow and become resistant to drug treatment over time. This approach to building physical models of disease can help identify why and in what circumstance certain medicines work well on one individual but not on others with the same disease.

CONCLUSION

Innovative technologies are essential for driving novel basic science advances and for delivering life-saving discoveries for patients. These are a few examples of ongoing efforts to develop more powerful tools to make decisions, increase accessibility, and provide timely, personalized care. NIBIB's mission is to create and disseminate these technologies from "blackboard to benchtop to bedside," while stimulating innovation and growth in the economy. We are committed to working with our partners to **Engineer the Future of Health** for all Americans.