

# Innovations shaping the future of healthcare



**Innovation across health-related disciplines and technologies is transforming our lives. As we identify more inclusive ways to provide healthcare to an aging population, the traditional model of traveling to a hospital for treatment is no longer scalable.**

Disruptive technologies and the further consumerization of health could see a future where patients have the option of being continuously connected to the healthcare system as part of their ongoing wellness. Already, many of us are wearing smartwatches that measure our heartbeat, stress and movement. Over time, these devices could help us to understand chronic diseases better and accelerate change across healthcare operations. Working together and investing in the resources and systems that allow us to improve our health will transform the way we live. The digitalization of health has the potential to enhance recovery, better predict and avoid disease, and make our lives better.

## New ways to address today's health challenges

Wearables are the most significant type of remote monitoring, increasing a patient's engagement with their health and possibly lowering hospital costs. Leveraging accredited health devices alongside consumerization solutions have the potential to make a real difference to common diseases.

Diabetes is one of the leading causes of death worldwide. Having diabetes increases the risk of developing other severe illnesses, including COVID-19. Connecting a smartphone application to a smartwatch with two sensors and an insulin pump is an affordable solution to preventing complications in diabetics around the world.

Smartphones, smartwatches and sensors have the potential to generate vast amounts of data and information on individual health. Many of us today are much more involved in our health than ever before. We wear devices that can track our heart rates, sleeping habits and stress rates. Developing meaningful insights from data could benefit the next generation by offering more personalized health treatments.

As wearable technology evolves and moves towards the remote monitoring of blood oxygen saturation and heartbeat, bio-medical data can be measured over the long term in a much easier way. NTT is working with Laboratoires Réunis to combine devices and apps to diagnose cardiac conditions through a lung and cardio ultrasound, remotely. Most importantly, the data collected could fuel future physiological studies.

Telemedicine, telehealth and remote patient monitoring empowers patients to receive care from anywhere at any time. Similarly, as Wi-Fi networks within physician offices and hospitals became the backbone to clinical services and processes, the 5G network will have the same or perhaps even a more significant impact on healthcare.

## Growing digitization in healthcare

Some sectors have shifted to digital faster than others. Today, many hospitals and patients are already harnessing dedicated smart apps that support clinical and administrative processes, but there's so much more that we can do. Instead of complex platform or server applications, these apps focus on specific job activities or treatments. Nurses can focus on patients instead of IT. Patients can follow their hospitalization journey through intuitive apps that help them order meals, communicate with other patients, provide input on their medical files and access entertainment to enhance their stay.

Defining use cases and digital scenarios of the future means we can be better equipped to provide tomorrow's healthcare. Widespread remote monitoring, more sophisticated imaging and video are increasing pressures on network resources in performance and service quality. New business use cases will better define the data and analytics requirements. As IoT technologies continue to expand, we'll gain from the increased volume of generated data as a society. Scanning for cancers alone can produce multiple gigabytes of information per patient. Data and information have the power to inform medical decisions. Networks must be fast to store and correlate vast amounts of data.

AI and machine learning are already supporting the analysis of health data. On top of that, Augmented Reality (AR) is becoming a game-changer. AR can get medically relevant or life-saving information into a doctor's field of vision. Doctors will access the latest and most relevant medical information in real-time. Allergies are automatically displayed at the very moment when it becomes needed for the treatment process. The individual owns patient records in digital form on a mobile device, which can be accessed when required. The connected patient may share critical information with the hospital before arriving at the emergency room, providing warnings or support messages that enhance treatment. Locations of veins and organs may be projected onto the patient's body and surrounding environment as physicians take advantage of the information in real-time.



## Creating secure, integrated health platforms

Digital health platforms must successfully combine medical devices and patient management, remote patient monitoring, telemedicine and telehealth. The platform must further regulate the API communication for apps and IoT health devices, both inside and outside of medical spaces and national health systems. The communication with any backend systems needs to be reliable and front-end facing services must be secure by design. Ultimately, the communication between a global healthcare platform that regulates hospitals nation-wide finally realizes the strategy for the conception, implementation and operation of a national platform for the secure exchange and shared use of electronic health information.

The digital platform is not limited to a physical location or specific network. Integration with 5G means better geographical accessibility, higher bandwidth, network slicing to collect massive amounts of data and quality of service and security. This creates new possibilities because it allows pseudonymized AI to analyze the behavior of patients continuously. A federated electronic health record will become the most widespread application of big data in medicine. However, this will require more vital collaboration and record sharing via secure information systems made available for providers from the public and private sectors. While many countries are struggling with implementing a truly digital health platform, the eHealth data lake forms one of the most important national healthcare system pillars.

In the future, AI will be available at the backend and models will execute on smartphones, tablets and IoT health devices. AI supports real-time health features. Patients are evaluated for abnormalities combined with an environment unique to them — a breakthrough in healthcare.

## Reinventing health through the Bio Digital Twin

Many organizations are already investigating and trialing scenarios where remote monitoring and remote diagnosis are combined using AR. Bringing together AI and machine learning is also one of the most innovative fields of healthcare.

NTT Research is reinventing healthcare through its work on Bio Digital Twins technology. Alongside these efforts, teams work on robotics, nano-devices and microfluidics, wearable technology and translational biology.

It's a new approach, promising to offer individuals better, more effective and personalized care and leveraging data analytics, IoT, advanced AI applications, deep learning and increased sharing of information across healthcare providers.

## Data analytics to improve prediction and outcomes

The Bio Digital Twin is a virtual representation of a patient. It's a digital replication providing real-time insights for all that is known or that can be predicted about a patient's condition. Bio Digital Twin covers physiology, pathophysiology, genomics, multi-omics and lifestyle factors. Research and development around sensors also feed into the Bio Digital Twin. Individual sensor data enables digital twins to be personalized.

All these areas allow further care for predictive and preventative maintenance of health. Similar concepts are currently being used across other industries. Jet engines receive continuous input from sensors throughout a flight, collecting data on engine conditions and performance, and sending it to real-time digital twins operating on cloud platforms or in data centers.

## R&D to address the number one cause of death

As a starting point, NTT Research is building a Bio Digital Twin of the cardiovascular system and is planning to extend it onto other organs and systems of the human body. Clinical studies are expected to continue with a model developed by 2022 specifically for heart attacks and failure. By 2025, the aim is to have a validated operational model and a physical device ready to support it. By 2030, we will reach the vision of achieving a complete Bio Digital Twin of the cardiovascular system.

Heart disease is the number one cause of death around the world. In the coming years, the Bio Digital Twin of the human heart will help us predict, prevent and manage heart attacks and acute failure. For example, in a heart attack, biometric sensors would continuously monitor the patient's clinical status and response to the ongoing clinical interventions. Real-time feedback from the digital heart will decide the interpretation of the interventions for medication and control device settings. Doctors remain in control, though they're able to make faster decisions with intelligent robotics.

The NTT Research team conducts studies with the National Cardiovascular Center in Osaka, Japan, and two public proof concepts. These projects represent a critical part of the Bio Digital Twin strategy, as we build and test the platforms for global use. At the same time, we're developing physician and patient-oriented smart devices and web-based applications to support the strategy.

## Building an eHealth Data Lake to support the future of healthcare

Data growth, fueled by IoT in healthcare, is imminent. McKinsey projects a USD 11.1 trillion market by 2025, nearly one-third of which will comprise healthcare devices. The rate of growth in data collection will accelerate year-on-year. If we want to leverage data successfully for improved results and outcomes, we must lay the right foundations. Digital infrastructure supports the future of technology-enabled healthcare. A carefully considered strategy and architecture planning are vital for healthcare organizations and pursuing a national health platform.

One of the main challenges is to ensure the collection of data is gathered and optimized for healthcare organizations, doctors and patients. At the moment, we're seeing a flow of unstructured data being filtered across hospital information systems, databases and other traditional sources. Consolidation and aggregating data into a hybrid IT model - using pseudonymization at the core - offers a promising way forward.

The next generation of healthcare CIOs and CDOs are already refining and advancing internal systems towards digital platforms. While this is a great step forward, the focus must also be on integration and leveraging a national health platform.

eSante and hospitals are in desperate need of a solution that acts as a common data platform and integrates data originating from multiple sources, across various formats while preserving quality. Besides the lack of AI and machine learning platform capabilities, on-premises infrastructure costs can be a further challenge. Old data that is rarely used quickly accumulates and takes up unnecessary space.

Medical professionals increasingly expect immediate, direct and natural language access to the analysis of patient data. They also expect recommendations based on all available data in one place - covering physician notes, radiology reports, scans, genome files and information from wearables, respirators and blood pressure monitors.

High peak performance is essential for the accuracy of data analysis. Data Lakes offer archiving and integration through public cloud services. Data can be organized, maintained and transformed into actionable insights for providers and patients in the public cloud. Using Identity Access Management and pseudonymization, no patient data leaves the boundaries of the critical systems and platforms, and security levels are individually maintained. This is essential to ensure that patient data is managed sensitively, maintains strict privacy and adheres to compliance and regulations.

## Conclusion

As the applications and capabilities of wearable technology and new ways to predict our health continue to evolve, eHealth Data Lakes offers a cost-effective and scalable way to collect, store and manage data. By leveraging the public cloud, Data Lakes offer a fully secure and compliant way through pseudonymization and provide the means to extract impactful insights from their data. Putting the right digital data infrastructure in place will help the healthcare industry to navigate the disruptions ahead.