Internet of Things in Pharma

The Internet of Things (IoT) refers to the interconnected web of devices around us. These devices gather and exchange data with each other to process and present a myriad of information to users, enabling the "smart" in technologies that touch all facets of our lives.

Akshay Ray, Senior Manager, Technology Research & Advisory, Aranca emphasizes how IoT brings value to healthcare in improving patient health through remote monitoring, personalized treatment and enhanced diagnostics.

Over the past century, advancements in medical science have more than doubled human life expectancy from 32 years in 1900 to 71 years in 2021. Even though rapid industrialization and urbanization have created a new set of health challenges, access to better drugs and healthcare regimens has contributed significantly to the longevity. Adhering to a prescribed regimen of drugs and diet is the cornerstone of modern medicine, and it is ably supported by advances in non-invasive and rapid diagnostics and patient monitoring.

IoT has the potential to address several challenges in healthcare, including patient monitoring, patient compliance, decision making, engaging patients and infrastructure costs. The IoT ecosystem consists of data collection devices (such as smart watches, fitness trackers, ingestible sensors, implants), connectivity technology (such as Bluetooth, Wi-Fi, 5G network), and computing systems to analyze the data and provide decision-making insights and data points.

IoT brings value to healthcare by improving patient health through remote monitoring, personalized treatment and enhanced diagnostics, improving healthcare professionals' productivity and healthcare facility workflow by accessing, analyzing, and making available electronic health records on a real-time basis.

The use cases of IoT are as follows:
Remote monitoring & personalized treatment

Using IoT devices facilitates continuous monitoring of patients suffering from chronic diseases such as cardiac disease, hypertension, and diabetes. Smart devices track vitals and report them back to health professionals in real-time, enabling timely life-saving interventions as and when required. Continuous glucose monitoring systems, such as Dexcom G6, help track diabetic patients' blood sugar levels and relay the data to healthcare providers in real-time. Remote monitoring reduces the cost burden of hospital facilities while ensuring that the caregivers receive current vital stats for the patients.

Specialized wearable devices, such as ECG monitors (AliveCor and KardiaMobile), pulse oximeters (Masimo Rad-5v), smart blood pressure monitors (Omron), and neurological monitors (NeuroSky), widen the data points that can be monitored remotely to facilitate timely actions by the healthcare providers.

Healthcare professional productivity

IoT helps streamline administrative processes, reducing wait times and improving patient flow within healthcare facilities. Telehealth came into sharp focus during COVID-19, where the communicable nature

of the pandemic necessitated remote consultations. Underpinned by advances in communications technology, IoT helped increase healthcare professionals' reach and efficiency to attend to a substantial portion of patients remotely, particularly in rural and underserved regions.

Amwell is an example of a telehealth platform that facilitates virtual visits and has integrated devices like TytoCare, which augment virtual consultation with the ability to perform remote physical exams such as measuring temperature and heart rates, and performing non-invasive examinations of the skin, lungs, and heart. Another example is XRHealth that helps healthcare professionals remotely administer physical and mental health therapy through immersive virtual reality platforms individualized for physical, occupational, and mental health therapies.

Healthcare facility workflows

IoT helps optimize healthcare facility workflows and day-to-day operations by aiding workflow automation, medication management, asset tracking, patient and environmental monitoring and enhanced communications.

Hospitals use RFID and IoT based systems, such as GE Healthcare's AssetPlus, to track medical equipment and supplies, ensuring availability and proper maintenance of critical equipment, and reducing the time spent by hospital staff searching for the equipment. On the other side, remote patient monitoring systems, such as Medtronic's Vital Sync™, help hospitals manage patient data more efficiently, reducing wait times and improving care coordination.

Hill-Rom, a leader in hospital bed systems, developed a smart bed – Centrella Smart+ bed, which monitors patient movement and adjusts to prevent bed sores and alerts the nursing staff of patient attempts to get up to significantly reduce fall risks.

Vocera communications developed wearable badges that allow instantaneous communication between hospital staff to improve response time and coordination. Several hospitals now use IoT sensors and systems to automate day-to-day activities such as administrative tasks, predictive maintenance for equipment, and patient care.

Artificial intelligence (AI) and machine learning (ML) integration

The rapid increase in computing power made available in the small forms enables powerful AI and ML tools to be developed and applied to healthcare, where health data collected by IoT devices is analyzed to predict health issues and provide personalized recommendations. Computer-assisted diagnostics or CAD is an emerging field that relies on automated visual analysis of tissue samples for early detection of diseases and generating prognoses. Aidoc is one such platform used to analyze medical images to detect abnormalities. The output helps prioritize urgent cases for radiologists, improving diagnostic efficiency.

Other examples of AI use for analyzing large volumes of medical data are IBM's Watson Health which analyzes patient health data to improve diagnosis and Google's DeepMind Health that analyzes data gathered by IoT devices to predict patient deterioration. Babylon Health provides personalized health assessments, triage, and consultations based on AI through its app.

Outlook

With technology advancing rapidly, several different platforms are used to create IoT-based healthcare solutions, which brings new challenges in terms of interoperability of various platforms, infrastructure costs associated with advanced communications systems, and data protection.

The landscape of IoT in healthcare is very fragmented, with several different corporates and academia developing solutions tailored to specific challenges that they are tackling. This opens an opportunity to work on enhancing the interoperability between diverse systems, and Fast Healthcare Interoperability Resources (FHIR) standard by HL7 is a step in the right direction.

Fast communication is an important pillar of IoT and the wide roll out of 5G infrastructure will prove significantly advantageous for healthcare. Rush University Medical Center partnered with AT&T to become the first hospital to deploy 5G connectivity throughout their facilities, aiding use of IoT devices for patient care and telemedicine. On the other side of the world, Huawei and Guangdong Provincial People's

Hospital partnered to make the world's first remote robotic brain surgery over a 5G network possible.

Another significant challenge that IoT-enabled healthcare faces, in the medium- to long-term future, is that of data security. To enable analysis and quick decision-making, large amounts of personal health data are captured by the IoT devices and transferred over communications networks, which is vulnerable to hackers. Cybersecurity developers, such as MedCrypt and Irdeto, offer data security solutions for medical devices and patient data.

Conclusion

IoT-enabled healthcare paints a rosy future for improving patient care, enabling personalized treatment, enhancing operational efficiency and resource utilization, aiding healthcare professionals' productivity, and enabling new forms of patient engagement.

Rapid developments in AI, IT, communications technology, and cybersecurity and their wide adoption promises upliftment of the global healthcare standards and improve accessibility to effective healthcare worldwide. However, as is the case with any new technology, it is rife with several different solutions, and governments worldwide will have to adapt quickly to formulate appropriate regulatory frameworks to prevent misuse of a wonderful boon to humanity that has the potential to be a bane of equal, if not larger, proportion. ■

Author

Akshay Ray
Senior Manager, Technology Research & Advisory, Aranca