

Improving Healthcare and Patient Outcomes Through Connected Devices

A SCALABLE HEALTH WHITEPAPER



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Executive Summary

According to ABI Research, the mHealth wearables market is expected to grow 400% in the next 5 years.

mHealth IoT includes wearables for use in and out of the hospital allowing doctors to remotely monitor the health of their patients. Devices include blood pressure monitors, continuous glucose monitors, pulse oximeters, and electrocardiogram monitors. Market growth is being driven by many factors including an increasing population with chronic health issues that require constant monitoring, a greater acceptance of wearables by patients and practitioners, and the need for cost-effective alternatives to expensive in-person visits with care teams.

mHealth IoT offers many advantages addressing both the patient's needs and the provider's business practices. Wearables offer the ability to track movement, diet, and key health indicators giving practitioners real-time insights into overall health. This emergence of healthcare technology offers opportunities for better patient outcomes through monitoring vitals, which allows for early detection,

intervention, and preventative care while resulting in cost savings to the healthcare organization.

With the anticipated growth of mHealth IoT and wearables, the problem will only get worse.

Wearables represent the proverbial "the last mile" in patient data. And not unlike other last-mile environments, the mHealth wearable market is highly fragmented with disparate data technologies not easily connected to larger systems such as EHRs and other medical data platforms. However, healthcare organizations must incorporate the data outputs from these mHealth devices into larger data platforms to gain actionable insights from a complete patient profile.

This white paper will present the opportunities afforded by IoT in health care, as well as, the challenges in integrating the data collected from these mHealth devices.

| Vertical | Disease State | Total Savings Opportunity | Commercial Opportunity |
|---------------------------|---|---------------------------|------------------------|
| Remote Patient Monitoring | Heart Disease, COPD/Asthma, Diabetes. | \$200+ billion | ~\$15 billion |
| Telehealth | Routine & Psychological Care | \$100+ billion | ~\$12 billion |
| Remote Patient Monitoring | Obesity, smoking cessation, overall lifestyle improvement | Indefinitely large | ~\$6 billion |

Potential economic impact of healthcare IoT offerings by vertical

DIVERSE APPLICATIONS OF IoT

Integrating connected healthcare wearables offers many advantages. Healthcare organizations can use connected mHealth IoT devices to deliver enhanced quality of care resulting in better clinical outcomes. Other measurable benefits include reduced in-person visits, lower mortality rates, and emergency admissions, decreased readmissions, shorter lengths of stays in the hospital, and shorter recovery periods. IoT-based healthcare systems can also be applied to a wide range of fields including the supervision of chronic diseases, care for elderly and pediatric patients, and the management of post-surgical aftercare in the home environment.

The major applications of IoT include:

Chronic disease management:

Chronic ailments such as diabetes, cardiovascular disease, pulmonary problems, high cholesterol, obesity, hypertension, and other diseases affect millions of people worldwide. Chronic disease management focuses on maintaining the patient's lifestyle through constant engagement to support the patient and monitor compliance with a prescribed care program involving medications, treatment protocols, and diet regimens.

Care for the aged and the pediatric:

A connected healthcare program can be created to enhance patient care for aging and pediatric populations. The primary objective is to ensure ongoing care and maintenance of patients while offering them the ability to remain in the familiar environment of their homes.

Pediatric patients need more attention and dedicated care. At the other end of the spectrum, many elderly patients suffer from numerous chronic conditions. Their activities, physiological and psychological conditions, and home environment require continuous supervision. To further assess the quality of care received, IoT devices can detect emotions and moods to monitor the mental state of the patient.

Fitness and personal health management:

People who want to stay fit and healthy can do so with the help of a whole host of wearables. Users can monitor their fitness standards and daily exercises while using a web-based application or an app. These apps can be used to track adherence to schedules made by trainers. Usage of these apps combined with wearables can include activity monitors, weight sensors, blood pressure and heart rate monitors, connected treadmills, and other connected fitness equipment.

Creating awareness for children's health:

Creating awareness around children's health concerns and educating providers on the needs of children with behavioral, emotional, or mental health problems and their family members are vital. Researchers are motivated to develop specialized IoT services to address their needs, such as an app that encourages children to develop good nutritional habits with the help of their parents and teachers.



HOW IoT WILL REVOLUTIONIZE THE HEALTHCARE INDUSTRY

IoT offers an effective way of collecting patient-specific data in remote settings. Patients can return to their homes to convalesce in a friendly, known environment amongst friends and family members. Their care teams are notified of any significant changes in the health through notifications and can deliver the appropriate responses in a real-time manner. This further benefits healthcare organizations that are moving to value-based care. The patient is happier at home, he avoids costly hospital stays and the real-time interactions with his care providers result in better health outcomes. To remain competitive and meet the patient's needs, more and more healthcare organizations are incorporating wearables into their treatment protocols.

Medical professionals can offer more accurate treatments to patients with the availability of shared clinical records through the Internet.

Currently, communication between the patient and the doctor is pretty complicated. The doctor and patient have a face-to-face meeting only when they schedule an appointment, which requires much waiting time. With the help of eHealth and the IoT, several ways exist to resolve this such as face time meetings online. Connected Health helps patients properly follow their treatment and comply with their medication on time. Also, it helps in cost reduction and effectively improving the whole complicated doctor-patient process.

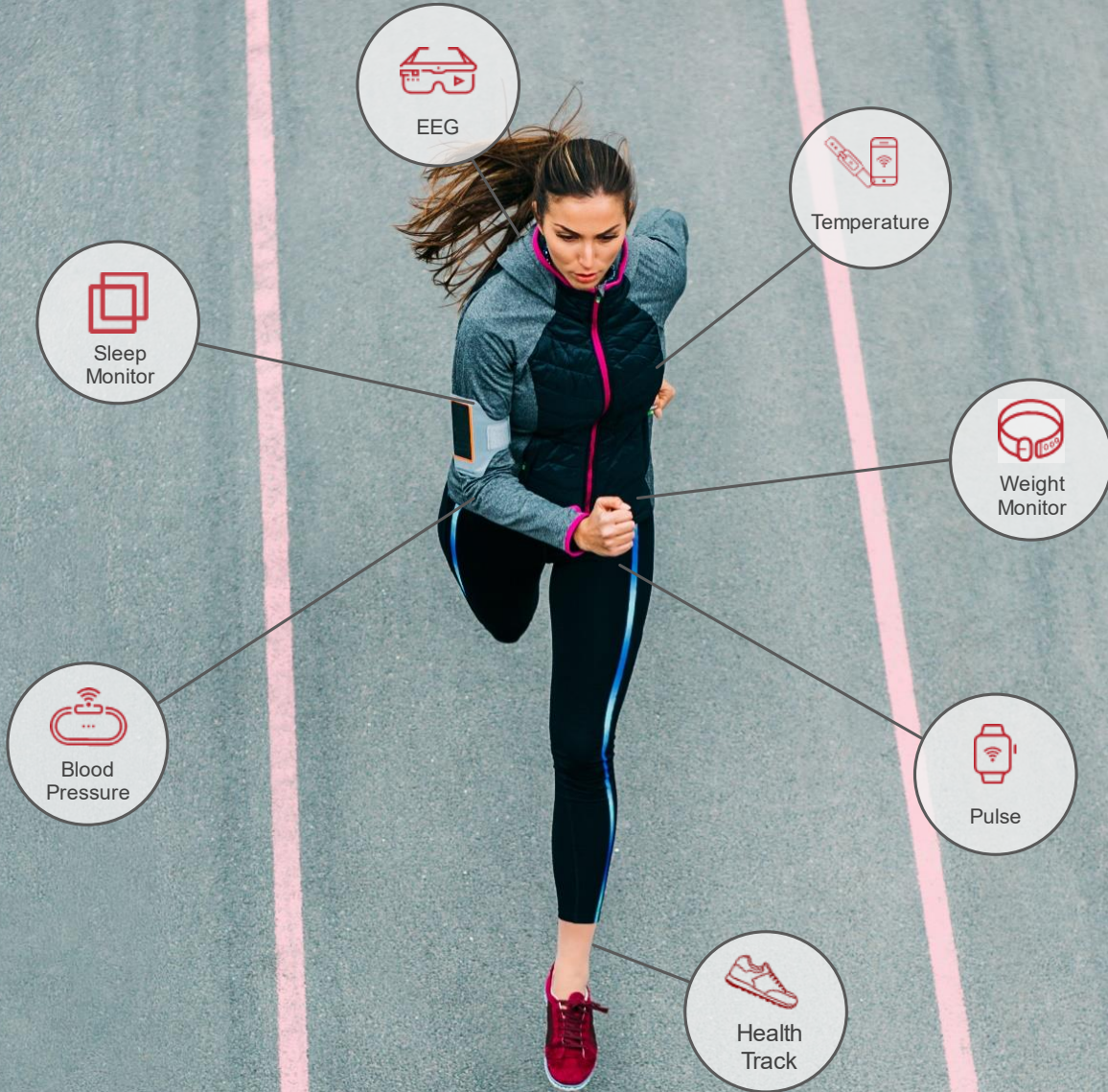
There is an increasing need for medical professionals and health centers worldwide, a critical challenge many developing countries are struggling with. However, with the availability of smartphones, patients

can be in direct contact with medical professionals even if there is a lack of resources. These smartphones reduce the need for the old traditional way of face-to-face meetings of doctors and patients at health centers. Now, with the help of IoT, a pregnant patient remains in touch with her doctor through text messages. In the case of epidemics such as the

The Ebola virus affected many regions of Africa, and smartphones were widely used to continuously follow up on the spread of the virus, where outbreaks were occurring, and the speed at which new cases were being identified.

This helped in the effective prediction of a virus outbreak in those areas that were uninfected and also in applying proper preventative measures. Several doctors and nurses obtained their medical training through their smartphones. This was a strategy never used before to combat epidemics that proved to be highly effective and useful. These strategies and the existing data can be again used in the future as well.

Connected health and IoT paves the pathway of sharing data between the doctors and the patients in such a convenient and effective approach. It helps patients fight against common health problems like high blood pressure, diabetes, high cholesterol, etc., for which the health data can be easily accessed by the patients. The healthcare future can be greatly improved with the help of connected health and IoT.



IoT ARCHITECTURE

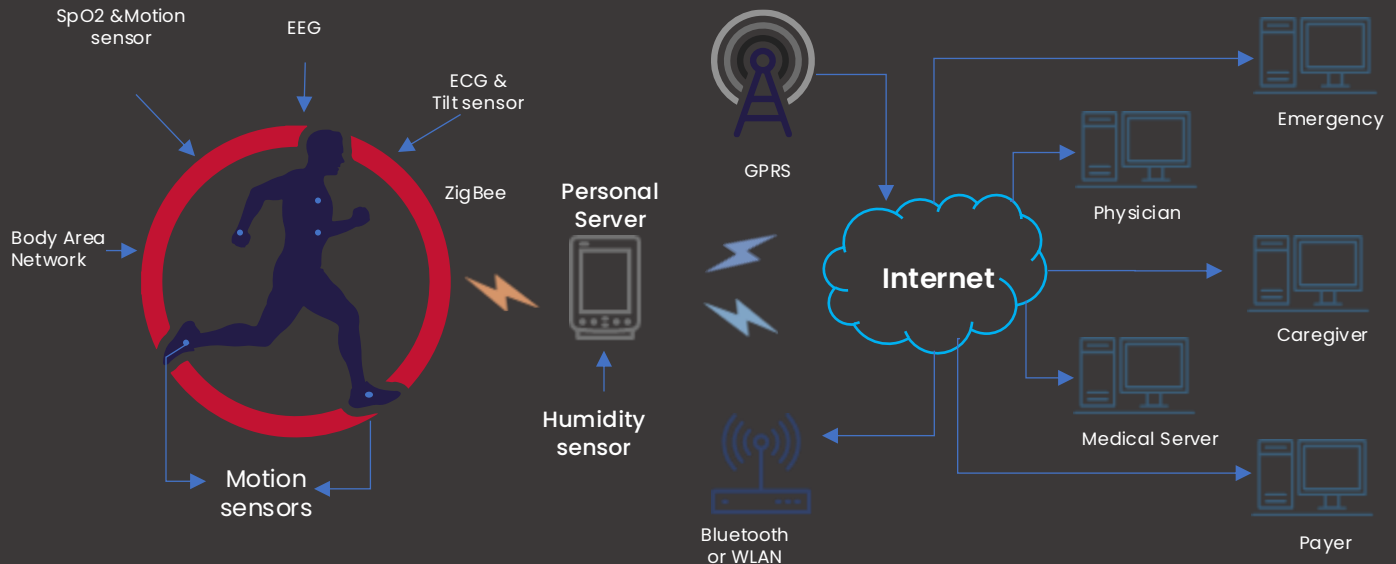
Medical solutions based on the IoT architecture allow healthcare professionals to safely communicate with their patients using simple architecture. The solution can be communicated with any of the connected devices over the internet.

Key Components

The main elements of the solution are:

- Wearable and other medical devices capture and transmit medical data, such as calculating patient vital signs.

- Access, obtain, standardize, and send data from the medical devices to data center infrastructure or cloud over a secure connection.
- Computing infrastructure includes the storage facility, servers, and application software to perform different operations such as aggregation, collection, and analytics on medical data.
- Healthcare providers use devices to visualize health data and create business intelligence, such as health outcomes per dollar spent



BENEFITS OF IoT IN HEALTHCARE

IoT services help healthcare organizations gain insights from medical data, understand patients better, and deliver a customized patient experience. It also gives physicians and clinicians anywhere/ anytime access to real-time data from patient records, test results, and prescriptions using smart devices and wearables.

Some of the other key benefits of IoT applications in healthcare are as follows:

Improved quality of life

For the critically ill aged and pediatric populations, IoT technology offers an improved quality of care. For example, the elderly population can live their life independently at any place of their choice while getting their medical condition observed.

Flexible patient monitoring

IoT can help to monitor both medication regimens as well as health issues, which in turn assist drug companies and healthcare providers to mitigate risks and losses.

Improved drug management

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Greater operational efficiency with better insights into patient data

Patient diagnostics and information can be tracked in real-time without the need for human involvement, thus reducing the time spent by doctors. Using an IoT-enabled device can ensure medication compliance and adherence.

Improved security and privacy

The IoT can help strengthen a healthcare provider's security by providing a comprehensive picture of where data is, how it is used, and who is accessing it.

Reduce cost of care

By using an IoT system, a patient's health can be monitored in real-time, thus minimizing the need to visit a doctor. Remaining at home for extended care instead of costly hospital stays.

Improved patient outcomes

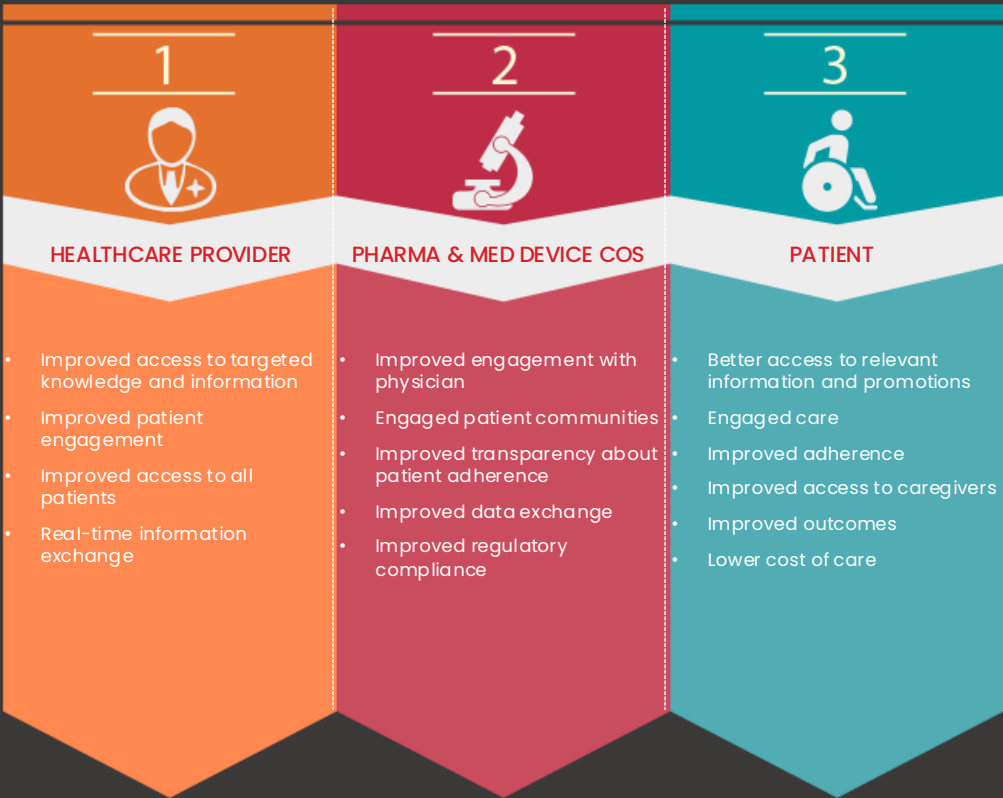
By taking information from an integrated knowledge base of former disease outbreaks and proven research methods, doctors and caregivers can practice evidence-based medicine for better patient outcomes. This real-time information can also assist them to deliver timely care and address various issues at an early stage.

Real time disease management

Inside a connected healthcare setting with constant remote monitoring, patients can get treated proactively before their condition worsens. This will help to monitor patients' health, as well as reduce the cost of care. The pre-emptive focus will shift care from 'treatment' to 'wellness'.

Faster scalability

Healthcare providers can rapidly achieve global scale using IoT solutions that provide managed services such as support and fulfilment, bigger capacity to meet the demands of a large patient base, and lower care cost, all while eliminating the need to increase hospital readmissions.



CHALLENGES IN IMPLEMENTATION OF IoT IN HEALTHCARE

The advancement of healthcare IoT is not without its challenges. Many clinicians, physicians, and health IT professionals are still trying to adjust to using and securing digital devices during work. The addition of IoT-generated data becomes information overload if not successfully integrated into the patient's record. As of now, the application of IoT in the fragmented nature of health systems presents many unattained challenges. This section shows why the development of IoT is in jeopardy in healthcare.

Internet of Things has a Big Data Problem:

Data is everywhere. The technological challenge is the process of combining health data and transforming it into usable information. The amount of data produced by IoT devices is vast, thus combining it using electronic medical records (EMR), genomic data, and other clinical data remains a huge challenge. Data is produced by multiple siloed sources such as pharmaceutical companies, healthcare providers, and life sciences organizations, in a variety of formats like videos, images, electronic records, digital text, paper files, numerical data, and multimedia files. This multiplicity makes it problematic to combine all of the available healthcare data into a single patient profile.

IoT Hits a Legacy Wall:

Always been a top priority for healthcare reform supporters, but very few tools and technologies have been able to customize the patient care experience until the introduction of wearables. These wearable devices, home monitors, and smartphone apps have only been made available to patients in the past few years. The data influx from IoTs is

overwhelming for clinicians who are still struggling to move their paper files into digital EHRs. Meanwhile, IoT developers are struggling to create interfaces that can simplify the burden of incorporating massive amounts of data from diet apps, sleep trackers, smartwatches, and heart monitors. The visionary technologies of the Internet of Things offer great advances in personalized care, and the benefits will only be realized when healthcare organizations equip themselves with the structure requirements and analytics competencies needed to meet patient expectations.

Data Integration:

There is an urgent need to integrate data from disparate sources to create an intelligent, situation-aware wellness and healthcare application, that can generate significant patient-related alerts. These data sources include - different kinds of medical devices such as weighing scales, blood pressure monitors, pulse-oximeters, thermometers, ECG monitors, equipment such as fitness machines, imaging systems, and glucose meters. Also, there is a need to integrate patient-specific data from other sources such as web resources, social network feeds, and mobile devices.

Apart from data integration, there is another issue, that healthcare organizations need to focus on- the structure of data. Data collection and device interface are not going to bring in results unless the composition and structure of data are clearly understood. Until data analysts can understand the structure, intelligent technologies such as complex event processing, correlation, and automated reasoning can be put together to gain valuable insights.

Flexibility of Applications:

As new techniques, healthcare models, analytics, and use cases evolve, innovative medical devices with upgraded capabilities will be developed. Newer software components and applications need regular upgrades by experts with detailed medical domain and technology expertise. Most of the applications are in the form of devoted in-built 'apps' created to reduce the challenges faced by the healthcare industry. There is a need to produce ecosystems and platforms that can sustain such an innovative health technology.

Need for Medical Expertise:

The diagnosis and communication of medical data to healthcare providers are directed by regulations. The inability to understand data captured from various medical devices, with patients trying to analyze themselves based on improper understanding, can lead to major perils. Every prognosis and diagnosis bases itself on present observations made by devices, as well as using the health profile and history of the individual patient. Thus, healthcare organizations need to adopt new techniques and better medical expertise for proper patient care management.

Interoperability Demands Reach a New High:

Healthcare reform is creating an increasing focus on data analytics creating havoc among healthcare providers and other stakeholders. Thus, providers need to move towards a standard and open-based product instead of a proprietary system.

Scale, Data Volume and Performance:

As the accuracy and quality of medical devices increase, more apps will be developed for the increasing user base. The amount of data to consume, store, and analyze is also likely to increase. Similarly, existing medical devices need to store data in high resolution, which can generate multimedia output such as high-resolution videos and images. This will altogether lead to an archetypal 'big data' issue where the total velocity and volume of data consumed will make typical legacy platforms and architectures insufficient. Thus, the database backend and applications need to be impeccably developed, as operations are likely to become more complex.


The Usability of the Connected Device:

Nowadays, wearables are all the rage. Devices measure sleep, track glucose levels, maintain knee health, and much more. However, people are not going to wear 50 devices at a single time. Therefore, companies need to focus on an integrated use case, thus creating a sustainable market.

Security:


HIPAA compliance is essential in healthcare. Healthcare organizations are legally required to maintain the security and privacy of patient data. The Healthcare sector does not currently have integrated methods on how to manage such huge data sets. When making medical data accessible to a group of people, healthcare organizations need to take stringent steps to ensure the integrity and security of their data.





 **60 BPM**
Pulse

 **115 mm Hg**
BP

 **99.3°C**
Temperature

 **135 mg/dL**
Cholesterol

 **200 mg/dL**
Blood Glucose

 **45 kg**
Weight

CONCLUSION – INCORPORATING THE IoT INTO HEALTHCARE

IoT and big data analytics are reshaping healthcare. IoT technology is proving to be very promising and is being widely adopted within society. Healthcare system developers are vigorously devoting their efforts and talent to R&D for such technology advancement, which would finally serve large health populations. Big data analytics and IoT technology aim towards healthy and sustainable living outcomes.

Successfully harnessing and capitalizing on the ever-expanding data landscape is of critical importance in the era of IoT. Big data insights create opportunities to improve patient management and treatment pathways, optimize the use of pharmaceuticals and treatment modalities, and increase profitability – all while delivering improved patient outcomes and experiences.

Healthcare is becoming more accessible and affordable through

data-driven innovation. Cloud analytics and IoT are crucial for integrating data and improving patient care. Organizations must adopt these technologies to stay competitive.

To maintain a competitive advantage, healthcare organizations will have to harness the power of IoT and adopt IoT-driven processes and systems. This innovative model of healthcare, which deeply relies on data analysis, is all set to change the way health services are being delivered. The patient-centric transformation is being powered by the need for innovation in healthcare.

IoT is here to stay and will continue to evolve fast, leading to positive and impactful changes for all stakeholders in the healthcare industry.

About Scalable Health

Scalable Health is healthcare division of Scalable Systems focused on providing innovative products and solutions in healthcare and life sciences market.

www.scalablehealth.com

About Scalable Systems

Scalable Systems is a Data, Analytics & Digital Transformation Company focused on vertical specific innovative solutions. By providing next generation technology solutions and services, we help organizations to identify risks & opportunities, achieve sales and operational excellence to gain an innovative edge.

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