



# **TATA ELXSI**

## CONNECTED MEDICAL DEVICES: A CASE FOR REMOTE PATIENT MONITORING

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## Abstract

Remote Health Monitoring (RPM) provides patients an opportunity to be more involved in the management of their health wherein caregivers can monitor vital information such as heart rate, blood pressure, oxygen level, etc., remotely. As hospital beds become a prized commodity in many countries, RPM can help doctors discourage unwarranted hospital stay and prevent readmission and physical appointments. RPM will be more crucial than ever because of the global covid-19 outbreak as it allows physicians to provide consultation and treatment to the patients without coming in contact with them and thus preventing the spread of the novel coronavirus. Global businesses are monitoring the emerging signs of a possible new order in the post-covid-19 world and starting to invest in RPM to address the galloping rise in the demand of the telehealth landscape.

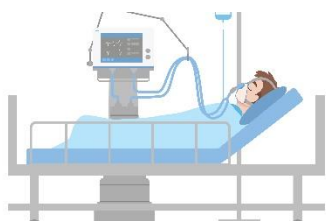
## Introduction

Telemedicine is one of the fastest developing areas in the healthcare sector. The advancements in telecommunication technology have enabled multiple telemedicine use cases that equally benefit healthcare service providers and patients. One of the critical components of telemedicine is remote patient monitoring that allows monitoring of patients outside of conventional clinical settings. With the rise in the overall population, aging population, lifestyle diseases, and healthcare service price, remote patient monitoring offers the resource, cost, and time benefit to both service providers and patients, and more so in the pandemic situation such as the covid-19 outbreak. As the nations across the globe are discouraging hospital visits for regular consultation and deferring medical procedures for non-critical conditions, healthcare providers are beginning to invest in telehealth for remote consultation and chronic conditions monitoring. As telemedicine is becoming an integral part of various national healthcare strategies to combat covid-19, the demand for remote patient monitoring devices that are interoperable with the service provider's telehealth infrastructure is bound to rise. Hence, medical device manufacturers must invest in technological advancements such as miniaturization, mobile-enabled RPM, cybersecurity, and interoperability to provide a seamless experience to users at both ends of the spectrum.



## Overview of Remote Patient Monitoring

According to the American Heart Association (AHA), “RPM is a subset of telehealth that facilitates patient monitoring as well as the timely transfer of patient-generated data from patient to care team and back to the patient.” The remote patient monitoring system comprises of portable devices for monitoring either vital signs such as blood pressure, heart rate, temperature, etc. or other health parameters such as blood glucose, cardiac rhythm, respiratory, etc. in remote or home-care settings, and a system to electronically transmit relevant information securely to the care provider for assessment and recommendations.



### Vital Sign Monitors

- Pulse Oximeters
- Temperature Monitor
- Blood Pressure Monitor
- Brain Monitoring (EEG)
- Heart Rate Monitor (ECG)
- Respiratory Rate Monitor



### Special Monitor

- Blood Glucose Monitor
- Respiratory Monitor
- Anesthesia Monitors
- Cardiac Rhythm Monitor
- Fetal Heart Monitor
- Multi-Parameter Monitor
- Prothrombin Monitor
- Others

Most specifically, the RPM system is used to cease or decrease the progression of chronic diseases and improve rehabilitation after being discharged from acute care. RPM system enables the use of ambulatory medical devices by patients and supports patients in need of chronic treatment, post-discharge care, or senior care. RPM has the power to improve the quality of care by enhancing doctors' ability to treat more patients anywhere at any time. Additionally, it also enables simultaneous monitoring of a group of patients by one doctor, or by a group of doctors.

### Mobile-enabled Remote Patient Monitoring (mRPM)

Mobile-enabled remote patient monitoring, a technology praised as both more powerful and cost-effective than traditional telephone RPM, is now being leveraged by more and more doctors. mRPM uses notifications to prompt patients to enter important data and provides large group and solo practitioners with nearly immediate clinical and financial value with little need for additional care staff. By serving as an automated scheduler that uses push notifications to prompt patients to enter requested biometric, objective, and subjective data, mRPM allays many doctor's apprehensions. At a time and place convenient for them, patients can then respond.

Once the information has been transferred, before determining if the findings warrant a face-to-face visit or phone call, a physician can seamlessly view and interpret the information. mRPM will greatly improve contact between physicians and patients with a dashboard for the doctor's practice and a patient-friendly mobile app for check-ins. Furthermore, without overburdening care staff, patients become more conscious and involved in their own care.

One of the biggest benefits of mRPM is that since smartphones and mobile devices are already so commonly used, mRPM doesn't require the patient to buy or learn a new device or specialized equipment. Many older adults, primarily due to the high prevalence of chronic diseases, derive positive ROI from RPM technology and home-based treatment.

As per the study conducted by Consumer Technology Association (CTA) in 2019, the healthcare workers indicated that the biggest benefits of using RPM to manage health include improved patient outcomes (48%), improved compliance rates (43%), and patients taking increased ownership over their health (41%). The researchers observed that among patients, the top three benefits were detailed information on personalized care (43%), faster access to health care services (42%), and more influence over their own well-being (37%). The survey results also revealed that over half (52%) of the consumers reported that they would use an RPM device as part of their treatment if a doctor made the recommendation.

Key benefits of RPM include:

- Convenience and cost savings in healthcare
- Preventing hospitalization and allowing physicians to handle their time better
- Boost follow-through for patients.

A research performed by the Medical Center of the University of Pittsburgh found that RPM decreased the likelihood of hospital readmissions by 76%. In addition, the researchers found more than 90% of technology and patient satisfaction ratings.

### RPM Market

The global Remote Patient Monitoring market is forecasted to grow at a rate of 14.1% from USD 786.4 Million in 2019 to USD 2.14 Billion in 2027.

Special monitors are further segmented into too many different devices, which held 87.4% of the overall share of the remote patient monitoring industry. Advanced technological features such as iPad connectivity and other wireless communication allow early diagnosis and higher adoption of the products.

The spread of the novel coronavirus has increased the risk of virus infections and has created more awareness against other viruses. The monitoring of patients from remote areas to limit virus spread has increased the demand for the product.

North America held the largest market share of 38.3% in 2019. The increased dominance is attributed to rising in cardiac diseases, the sedentary lifestyle, and the initiation of e-health in certain rural regions. The role of the government in introducing Telehealth in rural areas and the major players in the region further drive the market growth. The market for RPM in Europe is expected to be the second-largest. The paradigm shift towards more continuous and organized healthcare monitoring is expected to be the key factor for the growth of the market. The healthcare system is battling with an increased geriatric population globally. The recently developed remote patient monitoring is the most effective and globally accepted technology that aids patients across the world, especially in the Asia-Pacific region. Unchecked populations in China and India and an increase in the geriatric population in countries such as Japan and Singapore are factors influencing the market.

Asia Pacific is anticipated to grow with a CAGR of 14.6% during the forecast period. The region provides untapped opportunities due to emerging nations such as India and China. A rise in medical tourism and constant improvement in healthcare infrastructure is expected to propel the demand of the market.

### Healthcare industry trends driving the growth of RPM market

#### Shift in demographics

The 2019 revision of the United Nation's World Population Prospects estimated the global population of 7.7 billion. It is expected to rise to 8.5 billion by 2030 and 9.7 billion by 2050. As life expectancy is increasing year on year, the world population is bound to grow older. For the first time in history, in 2018, persons aged 65 and above outnumbered children under 5 years of age. The rise in the aging population and the prevalence of chronic or lifestyle diseases are boosting the demand for RPM systems for home care.

#### Shift to value-based and patient-centric care

The healthcare service provider industry is moving towards value-based care by shifting the focus from financial incentives to rewards based on how patients fare rather than by the number of visits. 85% of the health system and hospitals have invested or are planning to invest in remote patient monitoring technology that can significantly contribute to value-based care. For example, the collection of patient's vital data via Bluetooth enabled glucose meter or blood pressure monitor connected to a mobile app for sharing information securely with the care provider. The transition to value-based care can potentially help patients with chronic disease avert the risk of hospital admission.

#### Big data analytics

Big data has made a remarkable impact on the healthcare industry in the field of oncology, neurology, cardiology, and other specialties. The extensive use of wearable devices and smartphones has helped in accumulating a large volume of patient-specific data.



Big data enables a way for healthcare professionals to utilize the population data for new research and personalized treatment opportunities. The remote monitoring system can help collect this information and play a crucial role in making the advanced analysis of health parameters using big data.

### **Internet of Medical Things (IoMT)**

IoMT is at the core of remote patient monitoring. IoMT for remote patient monitoring enables patients and healthcare providers to work together for more effective and faster monitoring of chronic disease management. This adds more value to care service provided to elderly patients, those who need constant supervision or urgent medical attention. There is growing popularity in using IoMT driven healthcare devices such as wearable medical devices that allow patient data to be continuously monitored and transmitted through cloud-based platforms.

### **Advances in wearable medical technology**

Wearable devices are used to remotely monitor a patient's physiological parameters. During the covid-19 pandemic, the wearable device has become the key component of the healthcare system. Wearable devices and sensors provide a large amount of data and insights that help doctors to improve treatment methods and understand the body behavior of the patients. This will help to compare the impact of the treatment in the clinic and remote monitoring conditions. Pharmaceutical companies are incorporating the use of wearable devices in their clinical trials for improved drug discovery cycle.

### **Remote monitoring systems in hospitals and eHealth**

Many hospitals have an electronic patient data management system (PDMS) to manage data of admitted patients including prescriptions, diagnostics, and analytical test results medical reports, etc. Technically well-equipped hospitals also have modern PDMS, which helps to collect data in real-time such as cardiac monitors, pulse oximetry, blood pressure, etc. This helps doctors to fully optimize patient care eventually leading to a significant amount of time-saving and reduced unnecessary readmissions. Many modern hospitals are planning to implement the concept of "ICU without walls" where the patient is admitted to a hospital close to their family that provides physiological comfort by using remote monitoring to treat patients as if they are in ICU.



## Why remote patient monitoring is critical during and after Covid-19?

At the start of 2020, there was limited adoption of remote patient monitoring by patients and hospitals, despite the availability of technology. Even the healthcare system with relatively high telehealth adoption had low telehealth utilization. Reasons such as lack of reimbursement opportunities, incentives for providers, adaptability by old age patients to new technology, and awareness or knowledge of using RPM led to the inadequate adoption of telehealth.

With the global outbreak of covid-19 in February 2020, the need to adopt innovative digital health technologies has increased. Healthcare received a huge focus and more investment poured into the telehealth sector compared to previous years as healthcare systems witnessed a sudden surge in telehealth utilization.

The sudden change in the healthcare landscape led the industry to revise its RPM market projections and now the global RPM market size is expected to double in the next five years.

As covid-19 spread rapidly across the world and global healthcare infrastructure became overwhelmed with covid-19 cases, the applications of RPM technology are becoming more apparent. Some of the reasons which are leading to the sudden surge in demand for RPM systems are:

- Monitoring of high-risk patients outside the clinical setting
- Minimal need for non-essential in-person visits
- Reduction in the cost involved in the treatment of patients
- Optimization of clinical staff utilization as it reduces the need to address the patients frequently
- Detection of early warning signs for covid-19 symptoms through the symptomatic behaviors of patients

Before covid-19, very few healthcare service providers were adopting digital health. The current pandemic and increased health crisis have served as an impetus to adopt RPM program implementations. More than ever before, telehealth has become a crucial component of the global healthcare strategy to combat covid-19 as many countries' healthcare systems are running out of space to admit new patients. Telehealth services are reducing an individual's exposure to covid-19 by restricting hospital visits of non-critical cases and thus ensuring that the limited healthcare professionals are addressing the most critical and urgent needs.

The post-pandemic world would see a significant care-debt due to deferred medical and surgical treatments that will eventually lead to the surge in demand on constrained healthcare systems. Telehealth is not only sustaining the continuity of outpatient patient care during the pandemic but also presents a strong case for addressing downstream consequences in the post-pandemic recovery phase.

## The Future of Healthcare

According to IBISWorld, the telehealth industry's revenue has grown 34.7% from 2014 to 2019, the market size in 2019 was around \$45 billion but it is projected to grow to more than \$175 billion by 2026. In a study conducted by Consumer Technology Association (CTA) in 2019, 68% of the physicians strongly recommended the use of RPM technologies and 52% of consumers said they would use connected health devices if recommended by the doctors.

Although many healthcare systems were adopting digital health technologies, the limited utilization of services restricted service providers from realizing its full potential. According to a 2017 study conducted by Avizia, 82% of US consumers did not use telehealth services. Covid-19 disrupted the status quo in healthcare service delivery as the growth in demand for RPM technologies started stemming out of necessity. The pandemic is making patients and caregivers accustomed to telehealth services and it might become a standard form of healthcare service delivery across various care settings for years to come.

As of this writing, more people are experiencing benefits such as time and cost-saving due to less travel, faster service, and shorter wait times. Telehealth and RPM are redefining patient expectations in all aspects of quality healthcare. As telehealth service reimbursement and payment parity for providers are enforced, virtual care would become ubiquitous. Patients are becoming accustomed to telehealth and in the future, they will be able to choose their providers, health systems, and hospitals based on telemedicine access.

## Conclusion

Remote patient monitoring has become more crucial than ever, and its utility has gone beyond leaps and bounds. While hospitals are prioritizing the treatment of the sickest of the sick, physicians are using RPM to treat outpatient without coming in contact with them and thus preventing the spread of the novel coronavirus. With advanced technology and improvement in wearable devices and sensors, home-hospitalization will be a common practice, which will eventually reduce the cost and time burden for both patients and healthcare service providers. Trends such as miniaturization, IoT enablement, big data analytics, and predictive intelligence will help doctors to treat patients remotely as well as provide early signs of health parameter variations for proactive and urgent care. In times of growing care-debt, the advancements in RPM will continue to have a positive impact on both patients and healthcare service providers.



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## ABOUT TATA ELXSI

Tata Elxsi, a part of Tata Group, is amongst the world's leading providers of design, engineering, and regulatory compliance services. With 15+ years of experience in catering to medical device and healthcare companies, Tata Elxsi has built a broad services and solutions portfolio that adds value at every stage of the customer's product development lifecycle.

Tata Elxsi is an established name in technology consulting, new product design, development, verification and validation, and regulatory compliance services. Tata Elxsi also provides solutions and services for emerging technologies such as IoT (Internet of Things), Big Data Analytics, Cloud, Mobility, Virtual Reality, Cognitive Computing, and Artificial Intelligence (AI).

Tata Elxsi has a global presence and is supported by a talent pool of over 6,500 employees, a network of ISO 13485 certified design and development centers, and a robust ecosystem of technology, manufacturing, and internationally accredited testing partners.

For more information, please visit [www.tataelxsi.com](http://www.tataelxsi.com) click here



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