Telehealth and remote monitoring for geriatric patients

Ankita Dudhal[1]*, Santosh Palwe[2], Darshita Makhija[2], Rohit Khandare[2]

[1]Department of Pharmacology, Dr. D. Y. Patil College of Pharmacy, Akurdi-Pune
[2]B. Pharm, Dr. D. Y. Patil College of Pharmacy, Akurdi-Pune
Email: ankitadudhal@dyppharmaakurdi.ac.in

Abstract

Telehealth, also known as telemedicine, offers the convenience of consulting with healthcare professionals remotely via computer, tablet, or smartphone. A key aspect of telehealth is Remote Patient Monitoring (RPM), which involves using digital devices to track patients' health metrics from home. These devices include blood pressure monitors, glucose meters, scales, and pulse oximeters. RPM is considered a vital part of early intervention and preventive care, especially beneficial for older adults with chronic health conditions. Despite its advantages, older adults often face challenges with complex equipment. This study explores how an integrated, real-time monitoring system is perceived by older individuals, both with and without chronic conditions. It evaluates the system's user-friendliness and adherence over time, and compares it to other market devices, highlighting their benefits.

Keywords: Remote patient monitoring, real-time monitoring, telehealth, adhered

1. Introduction

In remote geriatric care, telemonitoring leverages technology to track elderly patients' health from afar. This approach employs wearable sensors, smart home devices, and communication tools to monitor health parameters and provide timely interventions. The technology enables continuous oversight of vital signs, activity levels, medication adherence, and other health indicators without frequent hospital visits. Telemonitoring is particularly beneficial for older adults with limited mobility or who live in remote areas. It supports chronic disease management by facilitating early diagnosis, timely treatment, and improved overall care quality. Given the prevalence of chronic conditions among seniors, digital health technologies are crucial in early detection and intervention. By enabling clinicians to monitor patients' vital signs between in-person visits, telemonitoring helps verify the effectiveness of treatment plans and make necessary adjustments. This continuous monitoring is invaluable as the senior population grows. However, even if RPM devices are user-friendly, patient education and training are essential to ensure effective use and maximize the benefits of remote monitoring. This review enlightens the system's role, benefits, and some limitations (1,2).

1.1. Telemonitoring in various diseases

Many illnesses, including dementia, Parkinson's disease, and Alzheimer's disease in cases of hearing and vision loss, can benefit from telemonitoring. Moreover, chronic conditions like diabetes, renal disease, and disorders connected to CVS are treated with it (3).

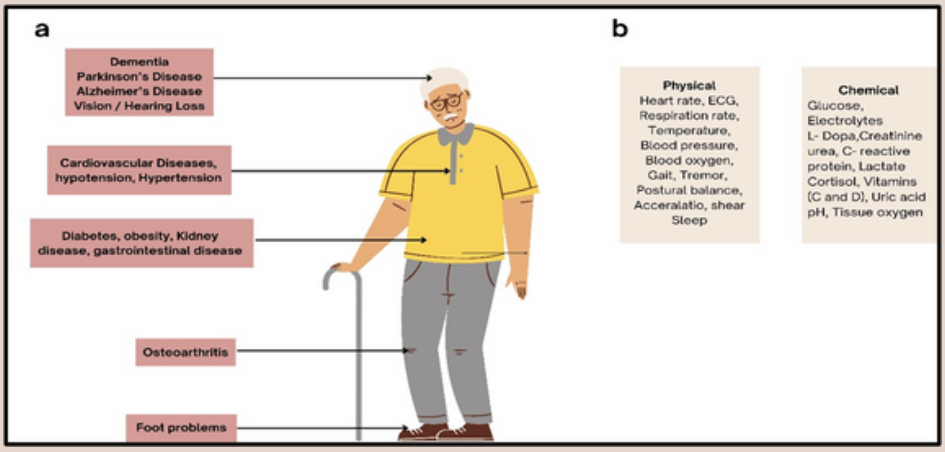

Figure 1. Tele-monitoring in various diseases

1.1.1. Devices Used in Telehealth

1.1.2. Apple watch

Apple Watch monitors heart rates in the background for anomalies that might indicate a significant underlying illness. The patients may be able to identify circumstances that call for more testing with this assistance (4).

1.1.3. Oura ring

The Oura smart ring analyses breathing and heart rate using an infrared photo-plethysmography sensor (PPG) on one or both sides of the finger. The instrument utilizes LEDs to send light, and a photodiode to receive it, allowing it to detect how light pulses passing through your arteries reflect the rhythm of your heart (5).

1.1.4. Philips vital patch

The Vital patch biosensor is an adhesive patch positioned on the torso to record heart rate, variability, and electrocardiography (ECG). It incorporates a wireless transceiver, built-in sensors, and rechargeable batteries (6).

1.1.5. Wearable ultrasound patch

A wearable ultrasonic patch created by Vital Engineers can provide continuous, non-invasive monitoring of brain blood flow. For the first time in wearable technology, the soft, flexible patch may be worn comfortably on the temple to offer three-dimensional data on cerebral blood flow.

1.1.6. Mobile cardiac outpatient telemetry ECG sensor

With mobile cardiac telemetry (MCT), patients can receive real-time ECG monitoring while not in the hospital. For up to 30 days, the patient wears a device that continuously records ECG (electrocardiogram) data, 24 hours a day.

1.1.7. Dexcom CGM

An FDA-approved wearable that continually monitors your blood sugar levels day and night is the Dexcom CGM system. Your glucose number is sent to your smartphone, smart devices, or receiver every five minutes. Dexcom CGM devices then translate your reading into dynamic reading so you may optimize your diabetic treatment.

1.1.8. Orpyx Insoles plantar pressure sensor

For patients requiring preventative care, the Orpyx SI® Flex Sensory Insoles monitor plantar pressure, adherence, step count, and temperature data to lower the likelihood of plantar problems (7,8).

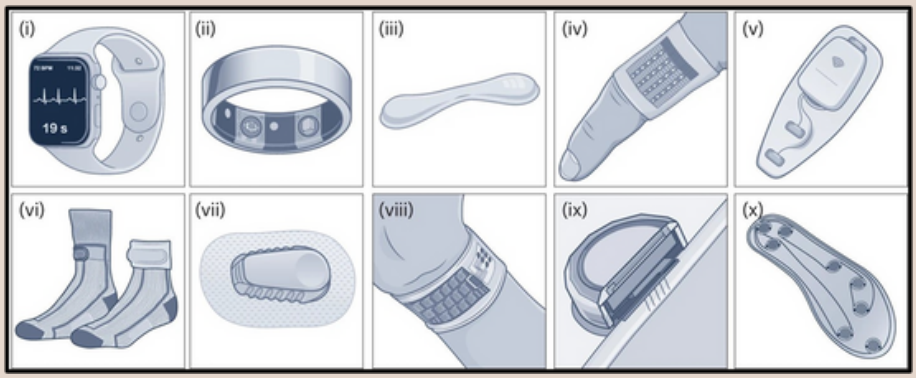

Figure 2. Devices used in telehealth (9)

2. Role of RPM in elderly care

One useful technique that enhances the quality of care for the elderly is remote patient monitoring. It is essential to provide care to the elderly.

- RPM continuously tracks vital signs such as weight, blood pressure, and blood sugar. These data enable healthcare professionals to create individualized treatment plans and change prescription regimens.
- RPM's continual monitoring helps to spot concerning trends in vital signs early on. By detecting problems early, complications can be avoided.
- Elderly patients can get care from home thanks to remote patient monitoring, greatly reducing the need for regular in-person check-ups.
- RPM optimizes the time and resources of healthcare providers by enabling them to monitor more patients remotely.

3. Benefits

The positive impacts of RPM as seen by medical professionals:

- Patient data preservation facilitates the visualization of long-term health patterns and aids in formulating optimal treatment strategies.
- Patient confidence may rise as a result of monitoring.
- Alerts resulting in timely and effective communication.
- Patients who are expected to manage themselves may benefit from telemonitoring (10).

4. Challenges

4.1. Data accuracy and availability in real-time

Presumably, the accuracy of data retrieved remotely presents the most complicated challenge. Patient and medical staff scrutiny is applied to many of these. Patients who are used to more conventional approaches find it hard to believe that a tiny device can give them excellent health information that they can share with their physicians. Similarly, decision-making by front-line medical service providers based on data gathered via conventional techniques is simple.

4.2. Data security and protection

The data's security and protection are as important as its availability and correctness. Healthcare standards must be followed in this situation. Effective data management procedures are also crucial. Third parties typically handle a sizable portion of data management, which presents a risk to the privacy of individual user information.

4.3. Selection of sensors and devices

Incorporating wearable technology and sensors is a standout feature of any remote health monitoring system (RHMS). They could come in a range of shapes and sizes. Every sensor could be critical in one disease while having no bearing in another. Choosing the right sensors is a complex process impacting the system's efficiency (11,12).

4.4. Detection of concept drift

Machine-learning algorithms are utilized in RHMS to create prediction models across edge layers, cloud, MEC, and fog. These models are developed using past medical records from various patients to forecast falls, strokes, fall detection, and various patient-related illnesses. These models do not, however, provide accurate long-term predictions.

5.Applications for remote patient monitoring

5.1. Remote vital signs surveillance

Vital signs like blood pressure, heart rate, and oxygen levels can be tracked by devices like wearable sensors or monitors placed in homes. Early health issue detection is made possible by the real-time transmission of this data to healthcare providers.

5.2. Adherence to medication

Through automatic warnings, telemonitoring systems can help elderly people remember to take their medicines on time. This enhances the patient's compliance with recommended therapy.

5.3. Management of chronic diseases

By utilizing ongoing data, medical professionals can alter treatment plans and reduce the likelihood of consequences for senior citizens.

5.4. Fall prevention and identification

When falls or alterations in a person's behaviour are detected by sensors, caretakers or emergency services may be notified. This lowers the chance of damage and encourages faster reaction times (13,14).

5.5. Virtual consultations

Virtual meetings with medical professionals are made possible by telemonitoring, and these sessions are beneficial for senior patients who might find it difficult to travel to consultations. This lowers healthcare expenses and improves access to healthcare services.

5.6. Improved quality of life

Elderly individuals may feel more independent and at ease knowing their health is always being watched thanks to remote health status monitoring.

5.7. Early intervention and hospital readmission reduction

Early intervention is made possible by the timely discovery of health deterioration, which may lessen the requirement for hospital stays and enhance overall health outcomes (15).

6. Examples of RPM for the elderly

Many alternatives are available in the telehealth and remote monitoring technology landscape for seniors, all intended to address different areas of senior care. Envoy Thome is one example, which uses door and motion sensors to dramatically lower the risk of falls in elders and reduce fall-related injuries by an astounding 40%. Since falls are the most common cause of injuries among older individuals, this approach is constructive in addressing a vital need that remote monitoring can significantly impact. Other telehealth options, as important for senior care, concentrate on medication administration, emergency response, and fall prevention. For example, Rest Assured utilizes expert camera monitoring to achieve a thirty percent faster response time during emergencies in senior living homes. This quick intervention may save a life when medical emergencies or other situations require immediate action (16,17).

7. Conclusion

The analysis indicates that medical professionals view telemonitoring as a helpful tool that is becoming more relevant for patient care, and a significant number of them believe that it is suitable for their environment. Medical experts frequently discussed the value of using different technologies to treat different patients, and they outlined several ways that telemonitoring could enhance patient outcomes and customize therapy. Even though telemonitoring is widely regarded favorably, healthcare experts continue to be concerned about several RPM features. As it becomes an essential strategy in contemporary healthcare, this platform might be improved by addressing these problems.

References

1. Rashid MM, Khan SU, Eusufzai F, Redwan MdA, Sabuj SR, Elsharief M. A Federated Learning-Based Approach for Improving Intrusion Detection in Industrial Internet of Things Networks. Network. 2023 Jan 30;3(1):158–79.
2. Mao A, Tam L, Xu A, Osborn K, Sheffrin M, Gould C, et al. Barriers to Telemedicine Video Visits for Older Adults in Independent Living Facilities: Mixed Methods Cross-sectional Needs Assessment. JMIR Aging. 2022 Apr 19;5(2):e34326.
3. Gay V, Leijdekkers P. Bringing Health and Fitness Data Together for Connected Health Care: Mobile Apps as Enablers of Interoperability. J Med Internet Res. 2015 Nov 18;17(11):e260.
4. Song J, Zhou T, Liang Z, Liu R, Guo J, Yu X, et al. Electrochemical Characteristics Based on Skin-Electrode Contact Pressure for Dry Biomedical Electrodes and the Application to Wearable ECG Signal Acquisition. Chien YR, editor. Journal of Sensors. 2021 Jan;2021(1):7741881.
5. Grifantini K. Tracking Sleep to Optimize Health. IEEE Pulse. 2020 Sep;11(5):12–6.
6. Tonino RPB, Larimer K, Eissen O, Schipperus MR. Remote Patient Monitoring in Adults Receiving Transfusion or Infusion for Hematological Disorders Using the VitalPatch and accelerateIQ Monitoring System: Quantitative Feasibility Study. JMIR Hum Factors. 2019 Dec 2;6(4):e15103.
7. Blount M, Batra VM, Capella AN, Ebling MR, Jerome WF, Martin SM, et al. Remote health-care monitoring using Personal Care Connect. IBM Syst J. 2007;46(1):95–113.
8. Haimi M, Gesser-Edelsburg A. Application and implementation of telehealth services designed for the elderly population during the COVID-19 pandemic: A systematic review. Health Informatics J. 2022 Jan;28(1):146045822210755.
9. Chen C, Ding S, Wang J. Digital health for aging populations. Nat Med. 2023 Jul;29(7):1623–30.
10. Dritsas E, Trigka M. Stroke Risk Prediction with Machine Learning Techniques. Sensors. 2022 Jun 21;22(13):4670.
11. Kalid N, Zaidan AA, Zaidan BB, Salman OH, Hashim M, Muzammil H. Based Real Time Remote Health Monitoring Systems: A Review on Patients Prioritization and Related “Big Data” Using Body Sensors information and Communication Technology. J Med Syst. 2018 Feb;42(2):30.
12. Gellis ZD, Kenaley BL, Have TT. Integrated Telehealth Care for Chronic Illness and Depression in Geriatric Home Care Patients: The Integrated Telehealth Education and Activation of Mood (I-TEAM) Study. J American Geriatrics Society. 2014 May;62(5):889–95.
13. Marko KI, Krapf JM, Meltzer AC, Oh J, Ganju N, Martinez AG, et al. Testing the Feasibility of Remote Patient Monitoring in Prenatal Care Using a Mobile App and Connected Devices: A Prospective Observational Trial. JMIR Res Protoc. 2016 Nov 18;5(4):e200.
14. Biese K, Handler SM, Wardlow L, Agha Z. Telehealth with older adults: Getting it right. J American Geriatrics Society. 2022 Dec;70(12):3359–61.
15. Ahmed S, Irfan S, Kiran N, Masood N, Anjum N, Ramzan N. Remote Health Monitoring Systems for Elderly People: A Survey. Sensors. 2023 Aug 10;23(16):7095.
16. Gama J, Medas P, Castillo G, Rodrigues P. Learning with Drift Detection. In: Bazzan ALC, Labidi S, editors. Advances in Artificial Intelligence – SBIA 2004 [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2004 [cited 2024 Jul 30]. p. 286–95. (Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, et al., editors. Lecture Notes in Computer Science; vol. 3171). Available from: http://link.springer.com/10.1007/978-3-540-28645-5_29
17. Ilali M, Le Berre M, Vedel I, Khanassov V. Telemedicine in the primary care of older adults: a systematic mixed studies review. BMC Prim Care. 2023 Jul 20;24(1):152.