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The Role of Technology in Enhancing Domiciliary Care: A Review of Strategies for Reducing Healthcare Costs and Improving Safety for Aged Adults and Carers

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Abstract
Chronic diseases are on the rise worldwide, and populations are ageing at an unprecedented rate, putting increasing pressure on healthcare systems. Domiciliary care (care at home) has become an essential alternative to traditional healthcare settings, allowing individuals to access the care they need without having to leave their homes. This paper reviews the literature on how technology can support domiciliary care, particularly for older adults. The aim is to identify and assess technologies that can improve patient safety, reduce caregiver burden, and lower healthcare costs. The paper discusses a range of technologies, including telehealth platforms, remote monitoring devices, assistive technologies, and smart home systems. These technologies can support a variety of functions, including remote consultations, medication reminders, fall detection, and real-time communication between patients, carers, and healthcare professionals. The paper argues that the strategic implementation of these technologies in domiciliary care can help to reduce hospital readmissions, shorten inpatient stays, and prevent avoidable health crises. The paper uses a literature review and case studies to highlight the economic and social benefits of technology-enabled home care. It also considers the ethical, data privacy, and accessibility challenges associated with widespread adoption, advocating for the design of user-friendly and accessible technology solutions.
Keywords: Domiciliary care, Technology-enabled care**,** Telehealth**,** Remote patient monitoring**,** Elderly care

1.0 Introduction

The global healthcare landscape is facing a crisis precipitated by the interplay of several convergent forces. The two major drivers transforming healthcare today include the rapid expansion of the elderly population and the widespread occurrence of chronic diseases, which healthcare systems struggle to manage sustainably. As such, domiciliary care has received growing attention as a model of care with the potential to provide high-quality care more efficiently and sustainably.

Domiciliary care involves the provision of care and support to people in their home environments. This can include medical care, rehabilitation, assistance with activities of daily living (ADLs), and other supportive services. Domiciliary care has several advantages over institutional care. It has been shown to improve quality of life and independence and reduce the burden on hospitals and long-term care facilities. In addition, domiciliary care is often preferred by patients and families.

Nevertheless, the provision of safe and effective domiciliary care is not without its challenges. These can include patient safety and quality of care concerns, care coordination among multiple providers, and caregiver burden. Caregiver burden is particularly pronounced when informal caregivers (such as family members) are required to provide care in addition to their other responsibilities. In recent years, advances in technology have emerged as a potential game-changer for domiciliary care. Solutions such as telehealth, remote health monitoring, and other assistive and smart home technologies can significantly extend the reach and impact of domiciliary care services. These can help to enhance patient safety, improve care coordination and efficiency, and reduce costs.

Telehealth, which involves the remote delivery of healthcare services via digital communications, is one such technology. Telehealth can be used to provide medical consultations, continuous remote patient monitoring, and other services to patients in their homes. Remote health monitoring technologies, such as wearable devices and smart home sensors, can also play a critical role in domiciliary care. These can be used to collect real-time data on a patient’s vital signs, activities, and other health metrics. This information can be used to monitor a patient’s condition, detect early warning signs of health deterioration, and enable early interventions. Assistive technologies, such as smart home automation systems, can also help to improve safety, accessibility, and independence for patients receiving domiciliary care.

Caregiver burden is another significant concern in domiciliary care. Informal caregivers, such as family members and friends, often provide a substantial amount of the care for people receiving domiciliary care. These caregivers can face significant physical, emotional, and financial strain, particularly if they are required to provide care on top of other responsibilities. Technology can help to reduce caregiver burden in several ways. For example, telehealth and remote patient monitoring can reduce the need for in-person visits and consultations. At the same time, smart home automation and assistive technologies can make it easier for caregivers to provide care and support.

Together, these technologies have the potential to significantly improve the safety, efficiency, and quality of life for patients receiving domiciliary care, as well as for the caregivers supporting them. This paper presents a systematic literature review on the role of technology in domiciliary care, with a specific focus on how technology can help to support patient safety, reduce healthcare costs, and reduce caregiver burden. The review will cover recent advances in this area and will be supported by evidence from relevant policy reports and illustrative case examples. The review will provide an overview of the economic, social, and quality of life benefits of technology-enabled domiciliary care, as well as some of the ethical and implementation challenges that must be considered to ensure that these solutions are adopted equitably and sustainably.

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Remote Health Monitoring

In the contemporary world, poor diet and insufficient exercise, together with a rapidly ageing population, have contributed to a dramatic rise in the prevalence and cost of chronic diseases. Heart disease and stroke, obesity, diabetes, and asthma are among the leading diseases today. Cardiovascular disease is the number one cause of death globally, according to the WHO. Diabetes is also on the rise and is expected to be the seventh leading cause of death by 2030. Outdoor air pollution in industrial and urban areas also exposes populations to increased risks of cancer, respiratory diseases, and cardiovascular problems. As of today, 235 million people worldwide have asthma. In 2015, asthma alone was responsible for an estimated 383,000 deaths worldwide.

Despite their high prevalence and associated healthcare costs, early diagnosis and treatment can help prevent and manage chronic diseases, avoid costly hospitalizations and complications, and allow people to live longer, more active, and healthier lives. The main issues here are the shortage of healthcare professionals, tight budgets, and the rapidly growing demand for their services, which prevents health authorities and insurance companies from providing long-term and regular monitoring of patient health, to diagnose chronic conditions as early as possible. These are some of the reasons why cost-effective, virtually staff-less and unobtrusive healthcare systems are needed to help people, particularly older adults, to live longer, safer, and healthier lives.

Remote health monitoring (RHM) systems can be used to provide regular, continuous physiological data collection and store it for later analysis. RHM systems are built on wearable sensors and environmental devices as well as wireless communication networks, which can collect and transmit data on patient health status (such as body vitals, signs of a fall, physical activity, etc.) in real-time, without disrupting patients' lives. The data can be securely delivered to healthcare providers or caregivers, who can then use it for timely follow-up interventions. In addition, the system can analyze the long-term trends in health data to detect early warning signs of the patient's health deterioration and trigger early interventions.

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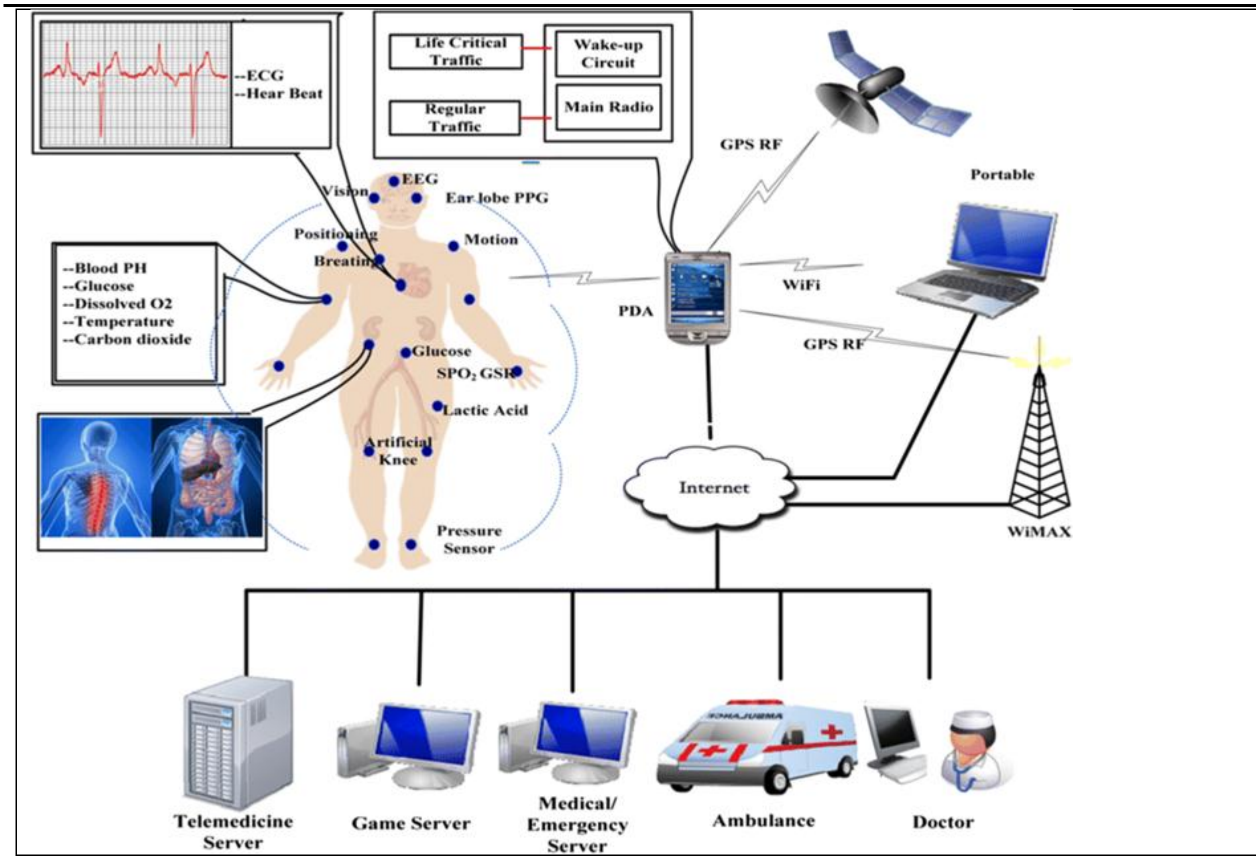

Figure 1: Wireless Body Area Network (WBAN) for wearable medical sensors.

Platforms for Remote Health Monitoring

One such platform is Envi-Bo, an embedded system designed to monitor and store patient vital signs and biomedical signals remotely. It also allows for direct patient-physician interactions. DexterNet is another open-source wireless body sensor network (BSN) that can be used for both in-home and outdoor real-time monitoring.

Technically, both systems use a similar three-layer architecture, which includes the following:

Body Sensor Layer (BSL) or Sensor Node Layer (SNL): This layer includes the sensors, which collect data.

Personal Network Layer (PNL) or Intermediate Node Layer (INL): This layer is responsible for processing and managing the data.

Global Network System (GNS) or Base Station Layer (BSL): This layer is responsible for global communications with healthcare providers and storage and further analysis of the data.

Table 1: Comparison of Remote Health Monitoring Devices

Device Type	Primary Function	Key Features	Advantages	Limitations
Wearable	Monitors vital	Heart rate, SpO_2,	Portable, user-	Battery life,

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Health Tracker	signs and activity	step count, sleep tracking	friendly, real-time data	data privacy concerns
Smart Home Health Sensor	Tracks environmental and physiological data	Temperature, air quality, movement detection	Non-intrusive, integrates with smart home systems	High initial cost, requires stable internet
Telehealth Kit	Enables remote consultations and monitoring	Video conferencing, data sharing, diagnostics	Improves access to healthcare, reduces travel	Dependent on user tech literacy
Fall Detection Device	Detects falls and sends emergency alerts	Accelerometer, GPS, automatic alert system	Immediate response to emergencies	Possible false alarms, device discomfort
Implantable Medical Device	Provides continuous internal health monitoring	Pacemaker, insulin pump, continuous glucose monitor	Accurate, continuous monitoring of chronic conditions	Invasive, requires surgical implantation

E-Health and M-Health

E-Health is the umbrella term used to refer to electronic or digital health. E-Health digitizes healthcare services such as e-prescriptions, e-supply chain management, and EHR management, using information and communication technologies (ICTs). Electronic health records (EHRs) can be used to store and share a complete medical history with a multidisciplinary healthcare team, to coordinate and facilitate team-based decision-making. Physiological data such as heart rate, blood pressure, respiration rate, and blood oxygen saturation, when measured in real-time, can also be continuously collected and securely stored in a central, encrypted database for analysis and timely access by healthcare providers, first responders, caregivers, and authorized family members. Theoretically, E-Health can deliver safe, effective, low-cost, and efficient healthcare with minimal errors. As E-Health is the foundation for M-Health, this section would be incomplete without a brief overview of mobile health (M-Health).

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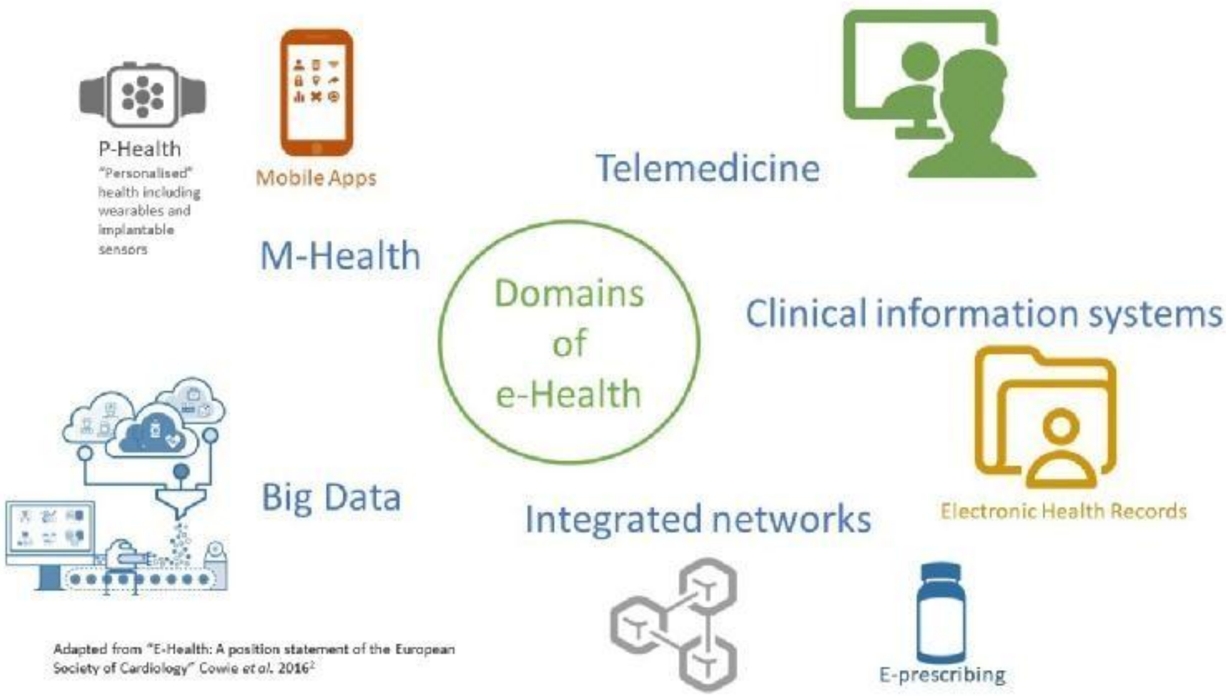

Figure 2. E-Health Infrastructure.

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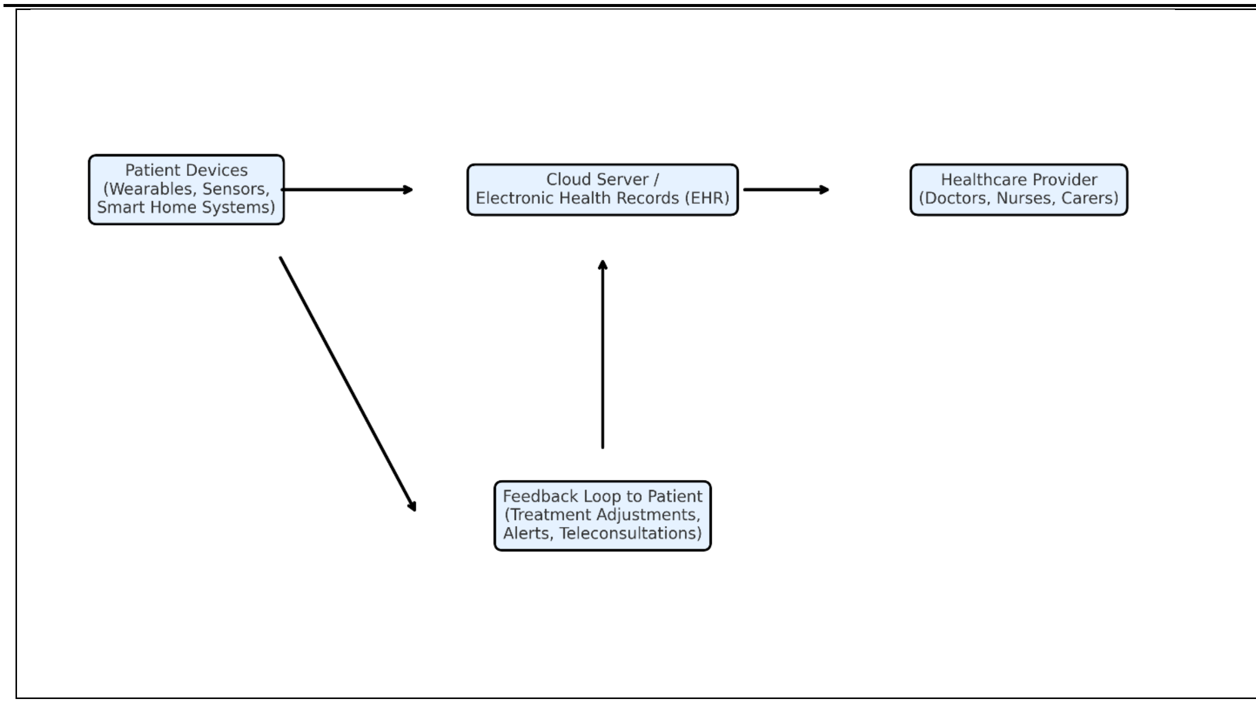

Figure 3: E-Health & M-Health Infrastructure

Mobile health (M-Health) refers to the set of mobile and wireless communication technologies such as EDGE, 3G/4G, and LTE, which can provide uninterrupted high-speed broadband communication. M-Health is essentially E-Health with the ability to be mobile. This mobile feature means that patients or healthcare teams can always be connected to the central healthcare system in real-time from anywhere.

M-Health environmental, biomedical, and motion sensors are placed at home, near the patient, or worn by the patient and collect the relevant data on health status and physical activities and pass it on to the gateway for transmission to the medical center. Wearable biomedical devices can be implanted on the patient (such as pacemakers and insulin injectors), worn on the body (electrodes for ECG or EEG), or placed nearby (gesture detectors, fall detectors).

Devices within the reach of a person are considered to be part of the body area network (BAN). BANs are capable of collecting and sending data to mobile devices and BAN gateways, as well as to a remote monitoring station directly. This can be a hospital, clinic, long-term care facility, or even a nursing home. In other words, with the aid of M-Health solutions, continuous monitoring can be achieved, and people can continue receiving care at home in an ambulatory manner, with their status being monitored by medical professionals in the background.

An example of a platform that makes use of this M-Health system is the HOMEBSD telemedicine system, which combines at-home vital sign monitoring with predictive analytics to detect early symptoms of health deterioration and involves wearable and nonwearable devices that connect to smartphones via Bluetooth and send data over wireless and cellular networks to medical servers. More innovations in the form of in-home wearables are being used for health monitoring. These can also be found in nonwearable smart home furniture like smart beds that

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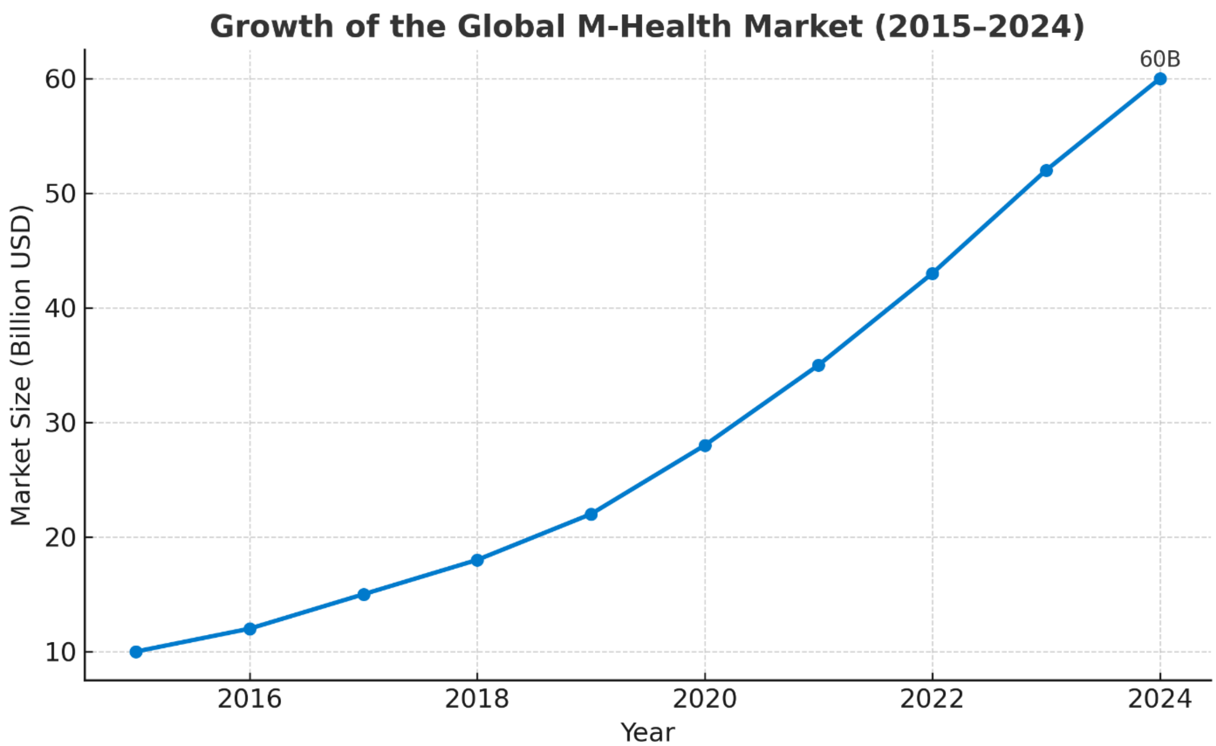
monitor sleep quality and detect possible cardiac events automatically, to trigger emergency alerts and reduce emergency response time.



Graph 1: Growth of M-Health Market Over Time

Internet of Things (IoT) & Connected Homes

IoT is a network of physical devices embedded with electronics, software, sensors, actuators, and network connectivity, which uses unique identifiers to enable these devices and systems to interact with each other and with people. It also allows objects to be sensed or controlled remotely across existing network infrastructure.

By combining miniaturized sensors and actuators, which are becoming cheaper and more energy-efficient, with the rapidly growing IoT, with almost all internet-ready devices like smartphones and tablets, it is becoming possible to start building innovative living environments. These environments can be integrated into the IoT and thus connected to the internet as a common communication infrastructure.

IoT systems can connect physical devices, household systems, and health-monitoring and assistive devices to the internet, and link them into an integrated network that supports automated control, real-time remote monitoring, and rapid first-response, all without the need for human interaction. IoT assigns a unique identifier to every object that is connected to the IoT infrastructure, turning each connected device into a data point and allowing data to be collected from and sent to each of these devices. This in turn creates a hyperconnected ecosystem of people and things that can support not only health but also home safety functions by, for

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example, sensing and monitoring environmental conditions, tracking activity and identifying unusual activity, and detecting and automatically responding to emergency events.

Significantly, in their report, NIC predicted IoT as one of the six disruptive and civil technologies to come that will substantially impact the nation’s critical infrastructure, people, and social systems. In this chapter, we will focus on an application of IoT in the context of smart homes and their implications for domiciliary care.

Table 2. Communication technologies for smart homes.

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Wireless Tech	Frequency	Range	DataRate	Power(mW)	Maximum Nodes	Network Topologies	Security
RFID	13.56MHz 860–960MHz	0–3m	640kbps	200	One at a time	peer-to-peer (P2P)passive	N/A
Bluetooth	2.4–2.5GHz	1–100m	3Mbps	2.5–100	1M+7S	P2P,star	56–128bitkey
BLE	2.4–2.5GHz	1–100m	1Mbps	10	1M+7S	P2P,star	128-bit AES
HomePlug GP	1.8–30MHz	~100 m	4–10Mbps	500	-	P2P, star, tree and mesh	128-bit AES
EnOcean	902,928,868 MHz	30–300m	125kbps	~0.05with energy harvesting	-	P2P,star,tree and mesh	128-bit AES
ZigBee	2.4–2.5GHz	10–100m	250kbps	50	65,533	P2P, star, tree and mesh	128-bit AES
WiFi	2.4–2.5GHz	150–200m	54Mbps	1000	255	P2P,star	WEP, WPA, WPA2
DASH7	315–915MHz	200m –2km	167kbps	<1	-	P2P, star, tree and mesh	128-bit AES
Insteon	RF:869.85, 915,921MHz powerline: 131.65KHz	40–50m	38kbps(RF) 2–13kbps (powerline)	-	64,000 nodes per network	P2P, star, tree and mesh	256-bit AES
Sigfox	868/902MHz	10–50km	10–1000bps	0.01–100	-	P2P,star	Node fault encryptio
NFC	13.56MHz	5cm	424kbps	15	One at a time	P2P	AES
Wireless HART™	2.4GHz	50–100m		10	-	P2P, star, tree and mesh	128-bit AES
6LoWPAN	2.4GHz	25–50m	250kbps	2.23	-	P2P, star, tree and mesh	128-bit AES
ANT 2.4–	2.5GHz	30m	20–60kbps	0.01–1	65,533 in one channel	P2P, star, tree and mesh	64-bit key
Z-Wave	860–960MHz	100m	9.6–100kbps	100	232	mesh	128-bit AES

Smart Homes in Healthcare

In this case, IoT technologies are used to link health-monitoring devices, smart homes, and other assistive and health safety systems to support and allow people to live independently, safer, and with reduced risks at home.

A smart home or an intelligent house is a connected home environment, where environmental, physiological, and activity-monitoring sensors are networked to automated systems and/or communications networks to help increase the safety, comfort, and health of the residents.
Intelligent systems that can be added to smart homes to support older adults and domiciliary care more generally include:

- Health monitoring devices;
- Safety and emergency systems (fall detectors, first-aid alerts, etc.);
- Assistive devices and robotics.
- Smart home systems (such as automated lights, smart locks, doorbells, heating systems, air conditioning systems, smart thermostats, smart blinds, refrigerators, and stoves);
- Other household appliances, systems, and furniture (smoke alarms, automated doors, smart blinds and curtains, smart beds, smart kitchen appliances, automated laundry systems, etc.);
- Communication systems (Internet connectivity).

The major components of a typical smart home include:

Sensors and Actuators: Environmental, wearable, and other sensors are used to sense temperature, humidity, gas leakage, presence of people, vital signs, blood glucose levels, physical activity, and gestures. Actuators include those used to control lights, automated doors, smart blinds, heating and air conditioning systems, and computerized stoves and refrigerators.

Communication Network: Communication technologies used in a smart home include Bluetooth Low Energy (BLE), ZigBee, ANT, RFID, or secured Wi-Fi or wired internet connectivity. The primary design considerations when building a communication network are reliability, low-power, and interoperability, i.e., systems built in such a way that all the devices and technologies can communicate with each other without any compatibility issues.

Computing and Decision-Making Platforms: Embedded processors, microcontrollers, programmable logic controllers (PLCs), or FPGAs that collect data from sensors and use the sensed data to control actuators, and provide real-time data analysis, context awareness, decision-making, and predictive alerts.

Services Layer: E-Health, safety and emergency response, long-term remote health monitoring systems, and other applications, which provide access to these services to people.

Four-Layer Architecture

Smart homes for healthcare applications are usually based on a 4-layer architecture. Layer 1, the sensors and actuators layer, is responsible for capturing the data and controlling home appliances and systems. The communication network layer is responsible for providing a communication channel for data transfer between the physical world and the computing layer. The third, computing and decision-making, layer is responsible for data analytics, context-awareness, automated decision-making, and issuing alerts, if needed. Finally, the services layer, which can also be called the user-access layer, is where the applications providing access to the above services to the end-users reside.

Figure 4: A four-layer architecture forsmart home.

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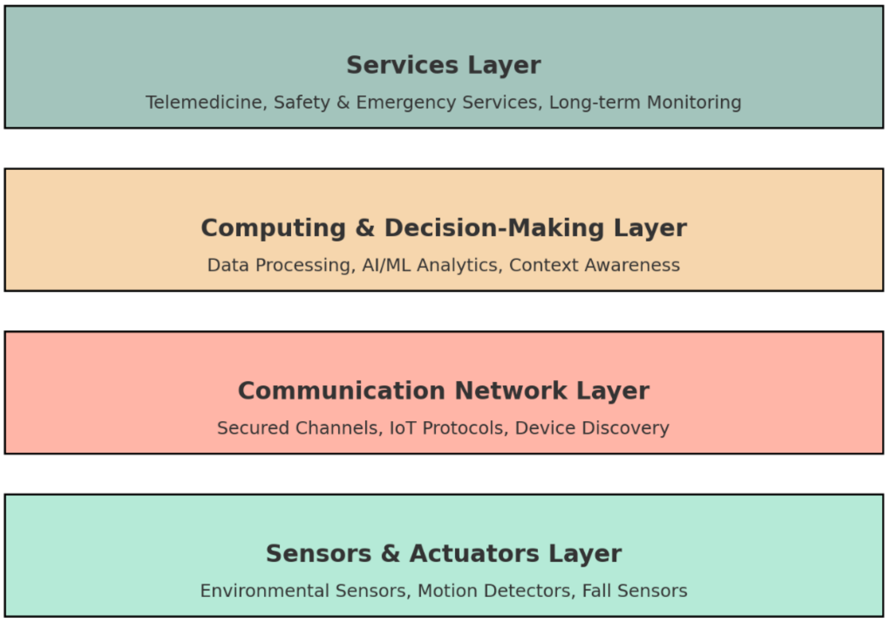

Services	**• Telemedicine and HealthCare Services** **• Safety and Emergency Services** **• Long-term Remote Monitoring Support**
Computing and Decision-Making Platform	• Information Analysis • Context-based Learning • Prediction by Intelligent Reasoning • Decision Making and Alert Notification
Communication Network	• Secured Communication Channels • Bridge Physical and Computing platforms • Sensors and Appliances Discovery
Sensors and Actuators	• Environmental Sensors • Wearable Sensors for Health Monitoring • Actuators for Appliance Control

Design considerations for building smart homes for healthcare applications

Energy-efficient, low-power systems: This is a key feature of IoT-enabled smart homes and allows them to be built at scale.

Interoperability: All devices and platforms must be interoperable with no single supplier lock-in.

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Reliability: Systems built must be error-free when sensing the environment or patient health data, accurately and reliably control devices and systems, and be highly reliable when issuing alerts.

Security and privacy: Secure storage, privacy compliance, and encrypted communication are key design considerations for IoT-enabled smart homes in healthcare, since the systems will be continuously generating sensitive and personal health information of people.

In summary, an IoT-enabled smart home architecture can be the foundation for technology-enabled domiciliary care. This is because it will allow older adults to live independently while remaining connected to the healthcare system, caregivers, and loved ones, and thus will support them in getting the care and support they need when needed, at home.

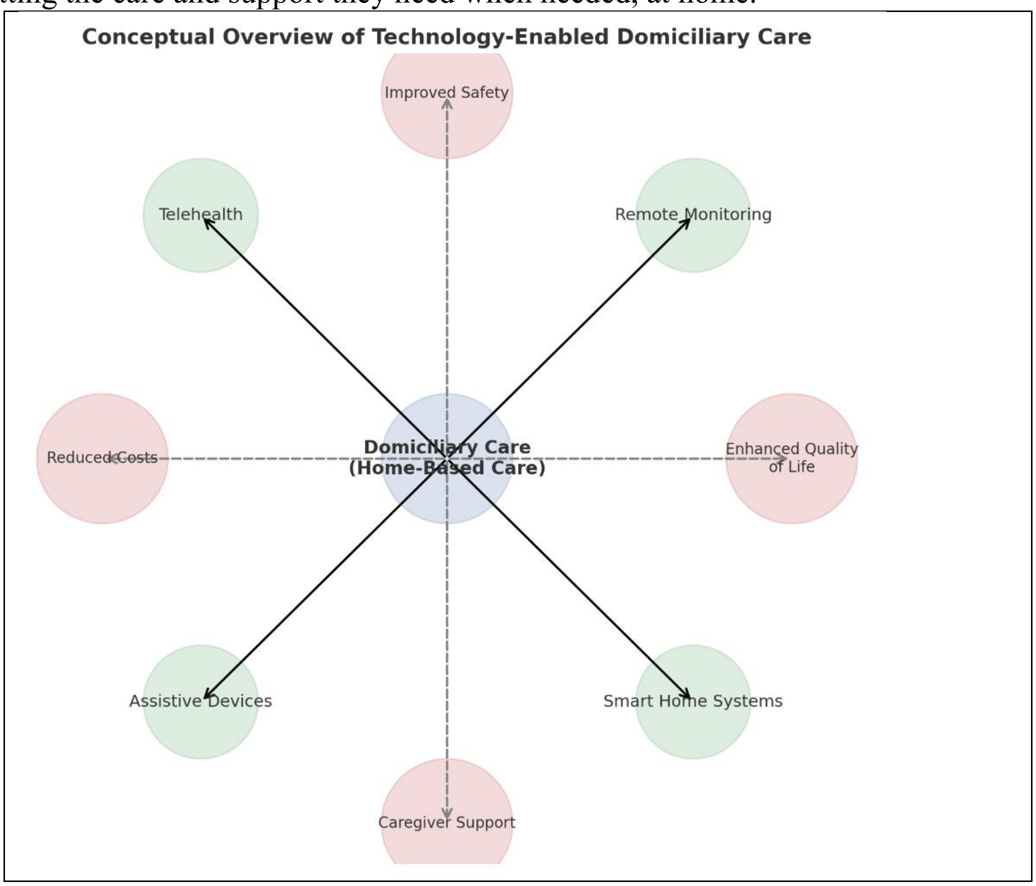

Figure 5 – Conceptual Overview of Technology-Enabled Domiciliary Care

2.0 Literature Review

The current literature review will draw on the available evidence related to the four listed above domains: Safety and reduction of hospitalizations, Economic value of technology in home care, Impact on caregivers and quality of life, Challenges and ethical issues:

2.1 Safety and reduction of hospitalizations through technology

Recent research in technology-enabled domiciliary care is increasingly supporting the potential of this approach to reduce hospitalizations and improve safety at home. Smart home health monitoring and assistive devices are shown to have positive impacts on the management of activities of daily living, including falls, the detection of cognitive changes, and the monitoring of common geriatric conditions, such as cardiovascular disease and dementia (Koumakis et al., 2019).

Fall detection systems, for example, can be particularly impactful, as falls are a leading cause of injury-related hospitalization for older adults. Wearable sensors, environmental monitoring systems, and automated fall detection and alert systems can provide real-time detection of incidents, notification to caregivers or emergency services, and rapid medical response, with fewer complications and hospitalizations as a result (Koumakis et al., 2019).

Telehealth interventions, such as remote patient monitoring, virtual care visits, and telerehabilitation, are also associated with fewer emergency department visits and hospital readmissions, particularly for people with chronic conditions. Remote monitoring of vital signs, symptoms, and medication adherence can enable early detection of negative health trends and allow for interventions to prevent full-blown medical emergencies.

2.2 Economic value of technology in home care

Cost is one of the potential barriers to the implementation of technology-enabled domiciliary care. However, while the initial investments may be high, research has found significant downstream cost savings for healthcare systems from reduced hospitalization and shorter inpatient lengths of stay, as well as prevention of more costly complications (Merkel & Enste, 2015).

Modelling also finds that early detection of changes in physical or mental health through remote monitoring allows for the avoidance of more intensive hospital-based treatment where possible, and that telehealth follow-up care can be associated with earlier discharge and fewer readmissions. Some technologies are more cost-effective than others, however, and the cost-effectiveness of particular technologies for a variety of conditions and care models requires further investigation. Scalable solutions that are financially viable in the long term are particularly in need of further research in the case of dementia care, as integrated systems for this population are still in the early stages of development (Koumakis et al., 2019).

2.3 Impact on caregivers and quality of life

In addition to clinical and financial impacts, technology-enabled domiciliary care is also associated with improved quality of life for the care recipient and their caregivers. Research in this field notes that assistive devices, communication tools, and environmental monitoring systems can increase autonomy, preserve dignity, and improve quality of life, as well as allowing people to stay in their homes, rather than receiving care in a facility (Zhu et al., 2022).

For caregivers, who are often family members themselves, these technologies also provide reassurance through increased access to real-time updates on the status of the care recipient, which can reduce anxiety and stress. Communication tools can also allow better coordination of care between healthcare professionals, family, and formal carers, which improves the continuity of care. However, barriers to adoption may remain in some cases due to usability issues among

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the older adult population, though this may be an issue that is overcome through the current trend of improving rates of technology adoption among older people (Fischer et al., 2014).

2.4 Challenges and ethical issues

Finally, several challenges and ethical issues must be considered in the implementation of technology-enabled domiciliary care, to ensure safe and equitable access for all potential users:

Data privacy and security: The collection and transmission of personal and often sensitive health data must be accompanied by strong data encryption, secure storage solutions, and careful adherence to all relevant privacy regulations.

Digital literacy and access: Care recipients, informal carers, and care organizations must all have the necessary levels of digital skills to use technology solutions, access to reliable internet service, and the ability to pay for and own any required devices, which are all areas where older adults and lower socioeconomic status populations have been shown to experience disparities.

Ethical technology design: Technology should be built to support, rather than replace, human interaction and must be developed with autonomy, dignity, and informed consent in mind, without perpetuating existing social inequities.

Algorithmic accuracy: In more advanced systems that use artificial intelligence or machine learning algorithms, these tools must be developed and trained on large, high-quality data sets to ensure that they are effective, accurate, and will not make biased or unsafe recommendations or decisions (Ullah et al., 2020).

A final consideration and possible pitfall to look out for in system design is that poorly developed systems could hurt quality of life for care recipients, by increasing their social isolation if not used in addition to, but rather as a replacement for, human caregiving. The potential for this negative Impact highlights the need for human-centered design principles in all technology-enabled care solutions (Fischer et al., 2014).

3.0 Methods

3.1 Study Design

This scoping literature review synthesized the current evidence on the use of technology in domiciliary care of older adults. The review focused on identifying key technological interventions that can help lower healthcare costs, improve patient safety, and enhance the quality of life for both care recipients and caregivers.

3.2 Search Strategy

The literature search was conducted in four electronic databases: PubMed, IEEE Xplore, ACM Digital Library, and Google Scholar. The search strategy included publications from January 2014 to December 2023 to ensure a comprehensive and up-to-date review of the literature.

Primary Keywords: Terms, variations/synonyms, and major search categories were used in combination with Boolean operators (“AND”, “OR”) and truncation symbols, where applicable, to broaden or narrow the search as follows:

- Domiciliary care
- Home care
- Technology-enabled care
- Telehealth

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- Remote monitoring
- Assistive technology
- Smart home
- Elderly care
- Caregiver support
- Healthcare costs
- Patient safety

3.3 Inclusion Criteria

The inclusion criteria for the literature review were as follows:

Relevance: The study must explicitly address the use of technology in the home care of older adults.

Timeframe: The study must have been published within the last 10 years (2014–2023).

Language: The study must be written in English.

Study Design: Quantitative, qualitative, or mixed-methods research, as well as systematic reviews and meta-analyses, were included.

3.4 Data Extraction and Analysis

The following information was extracted from each included study:

Study characteristics (authors, year of publication, country, design, sample size, and population)

Type of technology/equipment used for domiciliary care

Primary outcomes (cost reduction, safety improvements, quality-of-life measures, etc.)

Key findings and conclusions

A thematic analysis was performed on the collected data to synthesize the evidence and identify the major themes, patterns, and relationships in the literature on technology and its impact on domiciliary care.

3.5 Limitations

The following limitations of this study are acknowledged:

Publication Bias: This review includes only published studies and may not capture unpublished or negative results.

Heterogeneity: The included studies may vary in methodology, population, and interventions, which may affect their comparability and generalizability.

Rapid Technological Evolution: The field of technology-enabled domiciliary care is rapidly evolving, and newer evidence may have emerged after this review was completed.

Despite these limitations, the current study provides a comprehensive and up-to-date overview of the available evidence on the use of technology in domiciliary care for older adults, informing policy discussions and implementation strategies.

4.0 Results

The literature review revealed several research studies evaluating the use of technology-enabled domiciliary care concerning safety, health care utilisation and costs, and support to caregivers. The results are presented below under different thematic headings that emerged from the included studies.

4.1 Use of Technology in Home Care

The following technologies and categories of technology were found to be in current use in domiciliary care for older adults:

Telehealth Solutions: Remote monitoring devices for blood pressure, heart rate, oxygen saturation, and medication adherence, videoconferencing with healthcare professionals, and telerehabilitation programs.

Assistive and Enablement Technologies: Wearable sensors for fall detection and alerting, smart walkers and mobility aids, automated medication dispensers, and reminders.

Smart Home Systems: Environmental sensors (motion, temperature, humidity), automated lighting, thermostats and climate control, home security systems with cameras and alerts. Some systems also include voice assistants and AI-based predictive monitoring.

4.2 Impact on Safety and Healthcare Utilization

Multiple studies found that the use of technology was associated with improved patient safety and reduced healthcare utilization:

Fall Prevention and Response: Fall detection devices (wearable or embedded in the home environment) were associated with reduced time-to-response for falls, and decreased risk of hospitalization for fall-related injuries.

Chronic Disease Management: Remote monitoring via telehealth technologies allowed for earlier identification of exacerbations or changes in chronic conditions (e.g., heart failure, COPD, diabetes), which led to timely adjustments to treatment plans and a reduction in preventable hospitalizations.

Emergency Medical Response: Systems combining biometric alerts and direct connectivity to emergency medical services were found to reduce ambulance dispatch times and improve clinical outcomes in acute events.

4.3 Economic Implications

Few studies included complete cost-benefit analyses, but the evidence suggested the following trends:

Reduced Hospitalizations: Continuous monitoring and early intervention appear to lower the frequency of acute admissions.

Shorter Hospital Stays: Programs involving post-discharge telemonitoring support earlier safe discharge and reduce inpatient days.

Prevention of Complications: Remote monitoring appears to reduce the incidence of costly complications, especially in chronic disease management and post-operative care.

Cost-effectiveness of interventions varied based on the technology, patient population, and integration into existing care pathways.

4.4 Quality of Life and Caregiver Support

Technologies enabling remote monitoring, timely communication, and safety alerts have been shown to:

Increase Patient Autonomy: Older adults report feeling more secure and capable of independent management of daily activities.

Reduce Caregiver Burden: Family caregivers who receive real-time updates experience less anxiety and can balance caregiving with other responsibilities.

Promote Social Connectivity: Communication tools allow patients, caregivers, and healthcare providers to stay in touch, reducing the risk of social isolation.

4.5 Ongoing Challenges

Key ongoing barriers include:

Data Privacy & Security: Compliance with data protection regulations and standards is a challenge, especially for systems transmitting health data over public networks.

Digital Literacy: Some older adults and caregivers require training and technical support to use these technologies effectively.

Accessibility & Equity: Economic barriers, infrastructure gaps in rural and low-income areas, and affordability limit the reach of technology-enabled domiciliary care.

Interoperability: Inconsistent communication standards and protocols between devices and systems limit their ability to integrate into care pathways.

5.0 Discussion

The systematic literature review has confirmed that technology-enabled domiciliary care offers significant potential in improving patient safety, reducing healthcare costs, and enhancing the quality of life for older adults and their caregivers. The integration of telehealth, remote monitoring devices, assistive technologies, and smart home systems into home-based care addresses multiple challenges in supporting the aging population at home. These include timely detection of clinical deterioration, fall prevention, medication management, and improved coordination between patients, caregivers, and healthcare teams.

5.1 Multifaceted Role of Technology in Domiciliary Care

The wide range of technologies identified in the review reflects the versatility of tools available to meet the multiple needs of domiciliary care. Telehealth solutions allow remote consultations, monitoring, and chronic disease management. Assistive devices and environmental sensors improve safety, mobility, and independence. Smart home systems bring all these features together into a supportive ecosystem that adapts to both clinical and daily living needs.

The evidence shows these technologies contribute to early detection of health issues, which is critical for preventing avoidable hospitalizations and reducing the severity of medical events. The timely alerting and communication capabilities of these tools allow for faster response times in emergencies such as falls, significantly improving patient outcomes.

5.2 Economic Implications and Health System Benefits

Long-term cost savings balance the high upfront costs of implementing these technologies due to lower hospital admissions, shorter inpatient days, and prevention of costly complications. Telemonitoring programs for chronic disease management, in particular, show high cost efficiency potential if they are integrated into existing healthcare pathways.

However, the economic impact varies by type of technology, health condition, and patient population. There is a relative lack of comprehensive cost-effectiveness studies in the literature, highlighting the need for more economic research to guide large-scale adoption and policy initiatives.

5.3 Enhancing Quality of Life and Reducing Caregiver Burden

Beyond measurable clinical and economic outcomes, these technologies have important psychosocial benefits. For older adults, the combination of safety monitoring, independence support, and user-friendly design promotes autonomy, security, and dignity by making it possible to live at home with a safety net. For caregivers, access to real-time information reduces stress, increases confidence, and helps with work-life balance. Communication platforms also help patients and caregivers stay connected with family and healthcare providers, which is important for social connectedness and mitigating isolation risks.

5.4 Implementation Challenges and Ethical Considerations

Despite these advantages, several factors limit the adoption and effectiveness of technology solutions in domiciliary care.

Digital Literacy and Usability: Many older adults and caregivers require training to use these systems. User-friendly design and ongoing technical support are essential.

Equity and Accessibility: Socioeconomic disparities, infrastructure gaps in rural and low-income areas, and affordability are significant barriers to equitable access to technology-enabled domiciliary care.

Interoperability: Lack of consistent communication standards and protocols between devices and systems is a barrier to integration and scalability.

Privacy and Data Security: The transmission and storage of personal health information raise privacy concerns. Robust encryption, secure storage, and strict compliance with privacy regulations are essential.

From an ethical perspective, technology must be used to augment—not replace—human care. Too much reliance on automated or machine-driven systems may also inadvertently worsen social isolation if not accompanied by sufficient human contact and communication.

5.5 Future Directions

To harness the full potential of technology-enabled domiciliary care for the aging population, future research and implementation efforts should focus on:

1. Designing inclusive, age-friendly interfaces to accommodate users with a range of digital skills.
2. Robust cost-effectiveness studies across different patient populations and health systems.
3. Developing interoperable platforms to enable seamless communication between devices and data streams.
4. Establishing ethical guidelines for the use of technology to ensure patient autonomy, informed consent, and equitable access.
5. Examining the potential role of emerging technologies such as AI and predictive analytics in further enhancing preventive care and personalized interventions.

6.0 Conclusion

Technology-enabled domiciliary care offers a promising solution to supporting the healthcare needs of aging populations while also reducing the burden on overstretched health systems. By leveraging telehealth, remote monitoring devices, assistive technologies, and smart home systems, we can improve patient safety, reduce hospitalizations, enhance chronic disease management, and support independent living for older adults.

The results of this systematic literature review show that these technologies deliver not only measurable clinical and economic benefits but also improvements in quality of life for both care recipients and caregivers. However, challenges remain to be overcome if this potential is to be fully realized, including data privacy concerns, digital literacy and usability barriers, affordability and access issues, and interoperability limitations. Ethical considerations must also be prioritized to ensure that technology is used to support not replace human care relationships.

For widespread and equitable adoption, future efforts should prioritize user-centered design, economic evaluations, and policies that ensure all people can access and benefit from the latest technology, regardless of their background or socioeconomic status. With the right approach, technology-enabled domiciliary care can empower older adults to age in place with safety, dignity, and independence and help make home-based care a sustainable and patient-centered pillar of modern healthcare.

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