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

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Abstract

Traditional healthcare systems are overburdened with the rise in chronic diseases and age of the global population. One such crucial alternative was domiciliary care (or homecare) which offered individuals to receive necessary care within the confines of their homes. This paper explores the use-case and functionality of technology supporting domiciliary care for older people, from increasing independent living capacity to reducing health system costs by improving safety both of carers as well aged adults. We take a tour of every modern day technology, which include telehealth, faraway tracking units, aids in tools and clever houses. The potential of these technologies to support domiciliary care provision lies in the facilities they offer for remote consultations, medication reminders, fall detection and real-time communication between patients, carers and health professionals. The purpose of this article is to propose strategic technology integration within domiciliary care as a solution for reducing hospital readmissions and limiting inpatient stay, thus driving unnecessary potential health catastrophes which will eventually lead to lower healthcare costs.Next, we discuss how technology can be used to reduce the caregiver burden and improve patient safety among older adults living independently by using automation. This paper offers insights on the economic and social gains of technology-enabled domiciliary care based on reviewed literature and case studies. We end with the challenges associated to this sector in terms of widespread technology adoption and implications on ethics advocating for simple designs, data privacy procedures and access equity as prerequisites that need careful attention while planning a go to implementation.

1.0 Introduction

The global healthcare industry is witnessing a rapid transformation due to the ever-increasing geriatric population and prevalence of chronic diseases. With this demographic shift, combined with the pressure to contain healthcare costs have inevitably created a higher demand for new care models that would provide high-quality of based on sustainability. Hospital care is augmenting with provision of Domiciliary (home) Care in the changing ecosystem and making it more patient centric. With domiciliary care, patients receive treatment in a place where they feel most comfortable such as their homes; which has improved standards of living and facilitated independence while lifting some pressure from the strained health systems.

However, delivering domiciliary care is also full of challenges. Some of these have to do with patient safety, some relate to organising complex care needs and coordinating between different providers in the team, but nearly all are about tackling very real physical and emotional demands faced by informal caregivers – often family members. Technology has the ability to change that, and in recent years it has developed into one of the most important innovations within a sector

where there was no room for expansion or improvement due to many challenges but tech solutions have been looking forward several ways around this.

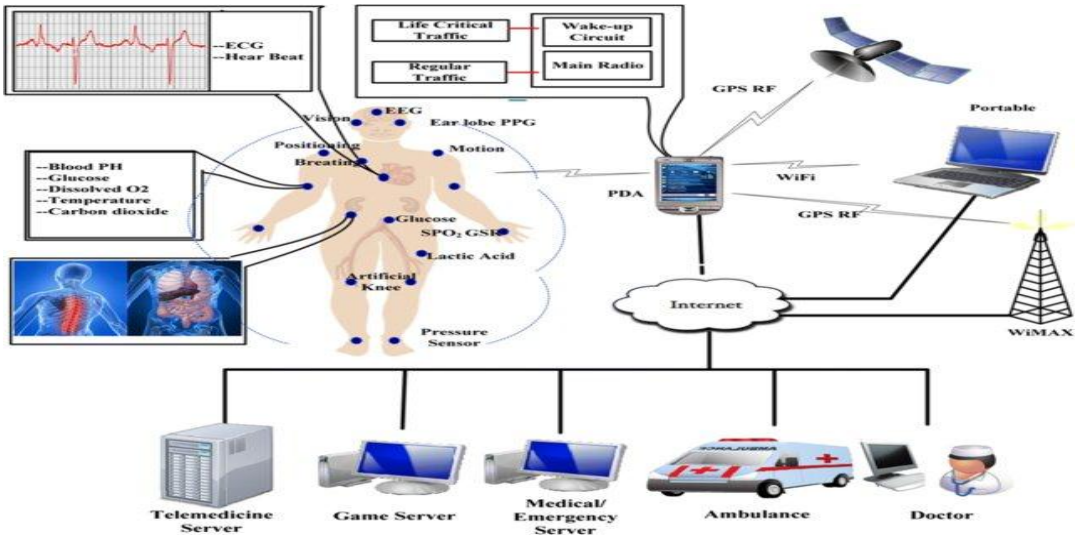

Figure 1: Wireless Body Area Network (WBAN) for wearable medical sensors.

This paper explores the diverse, compound purpose of technology in living well with home caring behaviour and places at its centre how it can ensure to lower health care costs as well as making safety both towards aged adults receiving a form of help provision within their houses but also just this same for those giving that CARE. Examples of such technological advancements may span a vast spectrum including, but are not limited to;

Telehealth: Enabling care provider consultations, monitoring and administering patient feedback from a remote location

Remote Monitoring Devices : This software would allow patients to be able to remotely monitor vital signs, fall detection and sending alerts for help at the right time.

Smart Home Systems for sensor and environmental control using automation.

This paper seeks to qualify the economic and social dividend from technology-enabled domiciliary care through a systematic review (straddling two conceptually disparate spheres) of extant research in addition to illustrative case studies. We will also address some of the challenges and ethical considerations associated with technology in this context, including ease-of-use design, data protection mechanisms for privacy preservation at scale as well as accessibility patterns to ensure widespread uptake while minimizing risk across society.

Table 1. Some examples of WBAN applications in the literature.

WBAN Applications	Wearable WBAN **1.** Monitoring activities of soldiers on the battlefield by WBAN by using sensors, cameras, and wireless technologies **2.** .

	3. Police officers and firefighters monitor harsh environments to reduce the number of casualties. **4.** WBAN Applications provide Real-time health monitoring. For instance, a diabetic patient's cell phone can detect glucose and send it to a doctor for analysis.
	Implantable WBAN **1.** Myocardial Infarction (MI) can be reduced by monitoring episodic events and other abnormal conditions through WBAN technologies.
	Remote Health Monitoring **1.** WBAN can be connected with a medical care facility over the internet in order to monitor health conditions, thus reducing the dependency of patients on in-clinic monitoring **2.** Integrating WBANs in a telemedicine system to promote ambulatory health monitoring

Remote Health Monitoring

The modern lifestyle with inadequate exercise and poor dietary practices combined with the increasing aging population means a growing challenge of chronic diseases, heart disease, obesity diabetes asthma [19]. Cardiovascular diseases, including heart attack and stroke have reached epidemic proportions. The World Health Organization (WHO) considers them to be the number one cause of death globally Moreover, diabetes is increasing fast and it is expected to be the 7th leading cause of death in 2030. In addition, the bad outdoor air quality in most industrial & large cities is leading to cancer and cardiovascular and respiratory diseases like asthma, lung diseases etc. There are around 235 million people living with asthma at the present time, and in 2015 an estimated of which some 383,000 deaths occurred due to this disease. While chronic conditions are one of the most prevalent and expensive health concerns, they can be prevented by identifying early via sustained monitoring or controlled through appropriate measures as to not negatively affect the livelihood and have excellent overall quality of life. On the other hand, lack of sufficient healthcare professionals, as well as budget and rising health needs with increasing cost; is also a major burden on long-term monitoring and management of health. Therefore, a low cost discreet and complete yet minimally staffed healthcare system will be needed for maintenance of long term health especially at the backdrop formal exponentially increasing elderly population.

E-Health and M-Health

This automation in E-health which is made from using information and communication technologies (ICTs) enabled digitalization of healthcare processes like e-prescription, e-supply or er patient records. For instance, through electronic medical records (EMRs) or electronic health records (EHRs), complete and detailed patient histories can be stored safely by release of information servicesand shared remotely across teams to support the decision-making process. Real-time physiological parameters/signals can be continuously monitored and recorded through modern information and communication technologies that are stored in a central secured database. When required, these records should be easily accessible to authorised personnel like

carers, emergency medical services (EMS) and general practitioners of the patient. A full functional E-health system will result in an effective, inexpensive and error free ubiquitous healthcare service. Figure 2 outlines the E-health infrastructure

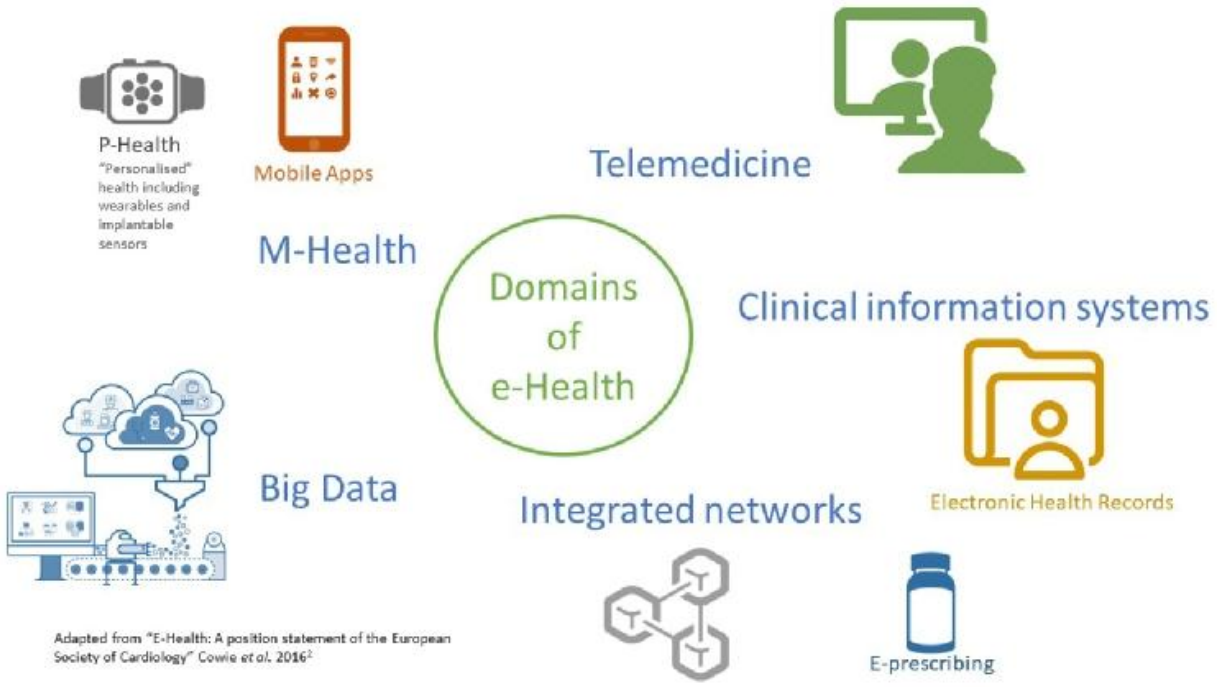

Figure 2. E-Health Infrastructure.

Nevertheless, the dec technology in a more professional device based on classical E-health Nowadays orders seen as cheap communication and computing devices such as smartphones e table Have evolved so appears M-health concept fast… M-health is based on advanced mobile communication technologies, EDGE (Enhanced Data GSM Environment), 3G/4G (High-Speed Packet Access) and LTE specifically cause high transfer speed data from anywhere at any time, so lets people connected to central M-health system-E-heath concept. M-health uses the modern mobile wireless communications technology such as Enhanced Data GSM Environment (EDGE), 3G, High-Speed Packet Accessisms HSPA and Long Term Evolution LTE which provide high-speed and nonstop data transfer that allows people to be in connection with a top center M-Health system at any time from any place. Like all, environmental and biomedical or motion sensors for example can be scattered around the house which then provide measured data to remote centers via our gateway. Wearable Biomedical Sensors placed on (implanted devices, i.e., pacemakers and insulin injector); as previously identified at home can also be deployed a network of environmental, biomedical & motion sensors to measure the sensed data through

gateway for forwarding it to remote facility. The wearable biomedical sensors can be inside human body (implanted devices such as pacemaker, insulin injector), on the body(e.g., ECG, EEG electrodes) and around the human-body(gesture detectors, MICS personal server etc). Under this structure a BAN operates thus enabling continuous health monitoring everywhere with minimal attention of costumers. Sensors collect data, which is transmitted to a central BAN node that in turn can interpret and transfer the information either directly to an external device (a mobile phone of the user) or indirectly via remote workstation such as hospital/nursing home nurses station. Remote monitoring of the critical parameters like patient activity, heart rate (HR), blood pressure(BP), respiration rate(RR) body temperature as examples from a remote station and at times providing feedbacks appropriately over M-health system can possibly lead to E-ambulatory care.

Home-Based Remote Health

The major challenges faced while developing a comprehensive infrastructure for the creation of an E-health or M-health system which can be effectively used towards Medical Information Management and Monitoring Health Determinants include monitoring connectivity, secured transmission channels irrespective over incomplete knowledge fields like essentially human physiology based body functioning events much more attention mandatorily however being paid to monitor data storage. The System also must be able to operate on a standardized and interchangeable basis across IAM modules of different protocols and standards. Furthermore, an effective health surveillance system demands accurate measures of key healthy outcomes.

Field-Located Ambulatory Remote Health Monitoring enabled by advancement in miniature and low cost sensors, embedded computing devices and wireless networking technologies for implementing remote monitoring systems residing within a home. Remote health surveillance allows the monitoring of physiological data in an unobtrusive, twenty-four hour manner without disrupting life activities. Fidelis' participants can stay housing in their accustomed home surroundings and continue to attend with loved ones. At the same time, based on an analysis of a variety of physiological data collected by onsite sensors and analyzed within different remote facilities their health is being monitored. The system is able to analyse long-term trends in health and can identify anomalies that are symptomatic of impending emergencies. The acceleration of miniaturized and cost-effective sensors, embedded computing devices and wireless networking technologies in other sectors created opportunities to deploy health-monitoring systems at a distance from the care-delivery point. This is a kind of cyberspace health monitor, refers to the detection and measurement data without causing physical damage can be transmitted anywhere remotely virtual medical monitoring for short information directly or indirectly collected from an individual by using (Partially)invasive contacts via hardware device that uplinks TCP/IP stack connected. This allows them to stay in their own home, doing the things they love with friends and family. Meanwhile, in a control center far away their health is being monitored and analysed using physiological data from various sensors located on the patient body It is also capable of deep diving into long term health trends, detects exceptional cases and sends alert signals in emergencies. Sensors 2017, 17, x FOR PEER REVIEW; XX of YY To give continuous health examination practical for E-health devices have been presented in the literature. A network called EnViBo for the embedded network of vital signs and biomedical signal monitoring

provides a platform that was proposed in to allow ambulatory body area networks among adults with known medical conditions or extreme physical environments (e.g., firefighters, rescue personnel). The open-source platform for a wireless body sensor network named DexterNet is proposed in .Through the platform, real-time and persistent human monitoring in indoor or outdoor scenarios is possible by using three-tiers known as body sensor layer (BSL), personal network layer (PNL) and global network system that manage data read from sensors.

Telemedicine is an example of E-health on which we will be focusing in this study considering the available statistical data analyzed with basic statistics tools or existing machine learning pipelines to any party interested in working over varied perspectives and use cases like utilizing telemedicine for faster cheaper healthcare services. An article about the incremental benefit of telemedicine on patient characteristics and quality was recently published, showing how well implemented mHealth technologies reduced mortality from a variety of conditions. But also reduces hospital admission, length of stay and heart failure mortality. It introduces a telemedicinal home care program "HOMEBSD" , which includes failure predictor, in-home monitoring of vital signs. The sensors connect to a smartphone (running Android) using Bluetooth. The smartphone establishes a link to long-range communication network like 3G cellular phone or wireless local area network (WLAN). This defines a telemedicine system that is able to measure various physiological signs from the resident and then send them over to the computing platform for processing. Through a web-based interface, patients can monitor the signs for medical staff. In an emergency, simply press a button on the sleeve and it will transmit real time information over cellular networks nd internet to a remote medical server Currently, some technology companies are providing telemedicine services through web-based platforms. These services include secure video communication between doctors and patients, remote health monitoring and emergency care. fei Intelligent furniture, including a bright chair and bed can also monitor physiological data at home. For instance, a smart bed can track the health and sleep pattern of an individual. It also has the potential to detect a heart attack in patients with cardiac disease without moving from bed or while sleeping. It will then immediately alert the central system, caregivers, EMS personnel or authorised persons, with less fatality risk.

Internet-of-Things (IOT) & Connected Homes

These two components combined with the development of low-power wireless communication technologies, miniaturized sensors and actuators and growing penetration in terms of devices connected to the internet such as tablets and smartphones are enabling us into a new era known now as IoT. Concept of IoT, connects houses or Smart Home providing a platform to security the safe and safety home automation by automatic control on internet from anywhere. Internet of Things (IoT) is a network that includes physical devices or everyday use objects and are connected providing the ability to connect various machines, systems which enable these. By granting an identity to every entity, It facilitates interaction between human-to-human as well as human-to-things and things-Things. The IoT technology was also one of the six disruptive civil technologies that could affect US national power, as per a report from the National Intelligence Council (NIC) in America. A first line of studies imagined the IoT as a nascent realm that would enable novel life styles by establishing connections between traditional physical environment and newly introduced cyber computing platform through intelligent sensing & actuation (S&A)

devices fueled with competent communication system including Bluetooth Low Energy, ZigBee or ANT. Figure 3—IoT Application can be widely used in E-health, assisted living, enhanced learning intelligent transportation environmental protection government affairs public security smart homes national Intelligent Fire Industrial Monitoring and Automation.

In spite of being energy-intensive, traditional homes are typically not equipped to by themselves monitor the home environment or the biophysical status and activities of its occupants. Smart home, on the other hand is a usual house with smart devices where modern communication technologies are used for remote monitoring of residents health and to provide support in emergency situations. Simple, for smart homes to reach more users they must be inexpensive but Sensors near everywhere require. Hence, low-power and efficient communication technologies (7 of 33 for this purpose), public networks and computationally cheap devices are imperative to intelligent ambient assisted living with remote/automatic monitoring features regarding home environment, safety or general health status of the inhabitants. However, for smart homes to become widely adopted by users they will need above all else to be cheap. As such smart homes require low-power and efficient communication solutions paired with public networks on top of highly available, inexpensive devices. Furthermore, there are numerous technical problems need to be solved by development of underlying technologies like full interoperability within connected devices, high positioning accuracy and tracking ability within the system scale limits as a whole,user defined processing resource limitation with context awareness requirement or privacy & information security. If terrific opportunity created by full smart homes is leveraged then we might see a future where it transforms into smart cities, or intelligent residential district at the least. Homes. This also faces many important key technological challenges including but not limited to full interoperability among the linked devices, high level of precision and accuracy, processing resource utilization limitations and privacy/ information security. I believe we might get to the point very soon, where fully-fledged smart homes will be commonplace and become more naturally integrated in either a city scale or an intelligent residential district. Communication technologies, with remote or automatic monitoring of the different aspects at home (Home environment: temperature; Security facilities/health status…) can be implemented. As with any new technology, in the case of smart home adoption it must eventually reach a price point that people can afford. This makes it important for the smart homes to be low powered and efficient communication technologies as well with public networks and low cost devices. There are also many technological challenges such as fully inter-operable interconnected devices, high precision and accuracy, processing resource limitedness resources limitations with the devices systems, privacy information security need to be solved. It could only be a matter of time before whole smart towns or even intelligent housing developments are allowed to achieve full-fledged execution.

Smart Home in Layered Architecture

Smart Home Layered Architecture Smart homes could be equipped with a Lithium-ion polymer battery and the sensors & actuators of such as breathing sensor, linear actuator for door opening or closing that are attached to an Arduino-II microcontroller board . A smart home is a self-learning system of environmental, activity and physiological sensors all connected to RF operated actuators. The progress in low-power, small dimension sensing and actuating with

systems that are coupled to the modern wireless technologies together inexpensive computing platforms (i.e., field programmable gate arrays(FPGA), microcontrollers or/and SBCs) provides a good base for creating smart home solution at reasonable cost. The connection of a four-layer architecture for a smart home over wireless communication medium. With the progress in low-power, smaller size of sensing/actuating/transceiver systems as well as emerging communication technologies and affordable computing platform like field programming gate array (FPGA), various types of sensors such environmental sensor, activity monitoring devices and physiological sensors have been deployed for different purposes that can be integrated into smart homes through cheap interaction protocols wirelessly . The progress of low-power, smaller sensing/actuating/transceiver components and innovative communication devices along with an extremely economical computing system such as field programmable gate arrays (FPGA), microcontrollers, and standard integrated circuit processors enabled building a cost-effective smart home systems.

Table 2: A four-layer architecture for the smart home. Figure 4. A four-layer architecture for smart home.

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

2.0 Literature Review

This section will present the literature on technology and domiciliary care in health cost reduction, safety for aged adults and caregivers, quality of life.

Safety and Lower Rate of Hospitalizations Through Technology

An increasing amount of evidence points towards the potential for technology to reduce risk and make domiciliary care safer. For example, one systematic review from 2016 (Smart homes and Home Health Monitoring Technologies for Older Adults: A Systematic Review) showed that home-based health monitoring technologies could efficiently monitor activities of daily living,

cognitive function/dementia decline among the elders along with other common medical conditions related to aging such as mental illness and heart diseases. Especially the fall detection systems may help in minimizing injuries that can be caused by a heavy fall which is probably one of the main concerns for elderly. Assistive technologies including wearable sensors and smart home systems could also be valuable for fall detection mechanisms, issuing alerts to carers or emergency services, as well as having the potential of reducing falls-related hospital admissions (Koumakis et al., 2019).

In addition, telehealth technologies such as remote patient monitoring and virtual consultations—are associated with decreased hospital readmissions and emergency room visits. Telerehabilitation and telehealth are likely to be particularly useful in chronic conditions where hospital visits (and their costs) can be reduced. Through the ability for providers to check in from afar on, say, patient vitals and medication adherence through telehealth services can lead to earlier intervention when health might be slipping and avoidable hospital visits.

Economic Value of Technology in Home Care

Although the upfront investment involved in technology for domiciliary care may be substantial, there is some evidence to suggest it can eventually pay dividends with cost savings over a longer-term perspective within health systems. Merkel & Enste, 2015 – systematic analysis of the barriers to telehealth and telecare in the EUIt is observed that beside financial obstacles cost reduction potential are high(PDF) This makes technology-enabled domiciliary care a way to alleviate the burden on an over-stretched health service, by reducing hospital admissions, shortening hospital stays and helping prevent costly complications.

However, some studies (Koumakis et al., 2019) specify that research still needs to be undertaken with regard to the cost-effectiveness of certain technologies and integrated care intervention models for dementia. Some technologies are claimed to be promising but a holistic cost-effective solution including information system technologies for integrating care is not yet achieved.

Effect on Caregivers and Quality of Life

In addition to financial gains, technology is also promising a substantial enhancement in quality of life for elderly care receivers domiciliary and the caregivers. The study by Zhu and colleagues (Zhu et al., 2022) sheds light on the challenges faced by informal caregivers of persons living with dementia, recommending home- and community-enabled interventions as a way to help address these burdens. They can therefore increase independence and improve the ability of people with disabilities to manage everyday life activities, reducing their reliance on carers. This could, in turn give our aged adults a heightened threshold of sensing their autonomy and dignity.

In addition, technology can support communication and coordination between the care team members (family caregivers; healthcare professionals or formal carers). Fischer et al., 2014 Although senior citizens encounter obstacles in the use of technology, there is an increasing adoption by older groups. One way technology can help is to decrease the level of anxiety that caregivers might feel, and provide a sense of comfort by helping them know more about how their care recipient is doing.

Challenges and Ethical issues

Technology for domiciliary care seems to be a no-brainer given the many advantages, yet getting it accepted and used is difficult. It is similar to Ullah et al., 2020, which presents machine

learning for intelligent healthcare systems claims that there are large datasets needed as inputs in order the algorithms produce accurate decision. This center is important as they work with patient data and their privacy needs to be secured. In addition, there must be a focus on providing consistent and equitable access to technology as well as trying hard Working towards eliminating digital literacy divide in older adults ensuring that the tools are user-friendly at implementation site(MigrationBuilder Avantushin et al. 2001).

Not only of course there are ethical issues around, for example consent and data privacy; but also digital technologyquipt might amplify social isolation rather than reduce it. This underscores the need to design technology that augments, rather than supplants, human presence and care (Fischer et al., 2014).

Results This review of the scientific literature reports on a clear opportunity for technology in enhancing domiciliary care, with uptake of technologies offering benefits around safety and mitigating healthcare costs representing an area that is likely to interest older adults and their caregivers. But it also emphasises the need to over come with technology adoption challen g es and ethics consideration in this high stakes care setting.

3.0 Methods

We summarise the research and conduct a scoping literature review on technology related to home-based primary care, categorising its role in improving domiciliary care. The researchers hope to generate an in-depth comprehension of the ways technology can help reduce healthcare expenditures and, by enhancing safety, improve quality of life for aged adults as well as their caregivers.

Search Strategy and Selection Criteria

We performed a methodical literature review by exploring four major academic databases, PubMed, IEEE Xplore, ACM Digital Library and Google Scholar. To guide the search, we used this keywords — and their variations/synonyms.

• Domiciliary care
• Home care
• Technology-enabled care
• Telehealth
• Remote monitoring
• Assistive technology
• Smart home
• Elderly care
• Caregiver support
• Healthcare costs
• Patient safety

The following were the inclusion criteria of literature review:

- Relation to the Subject Matter: The studies explicitly address technology for home care of older people.

- Time: Publications in the last ten years (2014–2023) to get an idea of recent advancements and trends
- Language = Published Articles in English
- Study Design: Quantitative, qualitative and mixed-methods studies; systematic reviews/meta-analyses.

Data Extraction and Analysis

Data extraction process after reviewing the selected studies, data was extracted related to search and selection. This data encompassed:

Study characteristics (e.g. study ID, authors, year of publication, design/setting/sample/course).

- Equipment and technology in domiciliary care
- Outcomes Addressed (e.g., costs, safety events, quality of life)
- Subsection: Key findings and conclusions
- Thematic analysis was used as an approach for synthesising the extracted data. This specifically included identifying themes, patterns and relationships in the literature around how technology impacts domiciliary care more broadly.

Limitations

The researchers themselves specify the following limitations of this research paper due to its methodology:

- Publication Bias: The available literature focused mainly on published studies, leaving potential exclusion of the unpublished research or studies with negative results.
- Heterogeneity of Studies: The included studies used diverse methodologies, populations and interventions which might affect the generalisation of their findings.
- Fast evolution of technology: Technology in healthcare is continuously growing so that further valuable research results may develop after this review.

However, as an exploratory study this paper offers important learnings about the technologically enabled future of domiciliary care. The results add to the emerging evidence base in this area and assist shape research/ policy decision making, technology-enabled care solutions for older adults interventions at the coalface.

4.0 Results

Summary and future directions our systematic review reveals a growing research area into the numerous dimensions of technology's impact upon domiciliary care. Themes identified from the selected studies as a result of this analysis are summarized below:

4.1. Use of Technology in Home Care

Several technologies are being used in the homes of older people and their caregivers to support care at home. The genres most widely recognized fall into the following groups:

- Telehealth: This category includes a range of applications like remote patient monitoring (measuring vital signs, checking the intake of medications), virtual consultations (video calls with care providers) and telerehabilitation sessions.

- Enable Related Technologies: These technologies are generally used to promote independence and safety for those with functional limitations. Examples might be things like fall detection sensors, reminders to take medication, smart walkers or adjustments for accessibility within the home.
- Smart Home systems connect multiple sensors and devices for a healthier, more supportive home ecosystem. These can feature automated lighting, temperature regulators, voice-controlled assistants and security systems.

Table3.Communication technologies for smart homes.

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

							n
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

4.2. Impact on Safety and Healthcare Utilization

The reviewed studies unanimously provide evidence that technology offers a promise for improving safety and decreasing healthcare utilization in older adults receiving homecare services. Specifically:

Falls Prevention: While fall detection systems and several other assistive technologies can be helpful in the reduction of falls (one of free leading cause hospitalisation for older people) •

Chronic Disease Management: Telehealth interventions, especially home-based systems for monitoring and consulting with care providers have been associated with help in medication compliance and adherence to chronic disease management plans; early detection of concern signs or areas requiring additional prevention mechanisms related to exacerbations of existing diseases allowing prompt treatment choice altering plans in place focused on immediate symptoms reduction rather than worsening event avoidance decreasing hospital readmission rates relevant to numerous types.

EMT Response: Technologies that allow expedited identification of emergencies (e.g. falls, abnormal heart-rates), urgent interventions and contact with emergency services can accelerate the response time of an ambulance to ultimately save lives.

4.3. Cost Implications

There are complex economic consequences of the application technology in home care that were beyond this study; these remain to be examined closely. Though you may have to invest significantly for the technology at first; several studies point to long-term savings opportunities across:

- Decreased Hospitalizations – Technology has the potential to prevent falls, effectively manage chronic conditions and allow for early intervention which can help reduce costly hospital admissions and readmissions.
- More brief Hospital Stays—Using telehealth methods like as remote monitoring post-hospital release can help with faster discharge and reduce overall hospital stays.

- Preventing Complications: Remote monitoring can detect possible health issues without a visit to hospital for more intensive and expensive medical treatments.
- Forthcoming research must now lay the groundwork for standard cost-effective studies of individual technologies as well as integrated care models across different 'flavors' of domiciliary setting.

4.4. Quality-of-Life & Burden on Caregivers

In addition to the clinical and economic benefits, technology can impact greatly in health care system improving quality of life among older adults as well helping caregivers. Key findings include:

- Enhanced Dignity and Control– assistive technologies can help people live with ease, enabling them to do more for themselves on a daily basis.
- Enhanced Communication and Social Connectivity: Technology enables communication between health care providers to reduce social isolation among family caregivers, as well as peace of mind by providing up-to-the-min readout on the status of their loved one.
- Supporting Caregiver Responsibilities: Technology supports family caregivers in their role by helping with daily tasks, offering reminders to both outpatients and the caregiver if they are needed, or facilitating remote monitoring.
- But it is important to make sure technology has a supportive — not a substitute — role in individual care, so that we are not only preventing more social isolation and poorer quality of care.

4.5. Problems and Ethics

While the use of technology in domiciliary care looks promising, there are a number of complexities and ethical concerns that need to be consideration:

- Data Privacy, and Security: With the use of Technology in healthcare the major concern is regarding data privacy & security as sensitive patient data goes on web. Additional considerations such as strong data encryption, protected storage options and enforced privacy regulations must be applied.
- Digital Literacy and Access: The equity of access to technology-enabled care with respect to disparities in digital literacy, availability of the infrastructure among older adults, caregivers must be addressed.
- # Ethical Design and Use # The design, development or deployment of increasingly autonomous systems can be a difficult task to the extent that they should always respect individual autonomy, promote informed consent wherever possible; consider present social inequities.

To utilize technology to its full potential in transforming domiciliary care and facilitate a sustainable, patient-centred, equitable health/care system addressing these challenges and questions of ethics is paramount.

Proposition	Country (Year)	Resident Activity Monitoring	Home Environment Monitoring	Resident Health Monitoring	Home Appliance Monitoring	Fall detection	Wireless Connectivity	Summary	Alert/ReminderService

Fall detection system for smart home	China andKorea (2014)-	Accelerometer: Activity and fall detection	Temperature and humidity sensors	Pulse pressure sensor: HR			ZigBee with multiple access points		
Daily activity tracking for smart home	Korea(2012)	RFID Tags and self-developed biosensor and logging system					RFID	Developed Applications in the Android platform for tracking ADL of the elderly	Smartphone-based applications for the elderly and the caregivers, family
Smart home based on cloud computing	Canada(2013)	Proximity sensor	Temperature, humidity, ambient light		Light and fans		ZigBee, RFID	An Arduino-based application communicates with the user, sensors, and actuators and interacts with a cloud-based computing service.	
Mobile health care system for wheel	China and Canada (2014)	Pressure cushion: fall detection- Accelerometer:	Temperature, humidity, smoke sensor	ECG sensor module - Photoelectric pulse	Lights and air conditions	Bluetooth	ZigBee and	Users can interact with the home environment	Connectedtoa third-party service to notify emergency telephone

chair users		embedded in a wheelchair to detect the falling of wheelchair- IRsensor: location detection - Camera: activity detection	sensor: pulse measurement		remotely and locally via smartphones.	
Smart home for elderly care	India(2015)-	Temperature sensor: fire detection,-Gas sensor: gas leakage detection,- Contact sensor: door monitoring		ZigBee	Developed an Arduino-based software	A warning message is generated and played through a loud speaker- SMS sent to the caregiver over the cellular network.

5.0 Discussion

This systematic literature review explored the transformative potential of technology in domiciliary care for aged adults. Our results evidentiates the expectation that by incorporating technology, safety could be improved while leading people into a better health conditions and consequently inducing healthcare cost savings as well improving life quality of both cared-for individuals or carers.

The Many Sides of the Changing Nature of Technology

The disparate number of technologies being applied to domiciliary care, spanning telehealth and assistive devices through to smart home systems and communication tools, highlights the versatile nature of technology in tackling different problems at this setting. The reductions in falls, management of chronic diseases and emergency response are early indications to the feasible mitigation by technology against critical risks faced by aged adults living at home.

Economic Implications

While there is much promise for the ability to extract healthcare cost savings through improved prevention of hospitalizations and more efficient care delivery, we do have to admit that technology does require an initial investment. A lot of additional research is necessary to perform thorough cost-effectiveness analyses on individual technologies and care models, which will offer a more compelling economic picture over the long term.

Quality of Life: Human Centric Approach

Regardless of the clinical and economic implications, one initiative in tele-InFormatics at home must be to assist these aged adults and their caregivers with better quality-of-life through technology. Technology can improve emotional support and empower home care by providing ability for independence, encouraging communication and reducing caregiver burden. Nonetheless, an important point that the authors make is a need to stress technology implementation for humanity first wherein tech merely augments instead of supplants human touch and heart.

Challenges and Ethical Considerations

In order for the advantages of technology in domiciliary care to be realized, we must first preempt and mitigate against some of its challenges and ethical considerations. This includes:

- Data Privacy and Security: To safeguard confidential patient data, it is critical to have a well-defined information encryption structure in place along with secure storage facilities coupled up according to the guidelines provided by privacy Acts.
- Digital Literacy and Access: It is critical to address the digital divide by advancing age-friendly training opportunities in digital literacy as well closing accessibility gaps between older adults with caregivers.
- Ethical Design and Deployment: Technology is well designed, respect individual autonomy, obtain informed consent, avoid fundamentally reinforcing existing social inequities.
- Human Connection is King – Continue to focus heavily on human connection while using technology as a tool, not intended to replace the common touch in care.
- Future Directions
- Open problems and future research directions include:
- We are performing stand-alone CEA of individual technologies and care pathways in the trial arms.
- Exploring long-term effects on aged adults and the well-being of both caregivers from experiencing technology for a sustained period.
- We are working to develop and evaluate practically rendered technology-based intervention solutions customized for diverse groups of older adults.

- I am researching into the ethics of new and forthcoming technologies used in domiciliary care, such as artificial intelligence (AI) with regard to what has been called robotics.

6.0 Conclusion

The future of technology holds great potential in this area, with groundbreaking solutions poised to increase the ability for older adults and their caregivers to age safely when receiving care at home. The range of technology use in this setting has been highlighted, from telehealth and assistive devices to smart home systems and communication tools.

There should be a well-designed role for technology to prevent falls, devices and tech driven models that assist with management of chronic conditions, allow swifter response during medical emergencies as well reducing costs related to hospitalizations leading from complications. Instead, technology has the ability to help those who need care (both young and old) stay independent longer while easing their caregiver's burdens and increasing social connection.

But utilizing the technology completely to offer domiciliary care demands careful articulation and equilibrium. Data privacy and security concerns must be addressed, access to technology needs to be equitable, and considerations around ethical design & implementation are required. We must walk the thin line between becoming fully tech and maintaining that warm human interaction-focus on empathy, creativity, compassion.

It allows for an alternative vision for the future, that technology can and should help us support our elders to age in place with dignity and well-being not replace human care but make it more sustainable, person-centred and equitable. Further research and development is necessary to exploit advances in technology across the board so it can help all those requiring social care.

References

1. Adriana.rios@urosario.edu.co, L L L E S S I N A M A R R. (2016, July 5). A systematic review of smart homes and home health monitoring technologies for older adults. https://www.sciencedirect.com/science/article/pii/S1386505616300648
2. Koumakis, L., Chatzaki, C., Kazantzaki, E., Maniadi, E., & Tsiknakis, M. (2019, January 1). Dementia Care Frameworks and Assistive Technologies for Their Implementation: A Review. Institute of Electrical and Electronics Engineers, 12, 4-18. https://doi.org/10.1109/rbme.2019.2892614
3. Said, M M A J M O H P S V L. (2013, January 1). Smart-Home Technologies to Assist Older People to Live Well at Home. https://www.omicsonline.org/open-access/smart-home-technologies-to-assist-older-people-to-live-well-at-home-jasc.1000101.pdf
4. Merkel, S., & Enste, P. (2015, January 1). Barriers to the diffusion of telecare and telehealth in the EU: a literature review. https://doi.org/10.1049/ic.2015.0128
5. Zhu, E M., Buljac- Samardžić, M., Ahaus, K., Sevdalis, N., & Huijsman, R. (2022, January 1). Implement and disseminate home and community-based interventions for informal caregivers of dementia patients: a systematic scoping review protocol. BMJ, 12(1), e052324-e052324. https://doi.org/10.1136/bmjopen-2021-052324
6. Fischer, S H., David, D., Crotty, B H., Dierks, M., & Safran, C. (2014, September 1). Acceptance and use of health information technology by community-dwelling elders. Elsevier BV, 83(9), 624-635. https://doi.org/10.1016/j.ijmedinf.2014.06.005

7. Ullah, Z., Al- Turjman, F., Mostarda, L., & Gagliardi, R. (2020, March 1). Applications of Artificial Intelligence and Machine learning in smart cities. Elsevier BV, 154, 313-323. https://doi.org/10.1016/j.comcom.2020.02.069
8. Bi, Shuochen, and Yufan Lian. "Advanced Portfolio Management in Finance using Deep Learning and Artificial Intelligence Techniques: Enhancing Investment Strategies through Machine Learning Models." Journal of Artificial Intelligence Research 4, no. 1 (2024): 233-298.
9. Pandiya, Dileep Kumar. 2022. "Performance Analysis of Microservices Architecture in Cloud Environments". *International Journal on Recent and Innovation Trends in Computing and Communication* 10 (12):264-74. https://ijritcc.org/index.php/ijritcc/article/view/10745.
10. Pureti, N. (2022). Building a Robust Cyber Defense Strategy for Your Business. *Revista de Inteligencia Artificial en Medicina*, *13*(1), 35-51.
11. Bhowmick, D., T. Islam, and K. S. Jogesh. "Assessment of Reservoir Performance of a Well in South-Eastern Part of Bangladesh Using Type Curve Analysis." *Oil Gas Res* 4, no. 159 (2019): 2472-0518.
12. Yanamala, Anil Kumar Yadav, Srikanth Suryadevara, and Venkata Dinesh Reddy Kalli. "Balancing Innovation and Privacy: The Intersection of Data Protection and Artificial Intelligence." *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence* 15, no. 1 (2024): 1-43.
13. Kothamali, Parameshwar Reddy, Subrata Banik, Nagaraj Mandaloju, and Noone Srinivas. "Real-Time Translation in Multilingual Education: Leveraging NLP for Inclusive Learning." *Journal Environmental Sciences And Technology* 3, no. 1 (2024): 992-116.
14. S. . Reddy Gayam, R. . Reddy Yellu, and P. Thuniki, "Artificial Intelligence for Real-Time Predictive Analytics: Advanced Algorithms and Applications in Dynamic Data Environments", *Distrib Learn Broad Appl Sci Res*, vol. 7, pp. 18–37, Feb. 2021, Accessed: Jul. 03, 2024. [Online]. Available: https://dlabi.org/index.php/journal/article/view/29
15. Banik, Subrata, Parameshwar Reddy Kothamali, and Sai Surya Mounika Dandyala. "Strengthening Cybersecurity in Edge Computing with Machine Learning." *Revista de Inteligencia Artificial en Medicina* 15, no. 1 (2024): 332-364.
16. Pureti, N. (2022). Insider Threats: Identifying and Preventing Internal Security Risks. *International Journal of Advanced Engineering Technologies and Innovations*, *1*(2), 98-132.
17. Kothamali, Parameshwar Reddy, Noone Srinivas, Nagaraj Mandaloju, and Vinod kumar Karne. "Smart Healthcare: Enhancing Remote Patient Monitoring with AI and IoT." *Revista de Inteligencia Artificial en Medicina* 14, no. 1 (2023): 113-146.
18. Yanamala, Anil Kumar Yadav, Srikanth Suryadevara, and Venkata Dinesh Reddy Kalli. "Evaluating the Impact of Data Protection Regulations on AI Development and Deployment." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 01 (2023): 319-353.
19. Kothamali, Parameshwar Reddy, Nagaraj Mandaloju, Noone Srinivas, and Sai Surya Mounika Dandyala. "Ensuring Supply Chain Security and Transparency with Blockchain and

AI." *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence* 14, no. 1 (2023): 165-194.

20. Deng, Tingting, Shuochen Bi, and Jue Xiao. "Comparative Analysis of Advanced Time Series Forecasting Techniques: Evaluating the Accuracy of ARIMA, Prophet, and Deep Learning Models for Predicting Inflation Rates, Exchange Rates, and Key Financial Indicators." *Advances in Deep Learning Techniques* 3, no. 1 (2023): 52-98.
21. Kothamali, Parameshwar Reddy, Noone Srinivas, and Nagaraj Mandaloju. "Smart Grid Energy Management: The Role of AI in Efficiency and Stability." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 03 (2023): 332-352.
22. Charankar , Nilesh. 2022. "FAULT TOLERANCE TECHNIQUES IN API AND MICRO SERVICES". *International Journal on Recent and Innovation Trends in Computing and Communication* 10 (12):275-85. https://ijritcc.org/index.php/ijritcc/article/view/10746.
23. Kothamali, Parameshwar Reddy, Nagaraj Mandaloju, and Sai Surya Mounika Dandyala. "Optimizing Resource Management in Smart Cities with AI." *Unique Endeavor in Business & Social Sciences* 1, no. 1 (2022): 174-191.
24. Raparthi, Mohan. "AI Integration in Precision Health-Advancements, Challenges, and Future Prospects." *Asian Journal of Multidisciplinary Research & Review* 1, no. 1 (2020): 90-96.
25. Muhammad, Shafi, Fatima Meerjat, Amna Meerjat, and Aryendra Dalal. "Safeguarding Data Privacy: Enhancing Cybersecurity Measures for Protecting Personal Data in the United States." *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence* 15, no. 1 (2024): 141-176.
26. Muhammad, Shafi, Fatima Meerjat, Amna Meerjat, and Aryendra Dalal. "Enhancing Cybersecurity Measures for Blockchain: Securing Transactions in Decentralized Systems." *Unique Endeavor in Business & Social Sciences* 2, no. 1 (2023): 120-141.
27. Kothamali, Parameshwar Reddy, Subrata Banik, Sai Surya Mounika Dandyala, and Vinod kumar Karne. "Advancing Telemedicine and Healthcare Systems with AI and Machine Learning." *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence* 15, no. 1 (2024): 177-207.
28. Muhammad, Shafi, Fatima Meerjat, Amna Meerjat, Sarwat Naz, and Aryendra Dalal. "Enhancing Cybersecurity Measures for Robust Fraud Detection and Prevention in US Online Banking." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 3 (2024): 510-541.
29. Raparthi, Mohan. "AI-Driven Decision Support Systems for Precision Medicine: Examining the Development and Implementation of AI-Driven Decision Support Systems in Precision Medicine." *Journal of Artificial Intelligence Research* 1, no. 1 (2021): 11-20.
30. Muhammad, Shafi, Fatima Meerjat, Aisha Meerjat, and Aryendra Dalal. "Integrating Artificial Intelligence and Machine Learning Algorithms to Enhance Cybersecurity for United States Online Banking Platforms." *Journal Environmental Sciences And Technology* 3, no. 1 (2024): 117-139.
31. Muhammad, Shafi, Fatima Meerjat, Aisha Meerjat, Sarwat Naz, and Aryendra Dalal. "Strengthening Mobile Platform Cybersecurity in the United States: Strategies and Innovations." *Revista de Inteligencia Artificial en Medicina* 14, no. 1 (2023): 84-112.

32. kumar Karne, Vinod, Sai Surya Mounika Dandyala, Parameshwar Reddy Kothamali, and Noone Srinivas. "Enhancing Environmental Monitoring and Disaster Prediction with AI." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 3 (2021): 53-73.
33. Raparthi, Mohan. "Real-Time AI Decision Making in IoT with Quantum Computing: Investigating & Exploring the Development and Implementation of Quantum-Supported AI Inference Systems for IoT Applications." *Internet of Things and Edge Computing Journal* 1, no. 1 (2021): 18-27.
34. Pureti, N. (2022). The Art of Social Engineering: How Hackers Manipulate Human Behavior. *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence*, *13*(1), 19-34.
35. Yanamala, Anil Kumar Yadav. "Secure and Private AI: Implementing Advanced Data Protection Techniques in Machine Learning Models." *International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence* 14, no. 1 (2023): 105-132.
36. Kothamali, Parameshwar Reddy, Vinod Kumar Karne, and Sai Surya Mounika Dandyala. "Integrating AI and Machine Learning in Quality Assurance for Automation Engineering." In *International Journal for Research Publication and Seminar*, vol. 15, no. 3, pp. 93-102. 2024.
37. Dandyala, Sai Surya Mounika, Vinod kumar Karne, and Parameshwar Reddy Kothamali. "Predictive Maintenance in Industrial IoT: Harnessing the Power of AI." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 4 (2020): 1-21.
38. Pureti, N. (2022). Zero-Day Exploits: Understanding the Most Dangerous Cyber Threats. *International Journal of Advanced Engineering Technologies and Innovations*, *1*(2), 70-97.
39. Kothamali, Parameshwar Reddy, Sai Surya Mounika Dandyala, and Vinod kumar Karne. "Leveraging Edge AI for Enhanced Real-Time Processing in Autonomous Vehicles." *International Journal of Advanced Engineering Technologies and Innovations* 1, no. 3 (2019): 19-40.

Yanamala, Anil Kumar Yadav. "Data-driven and artificial intelligence (AI) approach for modelling and analyzing healthcare security practice: a systematic review." *Revista de Inteligencia Artificial en Medicina* 14, no. 1 (2023): 54-83.