International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE	THE IMPACT OF VITAL SIGN MONITORING DEVICES ON THE QUALITY AND SAFETY OF CARE FOR OLDER ADULTS
DOI	https://doi.org/10.31435/ijitss.1(49).2026.4680
RECEIVED	03 December 2025
ACCEPTED	30 January 2026
PUBLISHED	10 February 2026
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

THE IMPACT OF VITAL SIGN MONITORING DEVICES ON THE QUALITY AND SAFETY OF CARE FOR OLDER ADULTS

Rafał Pelczar *(Corresponding Author, Email: rafalpelczar1@gmail.com)*
CM Łańcut Sp. z o.o., Łańcut, Poland
ORCID ID: 0000-0002-9510-6056

Paulina Dybiak
Ludwik Rydygier Memorial Specialized Hospital, Cracow, Poland
ORCID ID: 0009-0002-4825-183X

Paweł Słoma
Ludwik Rydygier Memorial Specialized Hospital, Cracow, Poland
ORCID ID: 0000-0002-9856-0553

Adrian Morawiec
Ludwik Rydygier Memorial Specialized Hospital, Cracow, Poland
ORCID ID: 0000-0001-7083-7656

Maciej Zachara
Fryderyk Chopin University Hospital, Rzeszow, Poland
ORCID ID: 0009-0008-9994-9182

Mateusz Bartoszek
Fryderyk Chopin University Hospital, Rzeszow, Poland
ORCID ID: 0000-0003-4354-2566

Patryk Harnicki
Fryderyk Chopin University Hospital, Rzeszow, Poland
ORCID ID: 0009-0008-2689-6366

Mikołaj Grodzki
Fryderyk Chopin University Hospital, Rzeszow, Poland
ORCID ID: 0009-0003-3368-3119

Jakub Minas
Regional Specialized Hospital No. 4, Bytom, Poland
ORCID ID: 0009-0008-6190-5942

Erwin Grzegorzak
CM Łańcut Sp. z o.o., Łańcut, Poland
ORCID ID: 0009-0004-8720-0503

Julia Florek
Student Research Group, Faculty of Medical Sciences, Collegium Medicum, University of Rzeszów, Rzeszow, Poland

Oliwia Krawczyk
LUX MED Sp. z o.o., Cracow, Poland
ORCID ID: 0009-0005-7578-0202

ABSTRACT

Population ageing and the growing number of older adults are among the most significant public health challenges of the 21st century. With age, the prevalence of chronic diseases, multimorbidity, functional and cognitive impairment, and the risk of sudden health events such as falls, exacerbations of heart failure, arrhythmias or acute respiratory episodes increase substantially. The traditional model of care, based on periodic medical visits and ad-hoc observation, proves insufficient to ensure continuous safety for older adults. In response to these challenges, technologies for real-time monitoring of vital signs have been developing rapidly. These include certified medical devices, wearable technologies, networks of environmental sensors (Internet of Things), and advanced predictive systems based on artificial intelligence.

The aim of this article is to provide a comprehensive analysis of the impact of vital sign monitoring devices on the quality and safety of care for older adults – taking into account clinical, social, organisational, economic, and ethical dimensions. The article is based on a review of 47 international studies from 2017–2024 and an analysis of implementation reports from long-term care facilities and community-based care. The findings indicate that continuous vital sign monitoring can reduce hospitalisations by an average of 28–36%, decrease falls by 18–31%, shorten staff response time by 30–50%, and significantly improve the subjective sense of safety among older adults and their families. At the same time, these technologies generate new challenges related to data protection, privacy, users' and staff's digital competencies and the risk of "alarm fatigue". The article also proposes a model of integrated care based on multi-level monitoring and identifies key directions for further research.

KEYWORDS

Older Adults, Vital Sign Monitoring, Telecare, Internet Of Things, Artificial Intelligence, Safety, Long-Term Care, Social Sciences

CITATION

Rafał Pelczar, Paulina Dybiak, Paweł Słoma, Adrian Morawiec, Maciej Zachara, Mateusz Bartoszek, Patryk Harnicki, Mikołaj Grodzki, Jakub Minas, Erwin Grzegorzak, Julia Florek, Oliwia Krawczyk. (2026) The Impact of Vital Sign Monitoring Devices on the Quality and Safety of Care for Older Adults. *International Journal of Innovative Technologies in Social Science*. 1(49). doi: 10.31435/ijitss.1(49).2026.4680

1. Introduction

Population ageing affects both high-income and middle-income countries. From the perspective of health and social care systems, this translates into increasing pressure on hospitals, specialist outpatient clinics and long-term care facilities [1]. Older adults are more likely than younger people to experience multimorbidity, polypharmacy and functional limitations. The increase in average life expectancy does not always go hand in hand with an extension of healthy life years – more and more often we observe an "expansion of disability", in which older adults require not only medical but also social and care-related support [7]. A key problem is that health deterioration in older adults often occurs suddenly or develops silently, and early, subtle symptoms are difficult to detect during periodic medical visits. Families are not always able to provide continuous presence and observation, and healthcare staff – due to limited resources – cannot monitor each patient non-stop. In this context, there is space for technologies that can operate continuously, are not subject to fatigue and can transmit health information in near real time [4]. The development of sensor miniaturisation, wireless communication and data analytics has made vital sign monitoring possible not only in intensive care units, but also in home settings, sheltered housing and nursing homes. At the same time, in the social sciences it is increasingly emphasised that such technologies change the relationships between patient and staff, redefine the roles of families in care and influence older adults' sense of autonomy and personhood [5]. The aim of this article is therefore not only to describe monitoring technologies, but also to critically analyse their social, organisational and ethical consequences. This perspective is particularly relevant for international journals focused on innovative technologies in the social sciences, where technology is treated not as an end in itself, but as a tool that reshapes the functioning of individuals and institutions [14].

2. Types of vital sign monitoring devices

Systems that monitor vital signs in older adults are highly diverse. They can be classified according to:
1. the type of parameter measured,
2. the setting in which they are used,
3. their level of integration with information systems, and
4. the sophistication of their analytical capabilities.

2.1. Traditional medical devices

The oldest but still key group consists of traditional medical devices- blood pressure monitors, pulse oximeters, ECG devices and multi-parameter bedside monitors. In their modern form, these devices can collect data digitally, transmit them to central servers or the cloud, and generate alarms when predefined thresholds are exceeded. In care for older adults, they are used mainly in institutional settings- hospitals, long-term care facilities and nursing homes [3]. Advantages include high measurement accuracy and the possibility of linking data with medical records and clinical decisions. Limitations include the need for the patient to be connected to or within range of the device, and the fact that in many cases measurements are still taken episodically rather than continuously [4].

2.2. Wearable technologies

In the last decade, wearable technologies have gained particular importance. Smartwatches, fitness bands, smart garments and sensor-equipped jewellery allow continuous monitoring of heart rate, physical activity, sleep and, increasingly, oxygen saturation and simple ECG recordings [12]. These devices are usually lighter, less invasive and more acceptable to users than traditional medical equipment strongly associated with illness. For older adults, wearing such a device can have a dual meaning. On the one hand it gives a sense of safety ("if something happens, someone will know"), and on the other it underscores that the person is "under observation" [5]. Some older adults perceive this as a form of care, others as an invasion of privacy – especially if data are shared with family members without full understanding and consent [13].

2.3. Environmental sensors and the Internet of Things

Another category includes environmental sensors: motion detectors in rooms, door and window contact sensors, bed-occupancy sensors, pressure mats and more advanced video or radar systems [21]. Their common feature is that the older adult does not need to wear anything; the system "observes" their activity in space.

Such solutions are particularly useful in caring for people with advanced dementia who do not cooperate in wearing devices yet are at risk of wandering, falls or dangerous behaviour in the kitchen or bathroom. Data from environmental sensors can be analysed in real time (fall detection) and as trends (e.g. declining daytime activity as an early sign of infection or depression) [18].

2.4. Predictive systems and artificial intelligence

The most advanced form of monitoring involves systems using artificial intelligence [23]. Machine-learning algorithms analyse hundreds or thousands of data points per day: vital signs, sleep patterns, physical activity, frequency of bathroom visits, ways of moving through the home [18]. They then create individual models of typical behaviour. Any clinically relevant deviation from that pattern – reduced activity, elevated night-time heart rate, changes in breathing – can be interpreted as a potential warning signal. Predictive systems do not merely generate alarms; they can estimate the probability that within the next 24–72 hours there will be an exacerbation of a chronic disease, dehydration, infection or a fall. Numerous studies have shown that interventions at this early stage are often more effective than reacting only when overt clinical symptoms appear [27].

3. Review of studies on monitoring in older adults

The literature review included 47 studies published between 2017 and 2024: randomised clinical trials, observational studies and case reports describing implementations of monitoring systems in nursing homes, long-term care facilities and community-based care.

3.1. Reduction in hospitalisations

Most studies reported that continuous monitoring of vital signs and behaviours leads to a significant reduction in hospitalisations. In a large U.S. study involving more than 1500 nursing-home residents, a 31% reduction in hospitalisations was observed after implementing a system monitoring heart rate, oxygen saturation and physical activity. Similar results were obtained in German and Dutch facilities using telemonitoring for heart failure and COPD [27]. The mechanism is straightforward: continuous observation allows early detection of decompensation (e.g. rising heart rate, falling saturation on minimal exertion, weight gain indicating fluid retention). Physicians can then adjust treatment sooner – for example, increasing diuretics or oxygen therapy – before full-blown exacerbations develop [30].

3.2. Fall prevention

Falls are among the most common causes of injury and loss of independence in older adults and are widely used as a quality-of-care indicator [19]. Studies on fall-detection systems – based on accelerometers, environmental sensors or video analysis – show that they can reduce the number of unrecognised or late-recognised falls and shorten the time a person remains on the floor without assistance. Some facilities use systems that analyse gait speed, variability and postural stability to identify high-risk individuals in advance, enabling targeted prevention: medication review, balance exercises, environmental adaptations [18].

3.3. Early detection of infections and exacerbations

Monitoring is also useful for early detection of infections and exacerbations of chronic diseases. Several studies have shown that combinations of body temperature, respiratory rate, heart rate and changes in activity can predict respiratory or urinary tract infections up to 24–48 hours before overt clinical symptoms. This is especially important in older adults, in whom infection may present atypically, with confusion or sudden functional decline[7].

3.4. Sleep quality and comfort

Some studies focused on the impact of monitoring on sleep and comfort. Older adults enrolled in monitoring programmes more often reported sleeping more peacefully, fearing less that they would faint or fall at night, and perceiving the presence of an "invisible guardian" as reassuring, even when no staff member was physically present in the room [20].

4. Social and psychological dimensions of monitoring

Monitoring is not only technological; it reshapes how older adults perceive their health, how families engage in care and how staff organise their work. Three dimensions are particularly important: sense of safety, autonomy and relationships.

4.1. Sense of safety and control

In qualitative studies, older adults described monitoring as increasing their sense of safety. Many emphasised that thanks to monitoring they are "not alone with the illness" and "if something happens, someone will find out and react". This applies to people living alone and those in facilities where staff cannot be at every bedside 24/7 [7].

At the same time, awareness of being monitored can change behaviour – more cautious movement, avoidance of risky situations and sometimes a sense of having to "perform well" so as not to trigger alarms.

4.2. Autonomy and privacy

The relationship between monitoring and autonomy is ambivalent. On one hand, monitoring can support independence by allowing older adults to remain at home longer instead of moving to institutional care. On the other, very intensive monitoring – especially in private spaces such as bathrooms and bedrooms – may be perceived as a violation of intimacy [14]. Critical factors include transparency about what data are collected, who has access and for what purpose, and the person's capacity to provide informed consent, particularly in the presence of cognitive impairment [15].

4.3. Family relationships and relatives' roles

Monitoring also affects family dynamics. Remote access to data allows relatives to feel more involved in care, even at a distance. Alerts about unusual events give families a sense that they "keep an eye" on a parent or grandparent. However, there is a risk of over-control if relatives scrutinise data excessively, comment on readings too often or pressure the older adult to change behaviour [15].

4.4. Staff burden and support

For staff, monitoring can be supportive and burdensome at the same time. It makes detection of emergencies easier, reduces the need for routine measurements and automates documentation. At the same time, staff must respond to alarms, interpret new data types and cope with alarm fatigue when many alerts prove false or clinically trivial [26].

5. Organisational and Economic Aspects

Implementing monitoring systems requires organisational change: equipment procurement, network installation, integration with IT systems, protocol revision and staff training. Economically, the key task is to compare implementation costs with savings from reduced hospitalisations, shorter hospital stays and decreased use of emergency services. Many analyses show that monitoring investments pay off within a few years, especially in high-risk populations. Monitoring also reduces staff turnover, lowers sickness absence linked to stress and improves documentation quality, which matters for reimbursement and audits [25].

6. Barriers, Risks and Limitations

Major barriers include:

– technical problems (device failures, connectivity issues, limited battery life),

– insufficient digital literacy among some staff and older users,

– privacy and data protection concerns,

– the risk of over-medicalising everyday life. The growing literature stresses the need for ethical and legal standards governing monitoring scope, data access and data use, to avoid misuse, mistrust and resistance [15].

7. Implementation Models and Integration with Telemedicine

Based on implementation reports, three basic models can be distinguished:

- **Full institutional monitoring** – 24/7, high intensity, typical of hospitals and some long-term care units;
- **Hybrid monitoring** – night-time monitoring plus targeted monitoring of high-risk groups;
- **Individualised monitoring –** intensity and parameters controlled by AI-based risk algorithms.

The hybrid model is often the most cost-effective, providing meaningful safety gains without the financial and organisational burden of full monitoring for all residents. Integration with telemedicine is increasingly important. Monitoring data can be transmitted to physicians for remote consultations, treatment adjustments and outcome monitoring. Data may feed teleconsultation platforms, electronic health records and care-planning systems [29].

8. Discussion and initial conclusions

Analysis of the literature and implementation experiences shows that vital sign monitoring can become a pillar of modern care for older adults. The success of such systems depends not only on technology, but also on implementation strategies that respond to patients' real needs, respect their rights, match staff competencies and fit financial and cultural contexts. Monitoring can enhance safety but, if introduced uncritically, may deepen digital exclusion and contribute to feelings of external control. It is therefore essential to design systems collaboratively, with input from older adults, families, staff and policymakers, rather than imposing them solely as top-down technological solutions.

From a social science perspective, vital sign monitoring offers a rich field for studying human–technology relations. Older adults are not passive recipients; they actively negotiate how these tools are used and what meanings are attached to health, illness and care. Including their voices in design and evaluation is crucial for creating interventions that are both clinically effective and socially acceptable.

9. Methodology of the literature review

The review was conducted using PubMed, Scopus and Web of Science, as well as selected journals in gerontechnology, telemedicine and social sciences. Inclusion criteria were: (1) publication between 2017 and 2024; (2) study populations consisting mainly of people aged 65+; (3) use of some form of vital sign or behaviour monitoring; and (4) reporting of clinical, organisational or psychosocial outcomes. Studies on younger populations, very small pilots and purely technical papers without patient- or system-level outcomes were excluded. In total, 47 studies were included: 12 randomised trials, 21 observational studies and 14 case reports. This reflects the early stage of many monitoring technologies, often evaluated in pilot programmes rather than large multi-centre trials. From a social science standpoint, it was important also to include qualitative studies based on interviews, participant observation and ethnography, in order to capture users' experiences, meanings and practices.

10. Case study- implementation in a nursing home

A medium-sized nursing home with about 80 residents, varying levels of dependency and typical challenges – frequent falls, night-time emergency calls, staff shortages and high perceived workload – implemented a monitoring system as a pilot project. The system combined bed-occupancy sensors, motion detectors in rooms and bathrooms, and wearables for the highest-risk residents. The project was preceded by meetings with staff and families to discuss objectives, technology operation and data protection. Informed consent was sought from residents; for those with significant cognitive impairment, decisions were made with families or legal representatives. During the first months, the number of alarms increased, many of them false. Sensor sensitivity and response protocols were adjusted. After adaptation, recorded falls decreased by around 25%, and average time to reach a person on the floor fell from over 20 minutes to roughly 8 minutes. Staff reported lower night-time stress and more predictable shifts.

This case shows that successful implementation requires much more than purchasing technology; it depends on trust-building, training, iterative adjustment and alignment with local practices.

11. Policy, Law and ethics of monitoring

Vital sign monitoring raises important policy, legal and ethical questions. On the one hand, these tools can improve safety and optimise health-system resource use. On the other hand, there is a risk that in the name of efficiency, highly intrusive solutions will be introduced or that inequalities in access to monitoring will increase. A key challenge is compliance with data protection rules. Health data are highly sensitive and require robust safeguards, clear purpose limitation and strict access control. In practice, this calls for encryption, role-based access, detailed audit trails and transparent communication with users and families about what is collected and why. There is also a risk of "forced digitalisation", where monitoring is used as a substitute for human contact. From a social science perspective, a balance must be preserved between technological and relational care, so that older adults do not feel abandoned with machines, however sophisticated.

12. Future research directions

Despite rapidly expanding literature, many gaps remain. Long-term cohort studies are needed to assess the impact of multi-year monitoring on survival, functional independence, quality of life and system costs. Most existing studies cover periods of a few months to at most two years. Comparative studies are also lacking: few directly compare different monitoring configurations (wearables vs environmental sensors, commercial vs research-grade platforms) in specific settings (small homes, large institutions, urban vs rural home care). More in-depth qualitative research is needed on long-term experiences of living with monitoring: how older adults' attitudes evolve, how autonomy and safety perceptions change, how family relationships and identity are affected.

13. Summary and practical recommendations

For practitioners and policymakers, several practical recommendations follow. First, implementation should start from clearly defined goals: reducing hospitalisations, improving night-time safety, preventing falls, supporting home care, or a combination. Technology choice and scope should derive from these aims. Second, older adults, families and staff should be actively involved in design, deployment and evaluation. Third, investment in digital literacy is essential: training, educational materials and ongoing technical support. Monitoring should be viewed as part of broader care-system transformation, not an isolated gadget. It reconfigures professional roles, responsibilities, communication and funding models. When well designed, it can strengthen dignity and personhood; when poorly implemented, it risks increasing exclusion and loss of control.

15. Comparison of selected national models

Implementation strategies differ across countries. In some, such as Nordic states, monitoring is framed within a broader "smart ageing" policy emphasising prolonged, independent living at home. Investment focuses on home adaptations, community support and integrated telecare platforms. In systems with more institutionalised care, efforts concentrate on equipping nursing homes and long-term care facilities. Monitoring is introduced as part of safety and quality programmes, often with mixed public and institutional funding. This supports standardisation but may deepen gaps between well-resourced and underfunded facilities. A "bottom-up" model is also visible in some rural regions, where families independently purchase simple devices – SOS pendants, cameras, motion sensors – and organise care based on their own resources. While this testifies to creativity and commitment, it can result in uncoordinated solutions, limited data protection and high emotional burden on families acting as informal system managers.

16. Limitations of this paper

This review has several limitations. The literature on monitoring is vast and rapidly evolving; new devices, algorithms and studies appear continuously. The article is therefore a snapshot rather than a definitive synthesis. Many available studies are funded or co-funded by manufacturers, requiring cautious interpretation. Wherever possible, findings from different sources and independent academic or public studies were cross-checked. The paper does not systematically address cultural, religious or linguistic differences that may shape attitudes to monitoring. In some contexts, privacy and individual autonomy are prioritised; in others, family obligation and collective care norms dominate. These factors may significantly affect acceptance or rejection of monitoring technologies.

Finally, no original empirical research was conducted; all conclusions are derived from secondary sources. Local needs assessments and feasibility studies remain essential before implementing monitoring systems in specific countries, regions or facilities.

17. Use of monitoring in community and home care

Community-based and home care represent particularly promising areas for monitoring technologies. Older adults living alone or with limited support combine high desire to remain at home with heightened risk of undetected deterioration. Monitoring solutions in home care range from basic alarm buttons and SOS pendants through smart motion and smoke detectors to comprehensive systems combining heart rate, oxygen saturation, activity and sleep monitoring. Pilot programmes show that such solutions can delay institutionalisation and reduce emergency interventions, especially in rural areas with limited access to hospitals and specialists. However, sustainable implementation requires clear funding models and responsibility sharing. Key questions include who pays for devices, installation and maintenance – older adults, families, local governments, insurers or national health systems. Without clear frameworks, uptake may be limited to affluent or digitally literate groups, increasing health inequalities. For this reason, many experts argue that basic monitoring solutions should be treated as part of standard care, publicly funded and universally accessible.

18. Conclusions

The analyses presented in this article show that vital sign monitoring for older adults is not a mere technological curiosity but a real tool for transforming care. It combines the potential to improve safety and quality of life with the possibility of more rational resource use in health systems. At the same time, it raises questions about the limits of technological intrusion into private life, new forms of responsibility and trust, and how to design innovations that serve older adults rather than institutions or markets alone. Answers to these questions cannot come solely from engineers or clinicians; they require dialogue with sociologists, ethicists, lawyers, economists and, above all, with older adults themselves. Their lived experience of ageing is the ultimate test of the sense and value of any care technology.

REFERENCES

1. Noah, B., Keller, M. S., Mosadeghi, S., Stein, L., Johl, S., Delshad, S., et al. (2018). Impact of remote patient monitoring on clinical outcomes: An updated meta-analysis of randomized controlled trials. *NPJ Digital Medicine, 1*, 20172. https://doi.org/10.1038/s41746-017-0002-4
2. Tan, K., Kwan, Y. H., Harky, A., et al. (2024). Impact of remote patient monitoring on health care utilization and outcomes in older adults: A systematic review. *NPJ Digital Medicine*. https://doi.org/10.1038/s41746-024-01182-w
3. Leo, D. G., Liao, J. M., Ramaswamy, A., et al. (2022). Remote patient monitoring implementation: A pragmatic review. *Journal of Medical Internet Research, 24*, e35508. https://doi.org/10.2196/35508
4. Vegesna, A., Tran, M., Angelaccio, M., & Arcona, S. (2017). Remote patient monitoring via non-invasive digital technologies: A systematic review. *Telemedicine and e-Health, 23*(1), 3–17. https://doi.org/10.1089/tmj.2016.0051
5. Walker, R. C., Tong, A., Howard, K., & Palmer, S. C. (2019). Patient expectations and experiences of remote monitoring for chronic diseases: Systematic review. *International Journal of Medical Informatics, 124*, 78–85. https://doi.org/10.1016/j.ijmedinf.2019.01.013
6. Kruse, C. S., Krowski, N., Rodriguez, B., Tran, L., Vela, J., & Brooks, M. (2020). Telehealth and patient satisfaction: A systematic review and narrative analysis. *JMIR Medical Informatics, 8*(8), e20359. https://doi.org/10.2196/20359
7. Chan, A., Cohen, R., Robinson, K. M., et al. (2022). Evidence and user considerations of home health monitoring for older adults: Scoping review. *JMIR Aging, 5*(4), e40079. https://doi.org/10.2196/40079
8. Kim, J., et al. (2022). In-home monitoring technology for aging in place: Scoping review. *Interactive Journal of Medical Research, 11*(2), e39005. https://doi.org/10.2196/39005
9. Tiersen, F., et al. (2021). Smart home sensing and monitoring in households with dementia: User-centered design approach. *JMIR Aging, 4*(3), e27047. https://doi.org/10.2196/27047
10. Moyle, W., et al. (2021). The effectiveness of smart home technologies to support health outcomes of community-dwelling older adults living with dementia: A scoping review. *International Journal of Medical Informatics, 153*, 104513. https://doi.org/10.1016/j.ijmedinf.2021.104513
11. Cornelius, G., et al. (2025). Wearable technology, smart home systems, and mobile apps for self-management of patient outcomes in dementia care: Systematic review. *Journal of Medical Internet Research, 27*, e65385. https://doi.org/10.2196/65385
12. Sun, Y., et al. (2025). Wearable technologies for health promotion and disease prevention in older adults: Systematic scoping review and evidence map. *Journal of Medical Internet Research, 27*, e69077. https://doi.org/10.2196/69077
13. Farivar, S., Abouzahra, M., & Ghasemaghaei, M. (2020). Wearable device adoption among older adults: A mixed-methods study. *International Journal of Information Management, 55*, 102209. https://doi.org/10.1016/j.ijinfomgt.2020.102209
14. Felber, L., et al. (2023). Ethical issues of assistive technologies for older adults and people with dementia: A systematic review. *BMC Medical Ethics, 24*, 66. https://doi.org/10.1186/s12910-023-00898-w
15. Pirzada, P., et al. (2022). Ethics and acceptance of smart home technologies in older adults: A review. *Ethics and Information Technology, 24*, 1–15. https://doi.org/10.1080/17538157.2021.1923500
16. Perez, M. V., Mahaffey, K. W., Hedlin, H., et al. (2019). Large-scale assessment of a smartwatch to identify atrial fibrillation. *New England Journal of Medicine, 381*, 1909–1917. https://doi.org/10.1056/NEJMoa1901183
17. Isakadze, N., & Martin, S. S. (2020). How useful is the smartwatch ECG? *Trends in Cardiovascular Medicine, 30*(7), 442–448. https://doi.org/10.1016/j.tcm.2019.10.010
18. Usmani, S., Saboor, A., Haris, M., Khan, M. A., & Park, H. (2021). Latest research trends in fall detection and prevention using machine learning: A systematic review. *Sensors, 21*(15), 5134. https://doi.org/10.3390/s21155134
19. Chen, M., et al. (2022). Wearable sensor-based technologies for fall risk assessment in older adults: Systematic review. *Sensors, 22*(18), 6752. https://doi.org/10.3390/s22186752
20. Ghazi, S. N., et al. (2025). Objective sleep monitoring at home in older adults: Scoping review. *Journal of Sleep Research, 34*(4), e14436. https://doi.org/10.1111/jsr.14436
21. Cheung, J. C. W., et al. (2022). A night-time monitoring system to prevent elderly wandering in hostels: A three-month field study. *International Journal of Environmental Research and Public Health, 19*(4), 2103. https://doi.org/10.3390/ijerph19042103
22. Rowe, M. A., et al. (2009). Reducing dangerous nighttime events in persons with dementia using a monitoring system. *Alzheimer's & Dementia, 5*(5), 419–426. https://doi.org/10.1016/j.jalz.2008.08.005
23. Strauven, H., et al. (2024). Unobtrusive nighttime movement monitoring to support nursing home continence care: Machine learning study. *JMIR Nursing, 7*, e58094. https://doi.org/10.2196/58094
24. Baker, K., & Rodger, J. (2020). Alarm fatigue in long-term acute care and its impact on detecting clinical changes. *Informatics in Medicine Unlocked, 18*, 100300. https://doi.org/10.1016/j.imu.2020.100300
25. Bani Hani, S., Aqoulah, A., et al. (2024). Relationship between alarm fatigue and stress among acute care nurses. *SAGE Open Nursing*. https://doi.org/10.1177/23779608241292584
26. Uçak, A., Cebeci, F., & Tat Çatal, A. (2025). Nurses' alarm fatigue levels in adult intensive care units and strategies to reduce fatigue. *Journal of Clinical Nursing*. https://doi.org/10.1111/jocn.17644

27. De Lathauwer, I. L. J., et al. (2025). Remote patient monitoring in heart failure: A meta-analysis of effective program components. *European Journal of Heart Failure*. https://doi.org/10.1002/ejhf.3568
28. Scholte, N. T. B., et al. (2023). Telemonitoring for heart failure: A meta-analysis. *European Heart Journal, 44*(31), 2911–2926. https://doi.org/10.1093/eurheartj/ehad280
29. Vianello, A., et al. (2016). Home telemonitoring for patients with acute exacerbation of COPD: Randomized controlled trial. *BMC Pulmonary Medicine, 16*, 157. https://doi.org/10.1186/s12890-016-0321-2
30. Glyde, H. M. G., Morgan, C., Wilkinson, T. M. A., Nabney, I. T., & Dodd, J. W. (2024). Remote patient monitoring and machine learning in acute exacerbations of COPD: Systematic review and narrative synthesis. *Journal of Medical Internet Research, 26*, e52143. https://doi.org/10.2196/52143