
Community Embedded Care and Service Quality in Elderly Care: A Survey

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Abstract

This survey paper explores the integration of community embedded care frameworks and service quality enhancement in elderly care, emphasizing the role of advanced technologies and evaluation indices. The demographic shift towards an aging population necessitates innovative approaches to healthcare delivery, leveraging community resources and technological advancements to enhance accessibility and quality of care. Community health workers (CHWs) play a pivotal role in bridging gaps in service delivery, supported by technologies such as Socially Assistive Robots (SARs) and non-intrusive monitoring systems. Evaluation indices provide benchmarks for assessing service quality, facilitating the development of AI-driven solutions and identifying areas for improvement. Challenges such as technology acceptance, privacy concerns, and workforce allocation are addressed through strategic planning and the integration of innovative methodologies. Best practices highlighted include the use of WiFi sensing systems for passive health monitoring and the implementation of participatory design approaches to ensure culturally sensitive care. Future research should focus on ethical and legal dimensions of technology integration, exploring adaptive systems that evolve with the changing needs of elderly users. The survey underscores the transformative potential of community embedded care frameworks in enhancing service quality and meeting the diverse needs of the aging population, emphasizing the importance of ongoing innovation and research in this field.

1 Introduction

1.1 Importance of Community Embedded Care

The demographic shift towards an aging population poses significant challenges for the healthcare sector, necessitating the integration of community-based approaches in elderly care [1]. This integration addresses the rising demand for healthcare services amid a shortage of nursing staff, raising concerns about the costs and affordability of care [2]. Community embedded care frameworks aim to optimize healthcare delivery by leveraging local resources and social networks, thereby enhancing the accessibility and quality of care for the elderly [3].

Community health workers play a pivotal role in this framework, bridging gaps in primary care and ensuring high-quality service delivery [4]. By employing participatory design approaches and leveraging technological advancements, such as Socially Assistive Robots (SARs) and non-contact monitoring systems, these frameworks promote independent living and culturally sensitive care.

The integration of health and social care is crucial for individuals with complex needs, ensuring that services are comprehensive and tailored to the unique requirements of the elderly [5]. This approach is particularly vital in regions like Europe, where the elderly population is rapidly expanding, creating significant challenges for stakeholders in elderly care [6]. Addressing these challenges requires context-specific theories and strategic utilization of information systems to enhance service delivery [3].

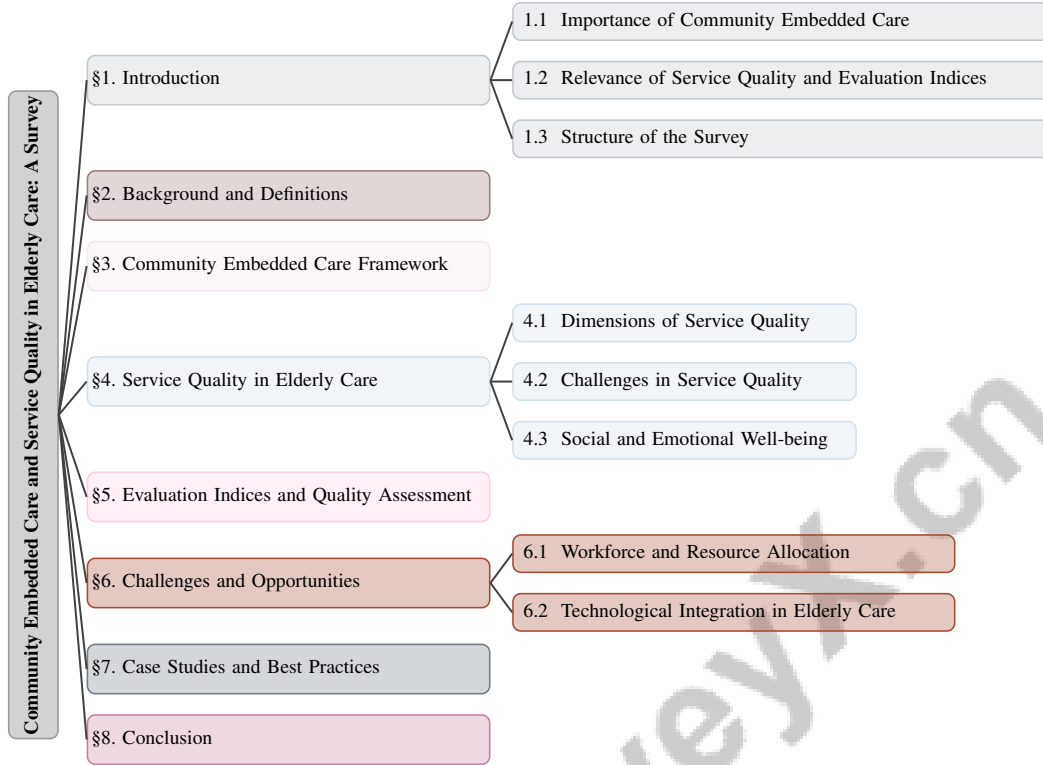


Figure 1: chapter structure

The significance of unobtrusive monitoring technologies is underscored as they bridge the gap between academic research and practical applications, ensuring that elderly care services are innovative and personalized [7]. Enhancing data collection and reporting practices is critical for informing public health responses and addressing the vulnerabilities of care home residents [8]. Community embedded care thus represents a transformative approach that meets the immediate needs of the aging population while significantly improving overall service quality through innovative and personalized care solutions.

1.2 Relevance of Service Quality and Evaluation Indices

Ensuring high service quality within community health services for the elderly is essential, as it directly influences patient satisfaction and loyalty [9]. This is particularly critical given the high hospitalization rates and subsequent readmissions for conditions such as heart failure, which necessitate stringent quality standards [10]. Evaluation indices are vital tools in this context, providing benchmarks for assessing service quality and facilitating the development of AI-driven solutions in nursing and elderly care [11]. These indices help identify areas for improvement, thereby enhancing service quality and patient satisfaction [12].

A holistic approach to service quality, integrating both medical and social factors, is necessary for comprehensive care delivery in community settings [13]. Innovative technologies, such as SARs, have emerged as promising solutions to address the challenges of a growing elderly population and a shortage of healthcare providers [14]. The application of SARs in elderly care not only highlights their effectiveness and user acceptance but also underscores the implementation challenges that must be addressed to fully realize their potential [15]. Advanced systems utilizing deep learning techniques for automated wellness analysis in care centers further demonstrate technology's potential to enhance service quality by analyzing facial expressions, physical activities, and social interactions [16].

However, the effective implementation of such technologies is often hindered by user-centered challenges, including unfamiliarity with technology, privacy concerns, and difficulties in command construction, as well as technological issues like speech recognition failures and system reliability [17].

Addressing these challenges is crucial for leveraging evaluation indices and innovative technologies to improve care standards.

Moreover, integrating various sensor modalities in monitoring systems can significantly enhance the accuracy and robustness of elderly care services, as evidenced by the use of WiFi sensing systems to recognize daily activities in home healthcare scenarios. The development of healthcare chatbots, such as HBot, which integrates a 3D human body model and knowledge graph, exemplifies the potential for interactive and informative consultations in elderly care settings [18]. These technological advancements, when effectively coordinated among stakeholders, including ICT experts, caregivers, patients, and families, can significantly enhance service quality and meet the evolving needs of the elderly population [19].

1.3 Structure of the Survey

This survey is meticulously structured to explore community embedded care and service quality in elderly care comprehensively. The introductory section establishes the foundational importance of integrating community-based approaches and the critical role of service quality and evaluation indices in enhancing healthcare delivery for the elderly. The second section delves into the background and definitions, providing an overview of key terms such as community health services, quality assessment, and evaluation indices, thus laying a solid groundwork for the ensuing discussion.

The third section focuses on the community embedded care framework, emphasizing the integration of community-based healthcare services and the pivotal roles of community health workers. This section also analyzes the impact of social factors and community engagement on the success of these frameworks. The fourth section examines the dimensions of service quality within elderly care settings, identifying influencing factors and their implications for patient satisfaction and outcomes.

Subsequently, the fifth section explores various evaluation indices and methodologies for assessing the quality of elderly care services, highlighting the importance of metrics in maintaining high care standards. This is followed by a discussion on the challenges and opportunities in implementing community embedded care and maintaining service quality, focusing on workforce and resource allocation and technological integration in elderly care.

The penultimate section presents case studies and best practices, showcasing successful community embedded care models and highlighting innovative approaches and lessons learned. Finally, the conclusion synthesizes the key findings of the survey, reflecting on the implications for the future of elderly care and suggesting areas for further research and development. The following sections are organized as shown in Figure 1.

2 Background and Definitions

2.1 Key Terms and Definitions

Key terms underpin the effective implementation and evaluation of elderly care services within community embedded care and service quality frameworks. 'Community health services' encompass a variety of healthcare and support services provided in community settings, crucial for promoting health and managing conditions like heart failure during transitions from hospital care [10]. These services ensure continuity and optimize health outcomes. 'Home health care' involves medical and supportive care delivered in patients' homes, requiring efficient routing and scheduling to meet the specific needs of the elderly [20]. 'Integrated care' addresses both health and social needs, overcoming service delivery barriers to ensure comprehensive care for the elderly [13].

'Service quality' evaluates the effectiveness and efficiency of healthcare services, directly impacting 'patient satisfaction' and loyalty [12]. This is closely linked to 'quality assessment', which measures perceived care quality and the degree to which patient expectations are met. 'Evaluation indices' are critical tools for assessing service quality, identifying improvement areas, and supporting the development of AI-driven solutions in nursing and elderly care [21]. These indices set benchmarks for maintaining high care standards.

'Socially Assistive Robots' (SARs) enhance the quality of life for the elderly by providing interactive assistance globally. 'Urban accessibility' refers to proximity-based city models, influencing the accessibility and quality assessment of community health services [22]. Recognizing 'user-centered

challenges' and 'technological challenges' is vital for implementing technologies in elderly care, addressing issues like user familiarity with technology, privacy concerns, and system reliability [17]. Terms such as 'care home residents' and 'mortality rates linked to COVID-19' highlight the vulnerability of this population and the pandemic's impact [8].

'Speech recognition systems' and 'elderly speech patterns' are relevant in technology use in elderly care, emphasizing the need for systems that accurately interpret older adults' speech [7]. Concepts like 'data privacy', 'machine learning', and 'differential privacy' ensure ethical data and technology use in healthcare [23]. 'Community health workers' (CHWs) provide essential patient-facing support in primary care, playing a significant role in community health services [4]. Understanding 'home care utilization' and 'social determinants of health' is also critical, as these factors influence care delivery and effectiveness [24]. These definitions establish a comprehensive foundation for enhancing community embedded care and service quality in elderly care settings.

2.2 Cultural and Ethical Considerations

Cultural and ethical considerations are crucial in implementing community embedded care and enhancing service quality for the elderly. The integration of technology, particularly robotics, into elderly care requires careful examination of ethical issues such as user acceptance, privacy, and autonomy [25]. These concerns directly affect the elderly's willingness to engage with technological innovations in their care.

User acceptance of technology is significantly shaped by cultural perceptions regarding its intrusiveness or supportiveness and the context of deployment. Understanding these factors is essential for developing context-specific theories of effective use, particularly in healthcare, where user experiences and organizational goals intersect to influence technology implementation [21, 26, 27, 12]. Ensuring culturally sensitive design and implementation of care technologies enhances acceptance and care delivery effectiveness.

Privacy is another critical consideration, as monitoring technologies and data-driven solutions in elderly care raise concerns about personal information security and confidentiality. Robust data protection measures and transparent management practices are essential to maintain trust and protect the rights of the elderly, especially as advancements like automated wellness analysis systems increasingly rely on personal data to enhance care quality and efficiency [26, 8, 16].

Preserving autonomy is fundamental in community embedded care. Technologies, particularly robotics and speech-based artificial intelligence, should empower the elderly, enabling them to maintain control over their care decisions and daily activities while facilitating independent living. With the elderly population in Western Europe projected to increase significantly, it is imperative for these technologies to enhance functionalities in care settings and address user-centered challenges to ensure efficacy and a positive experience for older adults [17, 25]. This empowerment is essential for preserving dignity and promoting independence among the elderly.

To successfully integrate community-embedded care frameworks, addressing cultural and ethical considerations is crucial, as these factors significantly influence care delivery effectiveness for individuals with complex needs, including those facing multimorbidity, mental health challenges, and social deprivation. This integration necessitates fostering authentic relationships among care providers, enhancing communication across health and social care sectors, and overcoming barriers that impede comprehensive care delivery [13, 27, 5]. By prioritizing user acceptance, privacy, and autonomy, healthcare providers can ensure that services are respectful, person-centered, and aligned with the unique cultural contexts of the elderly population.

In recent years, the importance of Community Health Workers (CHWs) in enhancing healthcare services for the elderly has garnered significant attention. This emphasis is particularly evident in the Community Embedded Care Framework, which categorizes the various roles of CHWs and highlights the critical interplay between technological integrations and social factors. As illustrated in Figure 2, the framework not only delineates the responsibilities of CHWs but also underscores the significance of community engagement strategies and the addressing of social determinants in improving healthcare outcomes for the elderly. By incorporating these elements, the framework provides a comprehensive understanding of how community dynamics can influence health care delivery and outcomes.

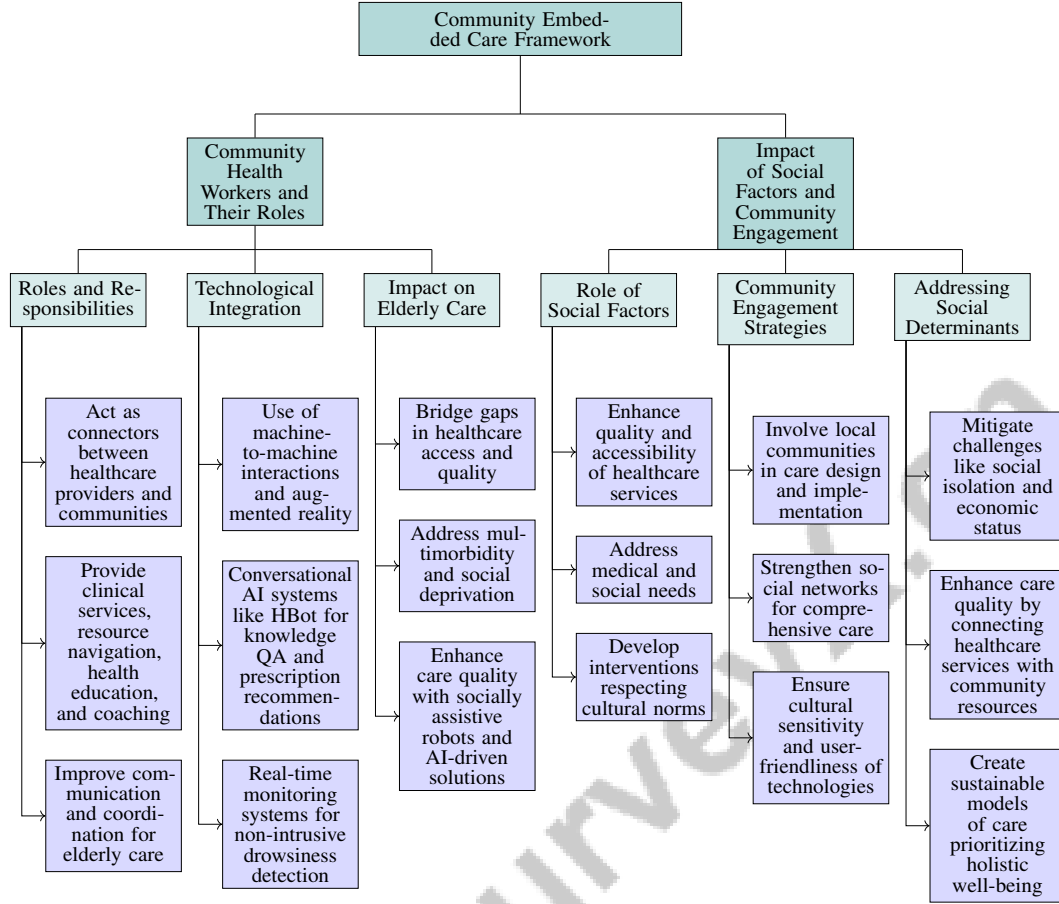


Figure 2: This figure illustrates the Community Embedded Care Framework, highlighting the roles and impact of Community Health Workers (CHWs) and the significance of social factors and community engagement. It categorizes the roles of CHWs, technological integrations, and their impact on elderly care, alongside the role of social factors, community engagement strategies, and addressing social determinants in enhancing healthcare services for the elderly.

3 Community Embedded Care Framework

3.1 Community Health Workers and Their Roles

Community health workers (CHWs) play a vital role in community embedded care frameworks, acting as key connectors between healthcare providers and the communities they serve, particularly the elderly [4]. Their responsibilities include clinical services, resource navigation, health education, and coaching, which collectively enhance service delivery and patient satisfaction. By improving communication and coordination, CHWs significantly contribute to effective elderly care and adherence to clinical guidelines [4].

As illustrated in Figure 3, the roles of CHWs in elderly care are multifaceted, encompassing not only their core responsibilities but also the integration of advanced technologies and the challenges they encounter. The figure emphasizes clinical services, resource navigation, and health education as key roles, while showcasing technological advancements such as machine-to-machine (M2M) interactions and conversational AI systems.

The integration of advanced technologies augments CHWs' capabilities in community embedded care. Technologies like augmented reality feedback systems, such as AGECare, demonstrate how technology can alleviate cognitive overload and improve elderly care efficiency [19]. These innovations enable CHWs to deliver personalized care by leveraging technological advancements.

Conversational AI systems, such as HBot, expand CHWs' care scope by offering conversational services, including knowledge QA and prescription recommendations [18]. However, aligning these systems with elderly users' needs remains challenging, as highlighted by frameworks that categorize challenges into user-centered and technological aspects [17]. Comprehensive datasets like VOTE400, which include dialog and read speech from elderly individuals, support the development of technologies tailored to this demographic's needs [7]. Additionally, real-time monitoring systems offering non-intrusive drowsiness detection exemplify technological advancements that enhance elderly safety and well-being without compromising privacy [2].

Through their diverse roles and the integration of innovative technologies, CHWs are pivotal in bridging gaps in healthcare access and quality. They employ a blend of traditional and innovative strategies to effectively address the evolving needs of the elderly, ensuring that community-based care frameworks are efficient and adaptable to challenges such as multimorbidity and social deprivation. By integrating health and social care, fostering authentic caregiver relationships, and utilizing advanced technologies like socially assistive robots and AI-driven solutions, CHWs enhance the quality of care for this demographic [14, 13, 25, 11, 15].

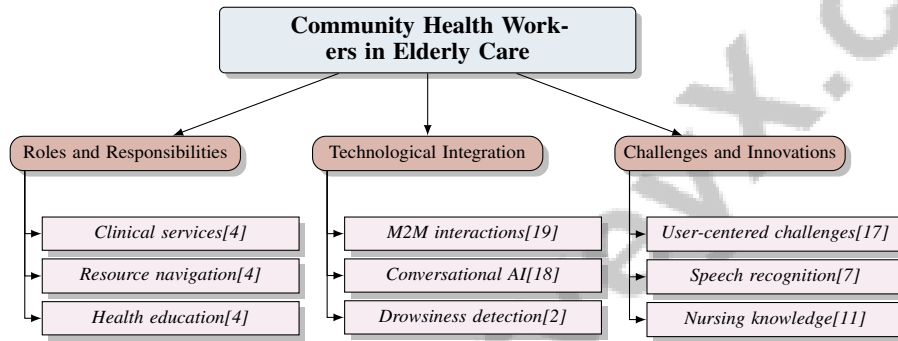


Figure 3: This figure illustrates the roles of community health workers in elderly care, highlighting their responsibilities, the integration of advanced technologies, and the challenges they face. It emphasizes clinical services, resource navigation, and health education as key roles, while showcasing technological advancements like machine-to-machine interactions and conversational AI. Additionally, it addresses challenges such as user-centered issues and innovations in speech recognition and nursing knowledge.

3.2 Impact of Social Factors and Community Engagement

Social factors and community engagement are critical to the effectiveness of community embedded care frameworks, particularly in elderly care settings. By fostering a supportive environment, these elements enhance the quality and accessibility of healthcare services, addressing both medical and social needs [13]. Community engagement enables the development of tailored interventions that respect cultural norms and values, thus increasing the acceptability and effectiveness of care strategies [25].

Involving local communities in the design and implementation of care services ensures that the unique needs of elderly individuals are met, promoting a sense of ownership and empowerment among community members. This participatory approach not only improves service delivery but also strengthens social networks essential for comprehensive care [1]. Socially Assistive Robots (SARs) and other technological innovations can be effectively integrated into care frameworks when community members actively participate in their deployment and adaptation, ensuring cultural sensitivity and user-friendliness [15].

Moreover, community engagement is vital in addressing social determinants of health that impact elderly well-being. Factors such as social isolation, economic status, and resource access significantly influence health outcomes, and community-driven initiatives can mitigate these challenges by fostering inclusive environments [24]. In this context, CHWs play a crucial role by connecting healthcare services with community resources, thereby enhancing overall care quality [4].

The success of community embedded care frameworks depends on the active participation of various stakeholders, including healthcare providers, patients, families, and community leaders. This collabo-

rative approach ensures that care services are comprehensive and adaptable to the changing needs of the elderly population [3]. By leveraging social capital and fostering community engagement, healthcare systems can create sustainable models of care that prioritize the holistic well-being of elderly individuals.

4 Service Quality in Elderly Care

4.1 Dimensions of Service Quality

Service quality in elderly care encompasses various dimensions crucial for enhancing the well-being and satisfaction of older adults. A key dimension is the integration of innovative technologies, such as the Vi-Wi method, which utilizes passive WiFi sensing to monitor vital signs, detect falls, and classify tremors without intrusive wearables, thereby improving safety and facilitating timely interventions [28]. Adaptability of care models to individual lifestyles also plays a significant role, as exemplified by Socially Assistive Robots (SARs), which offer personalized support, fostering emotional well-being and reducing loneliness among elderly users [6, 15].

As illustrated in Figure 4, the key dimensions of service quality in elderly care emphasize the critical roles of innovative technologies, operational efficiency, and community health workers in enhancing care delivery and patient satisfaction. Operational efficiency is another critical aspect, particularly in home health care. Optimization algorithms like the MA2 algorithm enhance operational efficiency, reduce costs, and improve service delivery, ensuring timely and cost-effective healthcare services for the elderly [29]. The participatory design approach further enhances service quality by incorporating elderly users' perspectives, ensuring solutions are relevant and beneficial, thereby increasing user satisfaction and engagement [1].

Community health workers (CHWs) are vital in improving patient access to care and providing culturally competent support, bridging the gap between healthcare providers and the community, and ensuring accessible and culturally sensitive care services, which enhances patient satisfaction and outcomes [4]. By focusing on advanced technologies, including robotics, automated vision systems, and large language models, healthcare providers can create comprehensive and responsive elderly care services, facilitating independent living and empowering caregivers with actionable insights [11, 25, 16].

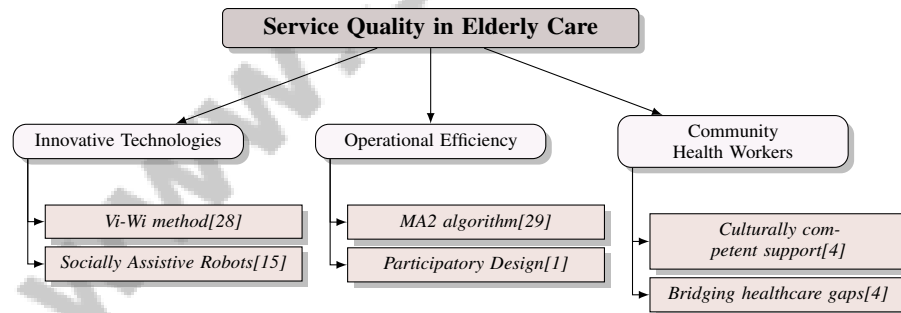


Figure 4: This figure illustrates the key dimensions of service quality in elderly care, emphasizing the role of innovative technologies, operational efficiency, and community health workers in enhancing care delivery and patient satisfaction.

4.2 Challenges in Service Quality

Elderly care service quality faces challenges, particularly in integrating advanced technologies and care models. Wearable technology, though beneficial for monitoring, is often met with resistance from the elderly due to discomfort or unfamiliarity [30]. Traditional monitoring methods can be intrusive, especially for those with cognitive impairments like dementia [28]. The integration of robotic systems also presents challenges, with high costs and user mistrust impeding widespread adoption [15]. Addressing these issues requires overcoming user acceptance and ethical concerns [25].

Network congestion, impacting service quality due to delays in information retrieval when multiple caregivers access data, underscores the need for robust network infrastructure and efficient data management systems [31]. Current monitoring technologies face limitations, such as inaccuracies in real-time drowsiness detection and head pose estimation under low light conditions [2], necessitating more advanced solutions.

Innovative approaches, like the Fast Preceding Questionnaire Model (FPQM), enhance service quality by reducing the number of questions while maintaining prediction accuracy [26]. Optimization algorithms, such as the hybrid memetic approach, manage dynamic service requests effectively [29]. A comprehensive strategy addressing technological advancements, infrastructure development, and user engagement is essential for successful healthcare technology implementation, ensuring elderly care services remain effective and accessible [17, 32, 27, 12].

4.3 Social and Emotional Well-being

Social and emotional well-being is crucial for service quality in elderly care, significantly impacting older adults' health and quality of life. Socially Assistive Robots (SARs) enhance emotional well-being by providing companionship and alleviating loneliness, offering interactive support that addresses seniors' emotional and social needs [15]. Social engagement is vital, as isolation and loneliness adversely affect health [24]. Community-based programs fostering social connections mitigate these challenges and enhance social networks, improving emotional well-being and quality of life [1].

Community health workers (CHWs) address the social and emotional needs of the elderly by facilitating access to resources and support services that promote social interaction, enhancing care quality [4]. Innovative technologies, such as non-intrusive monitoring systems, support emotional well-being by enabling independent living while ensuring safety, providing peace of mind to the elderly and their families [2].

5 Evaluation Indices and Quality Assessment

5.1 Methodologies for Quality Assessment

Benchmark	Size	Domain	Task Format	Metric
AURA[33]	7,436,828	Patient Activity Monitoring	Activity Recognition	Accuracy
NursingPiles[11]	2,777,526	Nursing	Question Answering	P-R-F1
ISCOMAT[10]	2,100	Cardiology	Clinical Outcomes Evaluation	All-Cause Mortality, Heart Failure-Related Hospitalisation Projected Palliative Care Need
PCN2040[34]	1,000,000	Palliative Care	Needs Assessment	Projected Palliative Care Need
VOTE400[7]	400	Speech Recognition	Speech Recognition	Accuracy

Table 1: Overview of representative benchmarks utilized in elderly care quality assessment. The table delineates benchmarks by their size, domain, task format, and metric, highlighting the diversity and specificity of data sources employed in evaluating care services.

Evaluating elderly care quality requires a comprehensive approach that integrates both quantitative and qualitative methodologies. Quantitative methods, like Path Analysis, systematically assess the impact of specific service attributes on patient satisfaction, enabling targeted enhancements [9]. In contrast, qualitative approaches, such as focus groups and interviews, capture the nuanced experiences of care recipients, providing a deeper understanding of service effectiveness [27].

Advanced technologies further augment these methodologies. The Vi-Wi method exemplifies non-intrusive monitoring through passive WiFi sensing for vital signs like breathing rates and fall detection [28]. Similarly, the BlockTheFall method uses real-time motion analysis via machine learning to evaluate fall prevention strategies, highlighting technology's evolving role in enhancing elderly safety [30].

User feedback is crucial for performance evaluation, as evidenced by systems like HBot, where user satisfaction ratings during testing provide insights into system accuracy and reliability [18]. The use of deep neural networks for activity recognition underscores the potential of AI in refining quality assessment methodologies [33].

Fuzzy logic systems offer a structured means to evaluate clinical staff adherence to care protocols, thereby upholding care standards [35]. Multidimensional evaluation tools that integrate user feedback with expert insights are increasingly vital for a holistic assessment of care quality [21].

Statistical methods, including Structural Equation Modeling (SEM), explore interrelationships among service quality components, providing insights into their collective influence on patient satisfaction [12]. Innovative models like the Fast Preceding Questionnaire Model (FPQM) streamline assessments by focusing on key factors, enhancing both efficiency and effectiveness [26].

Integrating diverse methodologies, from technological solutions to qualitative assessments, ensures a robust evaluation of elderly care services. As illustrated in Figure 5, the hierarchical categorization of methodologies used in elderly care quality assessment is divided into quantitative methods, qualitative methods, and technological solutions. Each category highlights specific techniques and innovations that contribute to the comprehensive evaluation of care services. Automated vision-based wellness analysis, AI-driven monitoring, and clinical decision support systems significantly enhance care quality, facilitating personalized interventions and improving caregiver insights into patient well-being, ultimately leading to increased satisfaction among the elderly [35, 16, 12, 25, 11]. Table 1 presents a comprehensive summary of various benchmarks employed in the assessment of elderly care quality, illustrating the range of domains and metrics used in this field.

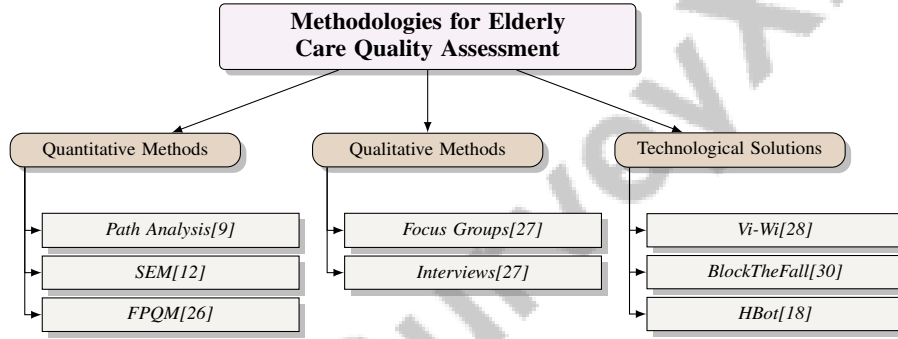


Figure 5: This figure illustrates the hierarchical categorization of methodologies used in elderly care quality assessment, divided into quantitative methods, qualitative methods, and technological solutions. Each category highlights specific techniques and innovations that contribute to the comprehensive evaluation of care services.

5.2 Data Management and Privacy Concerns

Effective data management and privacy assurance are critical in evaluating elderly care services. As advanced technologies become more integrated into healthcare, balancing data utility with individual privacy protection is essential, especially given the sensitivity of health information in elderly care contexts [23].

Data management encompasses systematic collection, secure storage, and thorough analysis of extensive information, including critical health metrics and personal insights. AI-driven systems and automated vision-based monitoring enhance caregiver efficiency and care quality. For instance, frameworks utilizing large language models facilitate real-time patient interaction, while automated systems analyze video data to extract wellness metrics and health patterns, aiding personalized care plans and improving service quality [35, 11, 16]. However, the risk of data breaches necessitates robust security measures, including encryption, access controls, and regular audits to maintain data integrity and confidentiality.

Privacy concerns are heightened by assistive technologies and monitoring systems that require continuous data collection. While these technologies, such as community-care electronic health records and socially assistive robots, enhance care quality through improved data management, they also pose risks of unauthorized access to sensitive health information [32, 27]. Establishing clear protocols for data use and consent is vital to ensure that elderly individuals are informed and retain control over their personal information.

The trade-off between data utility and privacy remains a significant challenge in healthcare. Comprehensive data analysis can enhance patient care outcomes by identifying key relationships between service quality and patient satisfaction, fostering innovations in service delivery [12, 27]. Conversely, excessive data collection or inadequate privacy protections can erode patient trust and lead to ethical violations. Achieving balance requires a commitment to transparency, patient empowerment, and the adoption of privacy-preserving technologies such as differential privacy and anonymization techniques.

6 Challenges and Opportunities

The dynamic landscape of elderly care necessitates addressing complex challenges within community-embedded care frameworks, particularly regarding workforce and resource allocation. These components are pivotal for effective care strategy implementation, directly influencing service quality and accessibility. This section delves into workforce dynamics and resource distribution, underscoring key challenges and potential strategies for enhancing elderly care delivery.

6.1 Workforce and Resource Allocation

The effective deployment of community-embedded elderly care is significantly impeded by workforce and resource allocation challenges. A critical issue is the integration of existing care systems, which often fall short of meeting the diverse and evolving needs of the aging population [3]. The caregiver shortage exacerbates this problem, demanding innovative strategies for efficient resource distribution and workforce management [31]. Flexible scheduling and routing for healthcare professionals, particularly in home health care, are essential to cater to the varied needs of elderly patients and ensure timely service delivery [20].

Advanced technologies offer potential solutions to these challenges. Non-invasive monitoring systems, such as the Vi-Wi method, reduce the need for direct healthcare worker intervention, alleviating workforce pressures [28]. Additionally, the Fast Preceding Questionnaire Model (FPQM) streamlines assessments, minimizing resource demands and enabling more efficient workforce allocation [26].

Despite these advancements, current research is limited in addressing the full spectrum of elderly needs, particularly regarding technology acceptance and the integration of diverse care models [6]. The challenges of recognizing daily activities using WiFi signals in uncontrolled environments underscore the need for robust technological infrastructure to support workforce efforts [33]. Addressing privacy concerns and the complexities of visual monitoring requires coordinated efforts across health and social sectors to develop effective solutions [36].

Future research should focus on integrating additional technologies, such as infrared cameras and wearables, to enhance data collection and analysis capabilities, thereby improving elderly care services [2]. Implementing privacy-preserving methods, like Decentralized Differential Learning, is crucial for addressing ethical concerns and ensuring secure management of sensitive health data [23].

A comprehensive strategy integrating technological innovations—such as socially assistive robots and AI-driven frameworks—with strategic planning and intersectoral coordination is essential to effectively address workforce and resource allocation challenges. This multifaceted approach enhances health and social services delivery to individuals with complex care needs, emphasizing the development of authentic relationships among care providers and the optimal use of electronic health records and other technologies [13, 11, 32, 27].

As illustrated in Figure 6, the hierarchical structure of workforce and resource allocation challenges and solutions in elderly care highlights key challenges, technological solutions, and future directions for improvement. By leveraging advanced monitoring systems and optimizing resource distribution, healthcare providers can enhance the quality and accessibility of care for the elderly.

6.2 Technological Integration in Elderly Care

Technological integration in elderly care services presents numerous opportunities for enhancing service delivery and improving health outcomes. Innovations such as augmented reality (AR) glasses provide immediate access to health information, enabling caregivers to deliver timely and informed

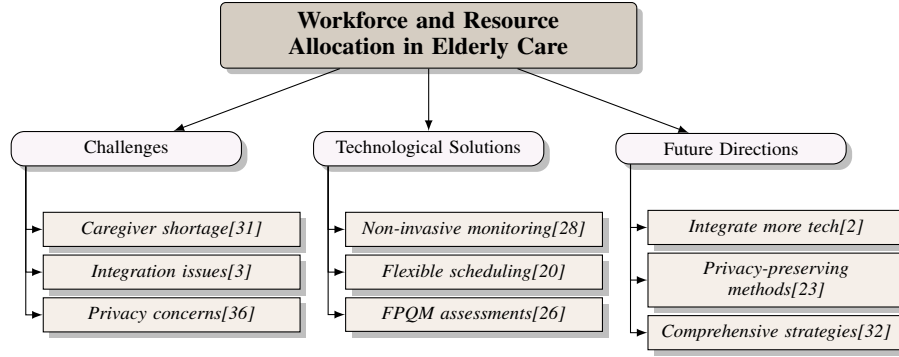


Figure 6: This figure illustrates the hierarchical structure of workforce and resource allocation challenges and solutions in elderly care, highlighting key challenges, technological solutions, and future directions for improvement.

care [31]. This technology facilitates real-time data access, enhancing care delivery efficiency and allowing for more personalized patient interactions.

Adaptive WiFi-based sensing systems offer non-intrusive monitoring capabilities to detect health metrics like breathing rates and physical activities without requiring wearable devices [33]. By leveraging existing infrastructure, these systems can be seamlessly integrated into care environments, providing continuous health monitoring and early detection of potential issues.

Future research aims to enhance these technologies by improving model accuracy and expanding capabilities to encompass a broader range of health metrics and activities [16]. The adaptability of systems like AGECare to different user needs is also a critical area of exploration, seeking to incorporate emerging technologies for more comprehensive and personalized elderly care solutions [19].

Voice technology holds significant potential for elderly care, particularly through expanding datasets to include diverse speech patterns and exploring new applications for voice recognition systems [7]. These advancements can enhance communication between caregivers and elderly patients, improving care delivery accuracy and effectiveness.

Moreover, integrating decentralized learning approaches, such as Decentralized Differential Learning, provides a pathway to enhance elderly care services while ensuring data privacy and security [23]. This approach addresses the critical need for secure data management amid increasing reliance on technology in healthcare.

The role of community health workers (CHWs) in facilitating the integration of these technologies is also vital. Effective strategies for incorporating CHWs into technology-driven care models can significantly impact health outcomes and reduce long-term healthcare costs [4]. By leveraging their unique position within communities, CHWs can bridge the gap between technological advancements and practical care delivery, ensuring that innovations are accessible and beneficial to the elderly population.

7 Case Studies and Best Practices

7.1 Best Practices and Innovations

Innovative technologies integrated into community-embedded care frameworks have notably advanced elderly care. The BlockTheFall system exemplifies this by employing wearable technology and blockchain to enhance fall detection and emergency responses, thereby improving detection accuracy and ensuring secure data management [30]. Robotic systems also represent best practices, offering interactive and personalized care that enhances emotional and social well-being, reduces caregiver burden, and promotes independence among seniors [25]. Urban analysis frameworks utilizing qualitative metrics enable urban planners to assess and improve health service accessibility and quality for elderly populations [22].

Non-intrusive monitoring technologies, such as WiFi sensing systems, provide continuous health monitoring without wearables, facilitating early health issue detection and improving safety and care quality. The intelligent elderly care management system effectively integrates community and family resources, serving as a model for holistic care delivery [3]. Additionally, new software evaluation frameworks that consider social impacts alongside usability and aesthetic metrics ensure technologies meet diverse user needs and contribute positively to quality of life [21].

These practices and innovations highlight the transformative potential of technology and strategic planning in community-embedded care. By implementing AI-driven patient monitoring and automated wellness analysis, healthcare providers can enhance service delivery and health outcomes, ensuring elderly individuals receive tailored, high-quality care. Such approaches empower caregivers with insights into seniors' well-being and long-term health patterns, fostering a more responsive healthcare system for the aging population [11, 12, 25, 16].

7.2 Lessons Learned and Future Directions

Exploring community-embedded care models has revealed crucial lessons for future research and practice. Integrated care models emphasizing proactive support and provider collaboration are essential for addressing the complex needs of the elderly [13]. The integration of advanced technologies, like Socially Assistive Robots (SARs) and non-intrusive monitoring systems, holds promise for enhancing care quality and autonomy for elderly individuals. However, successful implementation requires addressing challenges related to user acceptance, privacy, and alignment with seniors' specific needs. Future research should explore these technologies across diverse organizational contexts to identify best practices and optimize effectiveness [27].

The influence of social determinants on home care utilization and elderly care quality is a critical area for further exploration. Understanding these determinants' causal pathways and developing targeted interventions can enhance access and improve outcomes for older adults [24]. Future studies should focus on these pathways and design interventions addressing social and environmental factors impacting elderly care.

Lessons from case studies emphasize the importance of a participatory approach in designing and implementing care services. Engaging elderly individuals, their families, and community stakeholders in developing care models ensures services are culturally sensitive and aligned with population preferences. This approach enhances service quality and fosters a sense of ownership among community members, vital for improving patient satisfaction and effective healthcare delivery in community settings [13, 12, 9, 5].

8 Conclusion

Community embedded care frameworks and service quality enhancements hold significant promise for transforming elderly care. Integrating advanced technologies, such as automated quality-assessment systems, has been shown to enhance the accuracy and efficiency of care evaluations, thereby improving overall service quality in geriatric settings. Notably, systems like SHECS demonstrate the efficiency gains from facial recognition technologies, while large language models in nursing illustrate the potential for AI-driven improvements in healthcare outcomes.

The ISCOMAT trial underscores the effectiveness of methodologies like MaTI in improving clinical outcomes for heart failure patients, suggesting broader applications in reducing readmission rates and mortality among the elderly. In home healthcare, flexible routing strategies have proven effective in enhancing operational efficiency, supporting the goals of community embedded care.

Future research should address the ethical and legal challenges of integrating robotic systems in elderly care, with a focus on participatory design to ensure sensitive implementation. Enhancing user acceptance of robotic technologies through adaptive interaction models that evolve with the changing needs of elderly users is crucial. Hospitals must prioritize service excellence to boost patient loyalty and overall effectiveness, warranting further exploration in this domain.

The future of community embedded care also depends on inclusive urban planning that accommodates the diverse needs of elderly populations. The AGECare ecosystem exemplifies the benefits of integrating community and technological resources to provide seamless support. Additionally,

employing Decentralized Differential Learning can enhance data privacy in elderly care applications, addressing crucial security concerns. Collectively, these insights underscore the necessity for continuous innovation and research to optimize community embedded care frameworks, ensuring that elderly care services remain effective and responsive to the evolving needs of the aging population.

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