Built-Environment Barriers to Fall-Detection Sensors in Urban Smart Eldercare: Evidence From Hefei, China

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Abstract

China's urban community-based eldercare is often delivered through government-backed, project-driven safety-net programs. Fall-detection sensors can be procured and installed quickly, yet many are left unused, unplugged, or abandoned after brief trials. Existing research often attributes this problem to device performance or older adults' acceptance, but rarely treats policy implementation, community response reach, and residential spatial conditions as a coupled system. Taking Hefei, an early smart-eldercare pilot city with institutional arrangements similar to typical non-megacity contexts in China, this study examines why fall-detection sensors fail to persist in community home care. Based on multi-stakeholder semi-structured interviews, field observations, and grounded theory coding, the study traces the pathway from policy execution and device allocation to sensor placement, alarm verification, in-home response, and longer-term maintenance. The findings show that sustained use is constrained by linked misalignments across needs assessment, sensor placement, alarm detection, response arrangements, and follow-up maintenance. The study proposes a conditional mechanism of sustained device use, linking policy and service provision, spatial environment, and device technology. It offers implications for risk-space assessment, sensor placement, community response, and follow-up maintenance in urban smart eldercare.

Keywords: smart eldercare, fall-detection sensors, sustained use, community home care, built environment

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Introduction

Population aging is reshaping the basic conditions of eldercare and health support worldwide. The World Health Organization projects that by 2030, one in six people in the world will be aged 60 years or over, and that the population aged 60 years and over will reach 2.1 billion by 2050. China is undergoing the same transition at a rapid pace. According to the Statistical Communique on the 2025 National Economic and Social Development, China had 323.38 million people aged 60 years and over by the end of 2025, accounting for 23.0% of the total population; the population aged 65 years and over reached 223.65 million, accounting for 15.9%. This demographic shift is changing the structure of care needs and making safety and continuous support in home and community settings a common challenge for aging societies (National Bureau of Statistics of China, 2026; World Health Organization, 2025).

Among the risks embedded in everyday home life, falls are among the most consequential. The World Health Organization identifies falls as the second leading cause of unintentional injury deaths worldwide, causing about 684,000 deaths each year, with adults aged 60 years and over facing the highest risk of fatal falls. Falls may lead to fractures, head injuries, functional decline, reduced mobility, care dependence, and psychological insecurity. Earlier studies have therefore treated falls as the outcome of declining health, reduced mobility, and environmental hazards in daily life (Lord et al., 2007; Rubenstein, 2006; World Health Organization, 2021). For older adults aging at home, fall risk is not only a health issue; it also reorganizes family care burdens, community response capacity, and the delivery of eldercare services.

This issue is particularly salient in China's community home-care context. Home-based care remains the dominant form of eldercare, while the numbers of oldest-old, solitary-living, and functionally impaired older adults continue to grow. At the same time, artificial intelligence, the Internet of Things, platform systems, and ambient sensing technologies have made smart eldercare a prominent response to the pressure of home-based care. Smart eldercare is not simply a matter of installing devices in older adults' homes. Rather, it seeks to reorganize the relationship between home, community, and institution through smart terminals, data platforms, and service coordination. Existing studies suggest that smart eldercare in China is strongly shaped by policy support and platform integration, and is moving from isolated technological applications toward more systematic service organization (Chen et al., 2023; Khosravi & Ghapanchi, 2016; Ma et al., 2023; Ministry of Industry and Information Technology et al., 2021; Mitzner et al., 2010).

Fall-detection sensors are among the most common devices introduced into community-based smart eldercare. They are expected to identify risks after a fall, send alarms, and trigger service responses. In practice, however, they often display a pattern of rapid installation followed by weak use. Project procurement and in-home installation can bring devices into households quickly, but after installation, many devices encounter frequent false alarms, disconnection, idleness, missing maintenance, or limited community response. Fieldwork shows that some devices remain physically present in the home but do not enter older adults' everyday activity spaces; others are connected to platforms but fail to become actual care actions because of false alarms, offline states, or inadequate maintenance. Entering the home does not mean entering everyday life or the community care system (Chen et al., 2023; Huang et al., 2024; Peek et al., 2014).

Existing research helps explain parts of this problem. One strand focuses on fall-detection algorithms, sensor types, false alarms, and missed detection, emphasizing technical performance and the differences among monitoring solutions (Gorce & Jacquier-Bret, 2025; Igual et al., 2013; Mubashir et al., 2013). A second strand examines older adults' and families' acceptance of fall-detection technologies, including privacy concerns, comfort, perceived usefulness, care dependence, and expected benefits (Davis, 1989; Huang et al., 2024; Peek et al., 2014; Venkatesh et al., 2003). A third strand considers smart eldercare platforms, digital governance, and service provision, asking how policy, platform integration, and community eldercare systems support smart aging (Chen et al., 2023; Yang & Li, 2026). These studies clarify the importance of device performance, user acceptance, and institutional provision, but they leave the post-installation process insufficiently explained.

The home environment in which these devices operate has also received limited attention. Falls occur in specific spaces, such as bathrooms, bedsides, nighttime movement routes, entrances, and everyday activity areas. Environmental studies have shown that stairs, bathrooms, poor lighting, obstacles, and transfer points are associated with fall risks; spatial environments also interact with users' abilities, service support, and daily activities rather than acting alone (Blanchet & Edwards, 2018; Chen & Li, 2024; Li & Feng, 2025; Pighills et al., 2011). However, most of this research focuses on the link between environmental hazards and fall occurrence. Less is known about how sensor placement, home risk spaces, and community service reach together shape sustained use.

Taken together, existing studies have discussed device performance, technology acceptance, smart eldercare platforms, and home environments, but rarely bring policy implementation, community response reach, residential spatial conditions, and device technology into a single explanatory frame. In community home care, the sustained use of fall-detection sensors is a process involving project provision, risk scenarios, spatial placement, human verification, and follow-up maintenance. This study therefore asks: why can fall-detection sensors enter older adults' homes but fail to become sustained community care capacity? Using Hefei as an empirical setting, this study draws on multi-stakeholder interviews, field observations, and project materials, and applies grounded theory to explain how policy and service provision, spatial environment, and device technology jointly condition sustained use (Hefei Municipal People's Government, 2023; National Development and Reform Commission, 2022).

Case Selection and Data Collection

Case Selection

Hefei is one of the Chinese cities that moved relatively early in building a smart eldercare service system. In recent years, the city has used the Internet, the Internet of Things, big data, and artificial intelligence to promote smart eldercare across institutional care, home care, community services, and medical-care integration. Its practice combines policy support, platform construction, community service nodes, and in-home smart terminals. Compared with megacities such as Beijing, Shanghai, and Shenzhen, Hefei is a provincial capital with a more typical non-megacity governance context. It therefore provides a useful setting for examining how policies are implemented, how communities take over services, how devices enter homes, and how follow-up maintenance is organized.

The cases were drawn from a Hefei smart-eldercare case database constructed during earlier fieldwork. The research team first screened public government materials, smart health and eldercare demonstration cases, and project documents. It then conducted about six weeks of fieldwork in Hefei, visiting civil affairs departments, districts, subdistricts, communities, and eldercare institutions. The fieldwork examined smart devices, community home-care service delivery, and home safety monitoring. Seven community-based smart eldercare institutions were visited. Five cases involving the installation, alarm response, or maintenance of community home fall-detection devices were selected for analysis because their interview and observation materials were relatively complete. To protect the privacy of the communities and organizations, anonymous case names are used throughout the paper.

Table 1
Overview of Selected Cases

Case	Service Level	Start Year of Smart Eldercare Pilot	Service Coverage
F Community Eldercare Service Center	Subdistrict-level	2019	Covers 9–10 residential communities
Z Community Eldercare Service Center	Community-level	2019	Approx. 2–3 km service radius
Y Community Eldercare Service Center	Community-level	2019	Approx. 2–3 km service radius
L Community Eldercare Service Center	Community-level	2014	Approx. 3 km service radius
W Community Eldercare Service Center	Community-level	2024	Serves home-dwelling older adults within approx. 3–5 km

Data Collection

This study collected data through semi-structured interviews, field observations, project materials, and site photographs. Interviewees included civil affairs officials, subdistrict and community staff, managers of eldercare service providers, third-party service personnel, older adults, and family members. The interviews focused on smart eldercare project implementation, device installation, alarm handling, community home visits, device maintenance, user experience, and home risk scenarios. Field observations were conducted in community eldercare service centers, embedded community care facilities, and selected older adults' homes. The observations recorded device locations, everyday activity areas, home risk nodes, service distance, and response processes.

After fieldwork, interview recordings, on-site conversations, and observation notes were organized into text. Project documents, public materials, and photographs were used to verify the case context, device configuration, service process, and spatial setting. The five cases yielded approximately 113,000 Chinese characters of textual material. Four cases were used for coding and theoretical development, and one case was reserved for theoretical saturation checking.

Research Methods

This study adopts a qualitative case-study approach and uses procedural grounded theory as the main analytical method. Grounded theory, proposed by Glaser and Strauss, emphasizes the generation of concepts, categories, and theoretical explanations through continuous comparison with empirical materials (Glaser & Strauss, 1967). The sustained use of community home fall-detection sensors involves policy provision, community services, spatial environments, device technology, and older adults' everyday practices. Because the process is highly contextual, temporal, and action-oriented, grounded theory is suitable for developing an empirically grounded explanation.

The analysis follows the procedural coding approach of Strauss and Corbin, including open coding, axial coding, and selective coding (Strauss & Corbin, 1990, 1998). Open coding conceptualizes the original materials. Axial coding connects concepts and categories to form higher-level structures. Selective coding integrates the relationships among main categories and identifies a core category that explains the research problem. Because the materials contain devices, spaces, services, and user actors, the axial-coding stage also draws on Chen's idea of a building-type core category, in which a new main category is constructed above related categories rather than directly selected from one existing category (Chen, 2000).

To strengthen analytical reliability, the study used constant comparison, cross-case checking, and multi-source verification. Interview texts and observation notes formed the main coding materials, while project documents, public records, and photographs helped verify case background, device configuration, service processes, and spatial settings. After coding, the reserved case was used for theoretical saturation checking to determine whether additional concepts, categories, or relationships emerged. The overall research procedure is shown in Figure 1.

Figure 1

Grounded Theory-Based Research Procedure

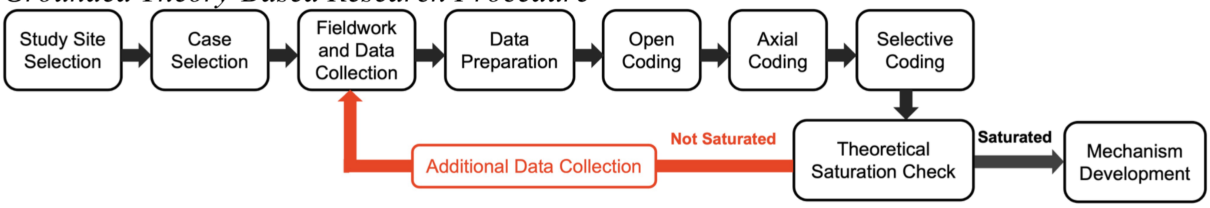


Figure 2

Fieldwork Sites and Data Collection Scenes

Research Process

Open Coding

Open coding was used to conceptualize the original materials. The research team read the texts from the four main coding cases line by line, extracting text segments that expressed independent analytical meanings as meaning units. Initial codes were assigned in ways that remained close to the original language. These codes identified concrete phenomena related to device entry, home risk spaces, older adults' use feedback, alarm handling, home visits, and follow-up maintenance.

The initial codes were then compared, merged, and abstracted into higher-level concepts. Open coding produced 205 meaning units and 205 initial coding records. Through further comparison and consolidation, 68 concepts were formed. Table 2 presents examples of the open-coding process.

Table 2
Examples of Open Coding

Meaning Unit	Initial Code	Concept
The community established records for key older adults and arranged in-home device installation according to eligibility conditions.	Device installation after priority-user registration	Screening of safety-net and high-risk users
Falls often occurred in bathrooms or during toileting, but monitoring devices were mainly placed near beds.	Bathroom fall risks not covered by devices	Bathroom and toileting risk spaces
Some older adults worried that cameras or monitoring devices would affect their privacy, and therefore refused installation or use.	Refusal caused by privacy concerns	Privacy concerns
After an alarm was generated, community staff or related personnel usually confirmed it by phone first.	Telephone confirmation of alarms	Telephone and SMS verification
Early smart eldercare pilots gradually stalled after the project cycle ended, making subsequent services difficult to sustain.	Service suspension after the pilot period	Pilot termination or stagnation

Axial Coding

Axial coding organized the concepts generated through open coding and clarified the relationships among concepts, subcategories, and main categories. On the basis of 68 concepts, the research team compared their meanings, contexts, and positions in the process of sustained use. Similar concepts were grouped into 15 subcategories.

Following the building-type category logic, related subcategories were further elevated into explanatory main categories. At the same time, the coding paradigm of procedural grounded theory was used to clarify causal conditions, contextual conditions, intervening conditions, actions or interactions, and outcomes (Strauss & Corbin, 1990, 1998). In this way, the 15 subcategories were organized into five main categories that jointly describe the key links and influencing elements of sustained device use. The axial coding results are shown in Table 3.

Table 3
Axial Coding Results

Main Category	Subcategories
A. Safety-Net-Oriented In-Home Device Deployment	A-1 Policy pilots and free installation; A-2 Screening of eligible older adults; A-3 Checklist-based device allocation; A-4 Community mobilization and third-party installation support
B. Home Fall-Risk Spaces and Device Placement	B-1 Coverage of key risk spaces; B-2 Accessibility of post-fall alarm activation and help-seeking
C. Older Adults' User Acceptance and Device Alarm Performance	C-1 Privacy concerns and acceptance of monitoring; C-2 Concerns about operation, wearing, and power consumption; C-3 Reliability of alarm detection
D. Alarm Verification and In-Home Response	D-1 Alarm delivery and manual confirmation; D-2 In-home verification by community staff, care assistants, and grid workers; D-3 Accessibility of home visits and emergency contact
E. Follow-Up Services and Device Maintenance	E-1 Service continuity after the pilot period; E-2 After-sales maintenance and follow-up; E-3 Funding and cost support for continued operation

Selective Coding

Selective coding further integrated the concepts, subcategories, main categories, and their logical relationships. According to procedural grounded theory, the core category should be connected with other categories and should summarize the central phenomenon of the study (Strauss & Corbin, 1990, 1998). By integrating category attributes and theoretical relationships, this study identifies the core category as the key links and influencing elements of sustained use of community home fall-detection sensors. This category summarizes the process through which fall-detection devices move from in-home installation toward sustained operation.

Theoretical Saturation and Quality Check

To test the stability of the category system, one community-level case that had not participated in the main coding process was used for theoretical saturation checking. The reserved case contained approximately 15,000 Chinese characters. It was analyzed through the same open-coding, axial-coding, and selective-coding procedures, and the results were compared with the existing 68 concepts, 15 subcategories, and five main categories. No new concepts, subcategories, main categories, or category relationships emerged. The category system was therefore considered theoretically saturated.

Results

Key Links From Device Entry to Service Maintenance

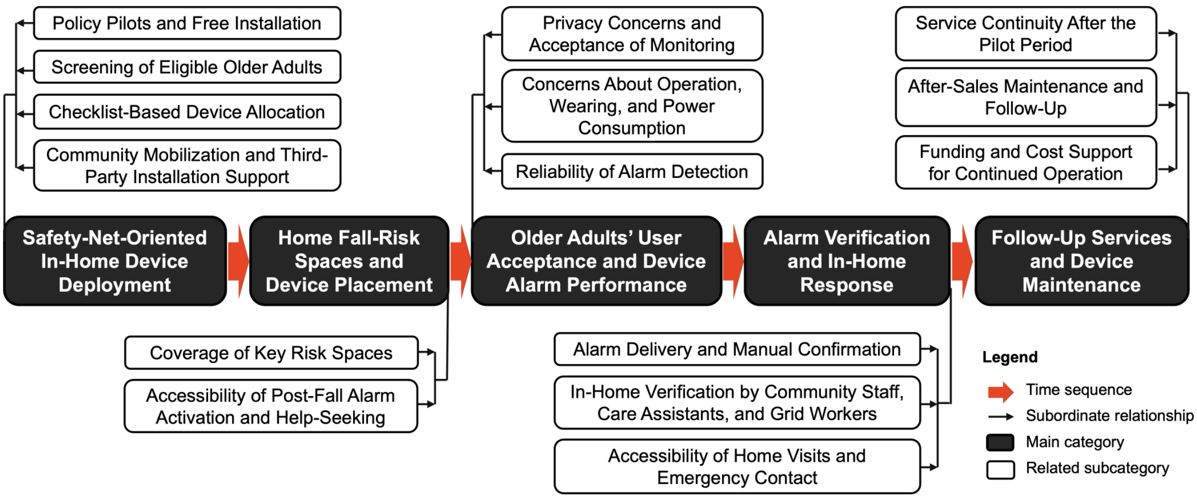
Based on the three stages of grounded-theory coding, the formation of sustained use can be summarized as a temporal sequence of in-home deployment, spatial adaptation and everyday use, alarm response, and follow-up maintenance. The entry of a device into an older adult's home is only the beginning. The device must then be aligned with home space, daily behavior, response routines, and maintenance arrangements before it can become stable community care support.

The first stage determines the service object, device type, and mode of entry. Policy pilots, subsidies, and safety-net screening provide the institutional basis for device allocation. Checklist-based provision defines the type and number of devices, while community mobilization and third-party support help complete in-home installation. After entry, spatial adaptation and everyday use become the basis for sustained operation. Bathrooms, bedsides, nighttime movement routes, entrances, and other daily activity areas are key fall-risk locations. Whether devices cover these areas, and whether alarms can be activated after a fall, directly affects their capacity to respond to actual risks.

During everyday use, devices must fit older adults' habits, physical conditions, and perceptions. Privacy concerns, operational difficulty, wearing habits, power-use concerns, and perceived alarm accuracy all influence whether devices are incorporated into daily life. When an alarm is generated, platform pushes, SMS alerts, telephone confirmation, community verification, and emergency contact turn monitoring information into a human response process. In the maintenance stage, service continuity, after-sales support, device replacement, and operating costs determine whether devices continue to function after the pilot period. Figure 3 summarizes the key links and influencing elements in this temporal sequence.

Figure 3

Key Links and Influencing Elements of Sustained Use



Operational Relationships in Sustained Use

The temporal sequence gains practical significance only when it is embedded in a multi-actor operational relationship. How devices enter homes, how back-end data are integrated into platforms, how alarms reach responsible actors, how on-site response is triggered, and how device problems are fed back for maintenance together shape the operation of sustained use.

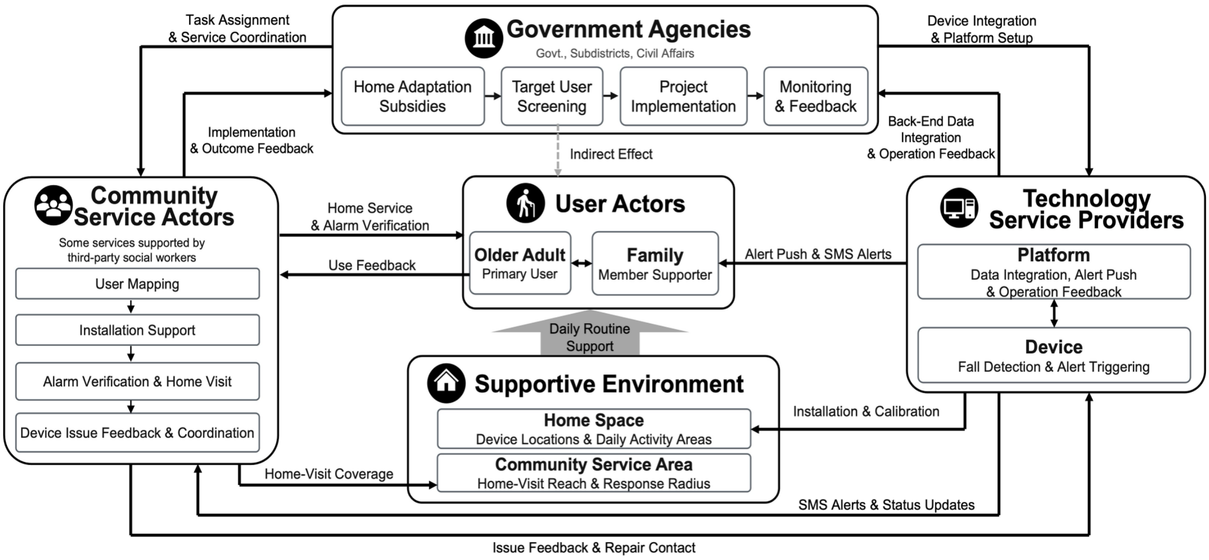
During device deployment, government agencies organize smart eldercare, home adaptation, and home safety projects. They define subsidy rules, device catalogues, and platform access requirements, and work through subdistricts and communities to identify older adults who are oldest-old, living alone, functionally impaired, or otherwise targeted by safety-net programs. Community service actors carry out user mapping, in-home communication, and installation support, thereby translating policy tasks into concrete household settings. Technology providers supply and install fall-detection devices and connect back-end data to government or civil-affairs platforms, creating a unified entry point for data aggregation and alarm delivery.

After installation, the relationship shifts toward alarm verification and care response. Devices sense risk in the home and transmit alarm information to family members and community staff through the platform. Family members usually conduct the first round of confirmation. If they cannot reach the older adult or if the situation remains unclear, community staff, care assistants, or grid workers continue by telephone or by home visit. When a real fall or other emergency is confirmed, the community contacts emergency resources such as 120 and coordinates follow-up with family members. Thus, a platform alarm becomes a care action only after family confirmation and community verification.

Sustained operation is also conditioned by home space and community service reach. Home space determines device placement and risk coverage, while the community service range determines whether home verification can be carried out in time. When devices generate false alarms, lose power, malfunction, or require replacement, older adults and families often report the problem to the community first; the community then contacts the technology provider for repair, calibration, or replacement. The coordination among government platforms, community delivery, family confirmation, technical maintenance, and spatial reach forms the operational basis of sustained use. Figure 4 presents these operational relationships and supporting conditions.

Figure 4

Operational Relationships and Supporting Conditions



Barriers to Sustained Use

The establishment of an operational relationship does not guarantee sustained use. Interviews, field observations, and coding results show that after installation, fall-detection devices in Hefei are constrained by five breakpoints. These breakpoints appear in needs assessment, spatial placement, alarm detection, service response, and follow-up maintenance, and together reveal misalignments between device deployment and continuous care.

First, project provision is misaligned with older adults' real needs. Devices are often allocated according to safety-net criteria such as advanced age, living alone, disability, or economic difficulty, and device configuration commonly follows project checklists. This approach helps projects achieve coverage quickly, but it does not sufficiently identify fall history, physical condition, everyday habits, or family care arrangements. In some home-care bed projects, devices such as smart mattresses, gas alarms, and fall-detection sensors were installed for many functionally impaired older adults, yet service continuity did not persist after the project ended. The project reached administratively defined target users, but not necessarily households with matching risk scenarios and willingness to use the devices.

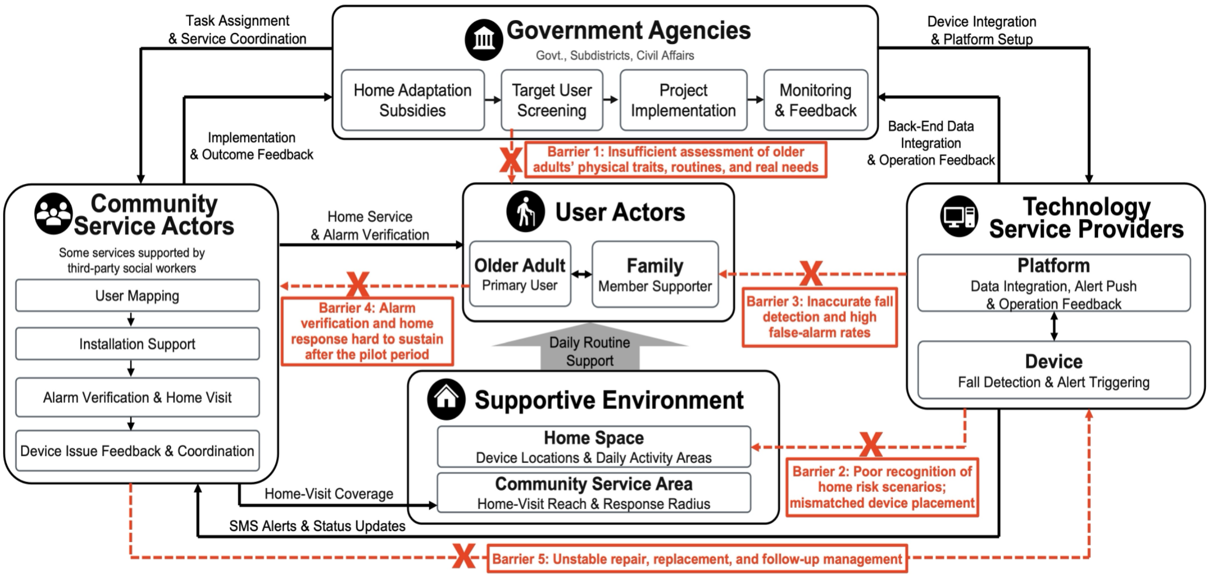
Second, sensor placement is misaligned with home fall-risk spaces. The materials show that some monitoring devices mainly covered the bed or bedside area, while bathrooms, nighttime routes, and entrances were not adequately included. In one community case, a millimeter-wave radar device was arranged by bed unit, with an effective fan-shaped range of about two meters. It could identify leaving-bed duration, sleep quality, and some abnormal states, but the bathroom was outside the monitored area. Falls, however, often occur during toileting, nighttime movement, getting out of bed, or moving between rooms. When spatial risks are not correctly identified, device coverage cannot easily become real protection.

Third, alarm detection is misaligned with older adults' daily behavior. False alarms, offline states, power disconnection, and resistance to camera-based devices appeared repeatedly during fieldwork. Community staff reported that some devices identified a person sitting on a sofa as a fall, while institutional staff noted alarms triggered by curtain movement, coughing, or device disconnection. Some older adults interpreted indicator lights as power consumption and unplugged batteries or power sources. For both older adults and frontline workers, frequent false alarms increase verification burdens and weaken trust in the device.

Fourth, project cycles are misaligned with response responsibilities. Alarm information must pass through platform pushes, telephone calls, SMS alerts, family contact, and community verification before it can lead to a home visit. A device alarm does not automatically produce care action; it still requires family members, community staff, care assistants, or grid workers to verify the situation. Community actors often undertake first- or second-round verification, but their response capacity is limited by service radius, staffing, and responsibility boundaries. After the project cycle ends, if these conditions are not continued, alarm information is difficult to translate into stable care action. The device may still be able to alarm, but the service chain behind it has become weaker.

Fifth, device delivery is misaligned with follow-up maintenance. Installation is often treated as the project delivery point, yet sustained operation requires calibration, troubleshooting, device replacement, platform maintenance, and user guidance. Communities can receive feedback from older adults and families, but they often lack repair authority, stable funding, and technical capacity. If after-sales service is not built into continuous service arrangements, maintenance relies on temporary contact. Fieldwork also showed delayed responses from external suppliers, remote troubleshooting for false alarms, and disconnection between platform data and frontline services. Over time, devices may become offline, lose power, sit idle, or be removed. These breakpoints push fall-detection devices from installation toward constrained use, discontinuation, and service exit. Figure 5 marks these breakpoints in the operational relationship.

Figure 5
Breakpoints in Sustained Use



Discussion

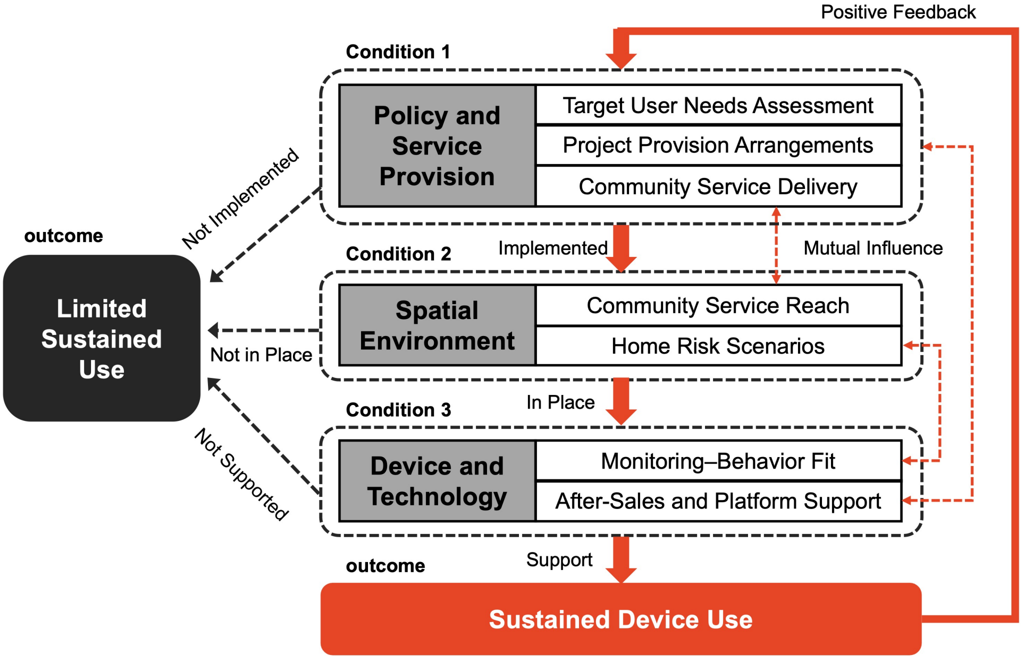
Conditions for Sustained Use

The results show that installation is only the starting point of sustained use. Whether community home fall-detection sensors continue to function depends on the coupling of three conditions: policy and service provision, spatial environment, and device and technology. This process can be conceptualized as a conditional mechanism of sustained use.

Policy and service provision includes target user needs assessment, project provision arrangements, and community service delivery. Spatial environment includes home risk scenarios and community service reach. Device and technology include monitoring-behavior fit and after-sales and platform support. For a fall-detection device to move from in-home installation to sustained use, the user's real risks must be identified, project provision must connect with community service delivery, device placement must cover key risk scenarios, monitoring technology must fit older adults' everyday behavior, and platform and after-sales support must persist. If any of these conditions remains weak, sustained use is constrained.

These conditions are not independent. Policy and service provision determine why and how devices enter homes and who takes responsibility for later services. Spatial environment determines where risks occur, how sensors should be placed, and whether a home visit is reachable after an alarm. Device and technology determine whether monitoring, alarm delivery, and maintenance can remain reliable. Together, the three conditions constitute the mechanism of sustained device use, as shown in Figure 6.

Figure 6
Conditional Mechanism of Sustained Device Use



Optimization Strategies for Sustained Use

The optimization of community home fall-detection sensors should shift from device coverage to the quality of sustained use. Future projects need to integrate household risk identification before entry, spatial and wiring conditions during installation, and alarm response and maintenance feedback after operation. Only in this way can devices move from being installed to being usable, responsive, and maintainable.

At the policy and service level, top-down target screening should be combined with bottom-up household risk identification. Criteria such as advanced age, living alone, and functional impairment help identify priority groups, but they do not show whether a device is suitable for a specific home. Before installation, communities should assess the older adult's fall history, physical condition, activity pattern, and family support. Alarm response should also avoid excessive concentration at the municipal platform terminal. A city-level platform can aggregate data and support supervision, but concrete alarm verification should be delegated more clearly to community eldercare service centers, eldercare stations, or grid-based service nodes, with the response responsibilities of family members, community staff, care assistants, and technology providers specified in advance.

At the spatial level, device placement should shift from standardized installation to scenario-based embedding. Many older adults in safety-net programs live in older residential communities whose homes were not designed for smart devices. During actual installation, devices are often placed wherever sockets, network access, or fixing points are available. This can reproduce the misalignment between device coverage and fall-risk spaces. Home assessment should therefore examine not only where falls are most likely to occur, but also whether power supply, wiring, network access, and fixing conditions support coverage of bathrooms, bedsides, nighttime routes, and entrances. Where necessary, basic wiring, socket adjustment, or network access should be incorporated into home-adaptation subsidies or service packages.

At the device and technology level, product design should better incorporate older adults' bodily states, transmission conditions, and maintenance feedback. High false-alarm rates are not only a technical performance issue; they also reveal limited understanding of older adults' postures and daily rhythms. Detection logic should better distinguish getting up, toileting, nighttime walking, sitting, lying down, and temporary stillness, so that ordinary behavior is not repeatedly misread as a fall. Data transmission should not rely entirely on household Wi-Fi that older adults must pay for and maintain. Depending on the housing context, cellular IoT, wired networks, or community public networks may reduce interruption caused by non-payment, disconnection, or unplugging. The platform should continuously record false alarms, offline states, repair needs, and response outcomes, and return this information to communities and technology providers. Evaluation should also move beyond device coverage rates to include normal-use rates, valid-alarm rates, response-completion rates, and maintenance-closure rates.

Limitations and Future Research

The mechanism and strategies proposed here are based on the empirical context of Hefei. As an early smart-eldercare pilot city with platform construction and community service delivery, Hefei has relevance for other Chinese provincial capitals and cities with similar conditions. Nevertheless, cities differ in fiscal capacity, community service density, service radius, platform maturity, and technology supply. The applicability of the mechanism should therefore be tested in other local settings. For other countries and regions, the mechanism is better understood as an analytical framework rather than a directly transferable practice model, because eldercare systems, family care patterns, and community governance structures vary considerably.

Methodologically, this study relies on interviews, field observations, and project materials. These sources reveal the process and mechanisms of constrained use, but they do not yet provide cross-validation with platform logs, alarm records, false-alarm rates, response times, or maintenance work orders. Future research could compare different cities and combine qualitative materials with platform data, device logs, and service records to further test how policy and service provision, spatial environment, and device and technology jointly affect sustained use.

Conclusion

This study examined community home fall-detection sensors in Hefei's smart eldercare practice. Using interviews, field observations, project materials, and grounded theory coding, it analyzed the key links, operational relationships, and breakpoints through which devices move from installation toward sustained use. The study identified a temporal sequence of device entry, spatial placement, everyday use, alarm response, and follow-up maintenance, and clarified the roles of government agencies, community service actors, user actors, technology providers, and supportive environments.

The findings show that sustained use is not the natural outcome of installation. It depends on the joint action of policy and service provision, spatial environment, and device and technology. Target user needs assessment, project provision arrangements, community service delivery, home risk scenarios, community service reach, monitoring-behavior fit, and after-sales and platform support together determine whether a device can move from in-home installation to sustained use. When these conditions fail to connect, devices are more likely to become constrained, discontinued, or withdrawn from service.

The study extends fall-detection sensor research from deployment to sustained use, and situates policy and service provision, spatial environment, and device technology within one mechanism. The mechanism offers implications for target-user screening, home risk-space assessment, sensor placement, alarm response, and follow-up service delivery in smart eldercare projects. Future work can expand the range of cases and use platform logs, alarm records, and maintenance work orders to test the stability of this mechanism. Smart eldercare should not stop at bringing devices into homes; it should bring services into the home. Without conditions that sustain use, device coverage rates will not translate into real improvements in older adults' sense of safety.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that ChatGPT by OpenAI was used to assist with English grammar checking, language polishing, and reference-format checking. The use was limited to proofreading, improving clarity, and checking formatting consistency. All AI-assisted suggestions were reviewed and edited by the authors. The ideas, research design, data processing, analyses, findings, and discussion were originally developed by the authors, who take full responsibility for the content of the manuscript.

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