Article

Not peer-reviewed version

Age-Friendly Built Environments: Integrating Architecture, Safety, and Corporate Security for Healthy and Independent Ageing

Jernej Bevk and Miha Dvojmoč *

Posted Date: 20 March 2026

doi: 10.20944/preprints202603.1596.v1

Keywords: age-friendly environment; universal design; safety; corporate security

 doi:10.20944/preprints202603.1596.v1

Article

Age-Friendly Built Environments: Integrating Architecture, Safety, and Corporate Security for Healthy and Independent Ageing

Jernej Bevk and Miha Dvojmoč *

Faculty of Criminal Justice and Security, University of Maribor

* Correspondence: miha.dvojmoc@um.si

Abstract

Population ageing intensifies the need for built environments that support healthy and independent living while reducing preventable risks. This review examines how architectural design, safety measures, and corporate security can function as an integrated, layered system for creating age friendly environments across public spaces, housing, and intergenerational community settings. Drawing on an integrative synthesis of recent research, international standards, and guidelines, the review analyses how universal design principles, injury prevention strategies, and governance routines intersect to sustain mobility, reduce harm, and protect data, devices, and operational continuity. The findings indicate that gaps in any layer, such as inaccessible layouts, poorly maintained safety systems, or weak cybersecurity, can undermine overall effectiveness, compromise trust, and affect older adults' autonomy. Conversely, when accessibility, safety, and corporate security are coordinated from design through to operation and maintenance, environments are more likely to remain reliable, equitable, and responsive over time. This review concludes that age friendly environments require not only barrier free architecture and proportionate safety measures, but also robust governance structures that ensure accountability, lifecycle maintenance, and responsible data practices. Integrating these domains provides a foundation for resilient, trustworthy, and health promoting environments that enable older adults to remain active, socially connected, and secure.

Keywords: age-friendly environment; universal design; safety; corporate security

1. Introduction

Population ageing represents a major demographic shift of the twenty-first century, affecting not only health and social care systems but also spatial planning, architecture, and safety governance. Beyond increasing lifespan, a central challenge for planners and designers is how to create environments that support older adults' independence and well-being, while also reducing preventable risks. As widely recognized in global public health literature, the goal is not simply to extend lifespan but to ensure longer healthy and independent years of life, achieved through environments that minimize barriers, reduce risks of injury and victimization, and actively sustain physical, cognitive and social capability [1,2]. Built environments play a pivotal role in shaping health trajectories in later life. Accessible streetscapes, adaptable housing, and socially enabling community settings influence mobility, exposure to hazards, mental well-being, and the ability to age in place [3,4]. Against this backdrop, ageing is not solely a biomedical issue but a spatial, design and governance priority requiring coordinated, multidisciplinary responses.

To address these interdependencies, this review adopts an integrative lens centered on three interlocking layers, reflecting the responsibilities for design, safety and security. The first layer concerns architecture, such as universal design, accessibility, environmental comfort, and clear wayfinding, which collectively remove physical and perceptual barriers and enable sustained, confident use of space [5]. The second layer concerns safety, encompassing fall risk reduction, fire

 doi:10.20944/preprints202603.1596.v1

safety, and traffic calming, which reduce exposure to preventable injury and enhance both perceived and actual security [6]. The third layer concerns corporate security, including governance risk and compliance systems, cybersecurity and privacy for connected devices, and operational resilience for organizations managing housing portfolios, estates or community infrastructure [7]. While age friendly design, injury prevention, and security governance are individually well studied, they are rarely theorized or implemented as a single system. This fragmentation limits both effectiveness and accountability, as accessible design can fail without safety maintenance; safety technologies can introduce novel vulnerabilities without cybersecurity; and governance failures can undermine otherwise well-designed physical environments [8,9].

The scope of this review spans the public realm and landscape environments, housing across the rural–urban continuum, and intergenerational community settings, selected because these settings concentrate the most frequent interactions between ageing, design and risk governance. Methodologically, the review draws on an integrative synthesis of research published in the last 10–15 years, supplemented, where relevant, by international guidelines and standards on accessibility, safety and information security [10]. The analysis addresses two central questions: how do architectural, safety and corporate security factors together shape the age friendliness of built environments and what integrated principles emerge for designing environments that are simultaneously accessible, safe and organizationally secure. Therefore, this review suggests that age friendly built environments function most effectively when architectural accessibility, safety, and corporate security are treated as a single, layered system that supports autonomy, reduces preventable harm, and protects data and operations. The following sections examine these themes across key environmental settings, beginning with the public realm, before turning to housing and intergenerational community contexts. These sections are then followed by a discussion that synthesizes implications and closes with conclusions and future directions outlining an agenda for research and implementation.

2. Integrated Dimensions of Age-Friendly Environments

2.1. Age-Friendly Landscape and the Public Realm

The public realm, such as streets, parks, squares, and greenways, plays a key role in supporting older adults' daily activities. Thoughtful design can encourage walking, help maintain balance, stimulate cognition, and foster social engagement, all of which contribute to mental well-being. Evidence links features such as continuous, step free walking surfaces, shaded seating at short intervals, glare free lighting, and legible wayfinding with higher walking rates and improved confidence among older adults [11]. Exposure to natural environments is further associated with stress reduction, enhanced affect and narrower health inequalities; benefits that are particularly salient for ageing populations whose functional reserves are sensitive to environmental barriers [12,13].

A genuinely age friendly public realm requires layered safety and security embedded alongside health promoting design. Fall preventive materials (e.g., slip resistant pavements), appropriate slopes and good drainage reduce surface hazards as well as traffic calming and protected pedestrian crossings lower collision risk can reduce both the incidence of preventable harm and the fear of victimization, a known deterrent to outdoor activity in later life [6]. Where "smart" features, such as emergency call points, adaptive lighting, or connected sensors are deployed, data governance and cybersecurity should be integral to procurement specifications, maintenance protocols and incident response to preserve reliability, privacy and public trust [14,15].

In practice, effectiveness depends as much on operations as on design intent. Routine inspection, preventative maintenance (e.g., addressing surface degradation, ponding and lighting failures), and transparent incident reporting sustain performance over time and help target remedial action where risks concentrate [15]. Governance should also prevent "surveillance creep" by prioritizing proportionality, purpose limitation and informed consent in any public data use; these are

 doi:10.20944/preprints202603.1596.v1

considerations that are especially salient in spaces frequented by older and other vulnerable users [6,14]. To support accountability and iterative improvement, outcome monitoring should combine behavioral and experiential indicators. For example, use and dwell time, perceived safety by day and night, preventable falls or near misses attributed to environmental factors, and equitable access to green spaces via accessible routes [12,13,16]. Used in combination, these measures help align evaluation with the aim of maintaining capability and reducing harm, as well as enabling municipalities and asset managers to prioritize interventions that deliver the greatest benefit for older adults. However, while public realm design shapes everyday mobility and exposure to risk, many of the most consequential age-related hazards occur within and around the home, necessitating a parallel focus on housing design, domestic safety and portfolio level governance.

2.2. Age-Friendly Housing Across the Rural-Urban Continuum

In practice, age friendly housing depends on architectural fundamentals that remove barriers, sustain comfort, and help prevent common domestic hazards over life course. Core features include visitable layouts (step free access and widened doorways), adaptable bathrooms and kitchens (e.g., reinforced walls for grab bars, walk in showers, adjustable worktops), contrasting stair edges and non-slip flooring, and nighttime pathway lighting to support safe nocturnal mobility [5,17]. Environmental quality—acoustic control, thermal stability, and indoor air quality—is equally important given age-related sensory changes and multimorbidity; these factors influence balance, attention, sleep, and symptom burden [9]. To anchor practice, housing retrofits should align with accessibility and usability standards and vertical transport guidance where lifts are present, while adopting evidence-based design principles shown to reduce falls and improve daily functioning [17–19].

Integrating domestic safety into these fundamentals is essential. It involves installing and regularly testing smoke and carbon monoxide (CO) detectors, ensuring fire compartmentation, and providing evacuation options that consider mobility and sensory impairments, such as areas of refuge and clear visual or tactile signage. Water and heat safety, for instance, anti-scald devices, thermostatic mixing valves, safe heating systems, and clear appliance controls, reduce injury risk, particularly for those with reduced sensation or cognition [9,20]. Given that a high proportion of injurious falls occur at home, design measures (contrasts, lighting, surface choice, layout clarity) should also be complemented by targeted fall prevention programs and periodic safety reviews to address evolving needs [17].

Additionally, where digital augmentation is used governance must be as robust as the technology. A governance risk compliance approach should prioritize data minimization and informed consent, along with encryption at rest/in transit and secure patching/update policies to reduce exploitable vulnerabilities [21]. Operational safeguards should include network segmentation to isolate critical devices, vendor due diligence, for example, security testing, support commitments, software bill of materials etc. This is a measure that is common in theory but unevenly implemented in housing portfolios in practice. In addition, continuity planning with clear fallback procedures during power or connectivity loss is also an important operational safeguard [22]. Older adults frequently express mixed attitudes towards connected monitoring, valuing safety yet concerned about privacy and intrusion, so transparent communication, opt in controls and the ability to tailor alert thresholds are essential to legitimacy and sustained use [23–25].

Rural specificities sharpen these requirements. Longer emergency response times, lower service density, greater energy poverty, and intermittent connectivity elevate both baseline risk and the consequences of system failure [26]. In rural contexts, lower service density increases the consequences of failure, so resilience and low-tech redundancy complement advanced features; for instance, redundant alarms, local audible alerts independent of networks, battery or generator backups, and manual call for help options should accompany any cloud reliant systems [27]. Therefore, community support models are critical complements to physical retrofits, providing

 doi:10.20944/preprints202603.1596.v1

periodic checks, equipment testing and rapid escalation pathways that compensate for sparse formal services [26].

In urban settings (e.g., municipal housing, social landlords, not for profits managing sheltered schemes), organizational practice determines whether design intent translates into durable safety and trust. Operators should maintain incident logging systems that integrate clinical and facilities events, deliver staff and resident training (e.g., fall risk awareness, alarm testing, phishing awareness where smart devices are deployed), and communicate autonomy–safety tradeoffs transparently to residents and families [28,29]. Periodic audits covering both environmental safety and cybersecurity, as well as plus lifecycle maintenance planning for alarms, lifts, lighting and sensors reduce downtime and risk drift [29,30]. While housing design establishes safe and adaptable individual dwellings, intergenerational and communal spaces extend these principles to social engagement, shared resources and collective safeguarding, providing a bridge to neighborhood scale care and inclusion.

Housing providers bear legal and operational responsibilities that extend beyond individual dwelling safety. A comprehensive corporate security system encompasses multiple coordinated processes: legal provision of lawful operations, protection of organization-specific security knowledge, legal and physical protection of information systems, protection of intellectual property, coordination with private security where deployed, and systematic safety activities [31]. These processes must be implemented in interdependence with other functions rather than as isolated technical requirements, ensuring that data protection obligations, physical security measures, staff competencies, and incident response protocols are aligned [29]. Board-level oversight, routine security audits covering both environmental safety and cybersecurity, and clear accountability structures ensure that governance is embedded systematically rather than treated as an afterthought. Where connected monitoring systems are deployed, organizations must maintain current device inventories, documented security configurations, tested incident response procedures, and vendor management protocols to meet duty-of-care obligations and minimize liability exposure [30]. Empirical evidence from organizational security research demonstrates significant gaps between recognition and implementation of corporate security systems. While managers typically acknowledge the importance of integrated security governance, actual implementation, particularly of physical security and business continuity measures, often lags behind information security compliance [32]. In housing portfolios, this pattern manifests as strong adherence to data protection regulations alongside weaker integration of environmental safety audits, resident training programs, and emergency preparedness protocols. Studies show significant disparities between managerial awareness and employee understanding, particularly regarding physical security and compliance procedures, with training programs inconsistently implemented even where policies exist [32]. Addressing this gap requires board-level commitment, clear accountability structures, and systematic staff development to ensure that governance functions as an operational backbone rather than a compliance afterthought.

2.3. Integenerational Design and Community Integration

Intergenerational and neighborhoods operationalize housing design principles through everyday social interaction and shared use of space, generating measurable psychosocial benefits by engineering everyday encounter and belonging. Spatial strategies include shared gardens, communal kitchens and lounges, visible circulation, barrier free routes, and fine-grained proximities that make spontaneous contact effortless. Such configurations enable routine, low effort interaction and mutual aid, which the literature associates with reduced loneliness, improved mental wellbeing, and stronger social capital among older residents [33]. Designs that maintain visual connectivity and create multiple “invitation points” (e.g., small seating bays along circulation, semiprivate thresholds opening onto shared greens) support frequent, casual encounters without imposing participation, a balance that is crucial for autonomy and dignity [34]. When routes are barrier free and legible, and when shared amenities are co located at short distances, older adults are more likely to use them, translating spatial affordances into habitual social engagement and everyday physical activity [33].

 doi:10.20944/preprints202603.1596.v1

Intergenerational design demonstrates how architectural accessibility, safety measures, and governance converge to produce both psychosocial and risk reduction outcomes, a model that can inform broader housing and community strategies.

Sustaining these benefits requires clear safeguarding measures and well-defined boundaries. Access controls, visitor policies, and safety protocols can protect residents while still allowing spaces to feel open and welcoming. Clear rules for the use of shared spaces and devices (booking norms, quiet hours, conflict resolution procedures) set expectations and reduce friction—especially salient in communities mixing age groups with differing rhythms and needs [34]. Importantly, safeguarding should be framed as enabling participation rather than restricting it, to avoid chilling effects on social life.

With increasing adoption of shared digital amenities, data and device governance becomes integral to community trust. When sensors are deployed in communal areas (e.g., flood/leak detection in shared laundry, environmental sensors in lounges, emergency pull cords), communities should establish explicit policies for data ownership, access rights, retention, and consent boundaries. Where feasible, residents should have opt out pathways and where those are not practical, signage must be prominent, plain language and continuous so that monitoring is always visible and understandable [23]. Transparent rules, co-developed with residents, help keep digital augmentation proportionate and acceptable, particularly in communities with diverse risk perceptions.

In intergenerational settings, corporate security must address the unique challenges of shared responsibility across mixed tenures and age groups. Operators should establish clear protocols defining who manages digital systems, who accesses data, and how security incidents affecting communal spaces are escalated and resolved. Multi-stakeholder governance models, involving residents, facility managers, and technology vendors, help ensure that security measures remain proportionate, transparent, and accountable [29]. Regular security reviews should assess both technical controls (encryption, access management, patch currency) and organizational practices, including staff training on privacy protection and appropriate data handling in shared environments where multiple users with varying digital literacy interact with connected amenities.

3. Discussion

This review advances a layered model in which architectural accessibility removes environmental barriers, safety by design mitigates preventable harms, and corporate security protects data, devices and operations. Empirically, accessible architecture enables mobility, supports everyday activity and extends time spent in such environments [35]. When paired with targeted safety measures, such as non-slip surfaces, calibrated lighting, clear wayfinding, fire detection, compartmentation and so on, both the prevalence and severity of injuries can decline [17]. In practice, these layers interact closely. When perceived safety improves, older adults are more likely to use public and shared spaces, boosting physical activity and psychosocial well-being [12]. At the same time, any gap in one layer can compromise overall effectiveness. Poorly maintained lighting can negate accessible design, and unsecured sensors can undermine trust and suppress uptake [8,22]. Rather than functioning as a simple checklist, the layered model operates synergistically, with outcomes shaped by the consistency of coordination across design, operations, and governance over time [7,36].

Corporate security serves as the operational backbone that sustains the layered model over time. While architectural accessibility and safety by design can be embedded at the point of construction or retrofit, governance requires ongoing organizational commitment, resource allocation, and accountability structures that prevent risk drift as technologies evolve and resident needs change. Effective governance encompasses board-level oversight of risk management, formal vendor due diligence processes, regular security audits spanning both physical and cyber domains, staff training programs, documented incident response capabilities, and lifecycle maintenance planning.

Recent empirical research on organizational security implementation reveals that recognition of security's strategic importance does not automatically translate into systematic practice. Studies

 doi:10.20944/preprints202603.1596.v1

show significant disparities between managerial awareness and employee understanding, particularly regarding physical security and compliance procedures, with training programs inconsistently implemented even where policies exist [32]. In age-friendly housing, this implementation gap can manifest as formal governance frameworks that remain disconnected from frontline operations, undermining the autonomy and security they were intended to support. This integration of corporate security into age-friendly design represents a departure from traditional practice, where security is often treated as a discrete IT concern rather than a fundamental dimension of environmental quality and resident wellbeing.

Several ethical tensions occur across implementation contexts. Balancing autonomy and protection require proportionate safety measures that support, rather than constraint, self-direction, especially in domestic and semipublic spaces. Tensions between convenience and privacy intensify where sensors and platforms are deployed as older adults value safety but remain wary of surveillance and data misuse [23–25]. Accordingly, this review advocates privacy by default and data minimization to reduce collection to what is strictly necessary, alongside participatory rule setting to sustain legitimacy and avoid chilling effects on social life. A further tension can be identified in standardization at the local context. Uniform specifications aid scalability and quality assurance, yet rural geographies with longer response times and intermittent connectivity require resilient, low-tech fallbacks that differ from solutions feasible in dense urban settings [26]. Participatory co design helps reconcile these tensions by aligning interventions with lived experience and operational capacity, thus supporting both uptake and sustained use [37]. These trade-offs are not new but become more visible and consequential as digital systems are embedded more deeply into everyday living environments.

Real world delivery hinges on implementation realism. Up front capital and retrofit costs can be substantial, and lifecycle maintenance burdens can erode performance if not planned from the outset [38]. Staff training is equally pivotal. Frontline teams require competencies in fall risk recognition, alarm testing and, where relevant, digital hygiene (e.g., phishing awareness, device resets) to prevent risk drift [28,29]. Vendor management should include clear procurement requirements, for instance, security testing, patch policies, support commitments, and routine verification, notably, segmentation for critical devices, reduces exposure to cyber physical failure modes [22,30].

Implementation must also confront digital inequality. Connectivity gaps, including uneven broadband coverage and unreliability, can suppress the benefits of systems, especially in rural contexts [26]. Digital literacy gaps likewise hinder uptake and safe use, even where connectivity exists; residents and staff may misconfigure devices or avoid them altogether due to uncertainty or mistrust [37]. Blending low tech redundancy with selective digital augmentation can mitigate these barriers. Investment in training further ensures that safety and accessibility gains are not contingent on ideal connectivity or specialist expertise [21,26].

Positioned within the policy and standards landscape, the layered model complements international agendas on healthy and age friendly environments while offering mechanisms for scalability and accountability. Public health frameworks underline the need to add life to years through environments that sustain capability; risk management and information security standards provide operational scaffolding for consistent delivery and oversight [29,39]. Privacy by design guidance articulates consumer centered protection for data enabled services, while occupational health and safety management standards support routine hazard control in staffed housing and community settings [28,40]. Crucially, the model is adaptable across scales, from a single sheltered housing scheme to municipal portfolios and mixed tenure neighborhoods, which makes it relevant to design practice (specification, detailing) and to asset governance (policies, audits, performance monitoring) [7,20]. By integrating architectural accessibility, corporate security, and safety by design as one system, stakeholders can deliver environments that are not only accessible and safe, but also trustworthy and resilient over time. By synthesizing safety, architectural design, and corporate security, the layered model provides a foundation for ongoing evaluation, iterative improvement, and strategic policy alignment in age friendly environments.

 doi:10.20944/preprints202603.1596.v1

4. Conclusions

Age-friendly environments are most effective when architectural accessibility, corporate security, and injury prevention are conceived and implemented as a single, layered system spanning homes and the public realm, across both rural and urban contexts. This review has demonstrated that these three domains, which are traditionally fragmented across professions and organizational silos, can function synergistically when integrated from design through to operation and maintenance. Universal design removes barriers and sustains capability; proportionate and domestic safety measures reduce preventable harm; and corporate security routines protect data, devices, and operations, sustaining reliability and trust over time [5,6,29]. In combination, these layers support older adults to remain active, autonomous, and socially connected, while aligning with public health objectives to add life to years through supportive environments [36].

The layered model advanced in this review offers several key contributions to age-friendly design practice and policy. First, it makes explicit the interdependence between physical design, safety systems, and organizational governance, demonstrating that gaps in any layer compromise overall system effectiveness. Second, it provides a practical framework for coordinating interventions across scales, from individual to municipal, and across contexts, from dense urban neighborhoods to dispersed rural communities. Third, it positions corporate security concept not as a supplementary IT concern but as a fundamental dimension of environmental quality, which is essential to maintaining trust, autonomy, and dignity as digital augmentation becomes more prevalent in housing and community settings.

Translating this model into practice requires baseline universal design in new builds and retrofits, proportionate and domestic safety measures (for example, fall prevention, fire/CO detection, compartmentation), and robust governance routines including privacy-by-design, security controls, vendor oversight, staff training, and continuity planning, particularly where connected devices are deployed [17]. Intergenerational designs can amplify psychosocial benefits and space utilization, provided they are accompanied by clear safeguarding protocols and transparent data governance policies that respect resident autonomy while maintaining safety [33].

For policymakers and regulators, the review underscores the need for integrated standards and guidance that span architecture, safety, and information security, rather than treating these as separate domains. Procurement frameworks, building codes, and funding mechanisms should incentivize layered approaches that embed governance from the outset, rather than retrofitting security as an afterthought. Capacity building must, therefore, be resourced as core components of implementation, not optional extras.

Ultimately, governance must be treated as equal to design if age-friendly interventions are to remain effective, operationally viable, trusted, and adaptable over time. The built environment does not remain static; technologies evolve, organizational capacities shift, and residents need change. Only through sustained governance—manifested in routine audits, lifecycle maintenance planning, incident response capabilities, and participatory review—can the layered model deliver on its promise of supporting older adults to remain active, autonomous, and socially connected in environments that truly add life to years [32,39].

5. Future Directions

Future research and practice should prioritize the development of a small, standardized set of indicators to enable benchmarking across sites and programs. These metrics should combine objective measures, such as preventable falls, incidents, and uptime of critical devices or services, with subjective measures, including perceived safety, trust, and usability, and incorporate equity-focused indicators, such as access to green spaces via accessible routes [12,41]. Consistent reporting over time, stratified by rural or urban context and levels of deprivation, will improve comparability and accountability, helping policymakers and practitioners identify gaps and prioritize interventions [35].

 doi:10.20944/preprints202603.1596.v1

Longitudinal and economic evaluations are equally important. Analyses should capture not only benefits, such as avoided injuries, reduced hospital utilization, and increased participation, but also costs, including maintenance overheads, to inform equitable and scalable investment strategies [38]. Therefore, studies should assess the long-term effectiveness and cost-effectiveness of both physical retrofits and digital augmentations, with particular attention to rural settings where service density is low and emergency response times are longer. Such evidence will strengthen the case for integrated, layered approaches and guide resource allocation.

The security and ethics of connected environments also demand focused attention. Systems employing sensors or digital platforms should adopt lightweight device certification, default data minimization, and consent processes that accommodate cognitive impairment, for example through plain-language notices and ongoing consent checks, with opt-out options where feasible [42]. Routine resilience testing, including audits, patching drills, and, where appropriate, red teaming, should become standard practice to prevent cyber-physical failures and maintain user trust. Addressing these challenges is critical as digital augmentation becomes increasingly embedded in housing and community settings.

Alongside digital resilience, building local governance and co-design capacity is crucial for long-term sustainability. Implementations should embed participatory approaches, training for residents and staff, maintenance budgets, and vendor oversight as core components rather than afterthoughts [37]. Aligning interventions with risk management and occupational safety frameworks supports iterative improvement, enabling layered systems to adapt as needs and technologies evolve.

By prioritizing capacity building alongside architectural design, safety, and security, stakeholders can keep interventions usable, maintainable, and trusted in everyday practice. Taken as a set, together, these priorities ensure the layered model remains effective, resilient, and equitable over time, providing a clear roadmap from standards and pilots to sustain real world impact.

Author Contributions: "Conceptualization, J. B. and M.D.; investigation, J.B.; resources, M.D.; writing—original draft preparation, M.D.; writing—review and editing, J.B.; visualization, M.D.; supervision, M.D.; project administration, J.B. All authors have read and agreed to the published version of the manuscript.".

Funding: "This research received no external funding".

Data Availability Statement: No data were created.

Conflicts of Interest: "The authors declare no conflicts of interest." "The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results".

References

1. Beard, J.R.; Bloom, D.E. Towards a comprehensive public health response to population ageing. Lancet **2015**, 385, 658–661.
2. World Health Organization. Global Strategy and Action Plan on Ageing and Health 2016–2020; WHO Press: Geneva, Switzerland, 2017.
3. Buffel, T.; Handler, S.; Phillipson, C. Age-Friendly Cities and Communities: Background, Theory and Development. In Age-Friendly Cities and Communities; Buffel, T., Handler, S., Phillipson, C., Eds.; Oxford University Press: Oxford, UK, 2018; pp. 1–72.
4. United Nations. World Population Ageing 2020 Highlights; Department of Economic and Social Affairs, Population Division: New York, NY, USA, 2020.
5. Steinfeld, E.; Maisel, J. Universal Design: Creating Inclusive Environments; Wiley: Hoboken, NJ, USA, 2012.
6. Cozens, P.; Love, T. A review and current status of crime prevention through environmental design (CPTED). J. Plan. Lit. **2015**, 30, 393–412.
7. Chaisiri, A.; Boonmee, K. Safety Risk Modeling in Smart Cities: A Multi-Layered Approach to Urban Infrastructure Protection. Trans. Embed. Syst. Real-Time Comput. Appl. **2025**, 15, 1–16.

 doi:10.20944/preprints202603.1596.v1

8. Marston, H.R.; Shore, L.; White, P.J. How does a (smart) age-friendly ecosystem look in a post-pandemic society? Int. J. Environ. Res. Public Health **2020**, 17, 8276.
9. van Hoof, J.; Demiris, G.; Wouters, E.J.M. Handbook of Smart Homes, Health Care and Well-Being; Springer: Cham, Switzerland, 2016.
10. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ **2009**, 339, b2535.
11. Wen, C.; Albert, C.; von Haaren, C. Nature-based recreation for the elderly in urban areas: assessing opportunities and demand as planning support. Ecol. Process. **2022**, 11, 44.
12. Mitchell, R.; Popham, F. Effect of exposure to natural environment on health inequalities: an observational population study. Lancet **2008**, 372, 1655–1660.
13. Aspinall, P.; Mavros, P.; Coyne, R.; Roe, J. The urban brain: analysing outdoor physical activity with mobile EEG. Br. J. Sports Med. **2015**, 49, 272–276.
14. Barns, S. Smart cities and urban data platforms: Designing interfaces for smart governance. City Cult. Soc. **2018**, 12, 5–12.
15. World Health Organization. Global Age-Friendly Cities: A Guide; WHO Press: Geneva, Switzerland, 2007.
16. Wood, L.; Hooper, P.; Foster, S.; Bull, F. Public green spaces and positive mental health–investigating the relationship between access, quantity and types of parks and mental wellbeing. Health Place **2017**, 48, 63–71.
17. Chase, C.A.; Mann, K.; Wasek, S.; Arbesman, M. Systematic review of the effect of home modification and fall prevention programs on falls and the performance of community-dwelling older adults. Am. J. Occup. Ther. **2012**, 66, 284–291.
18. International Organization for Standardization. ISO 21542: Building Construction—Accessibility and Usability of the Built Environment; ISO: Geneva, Switzerland, 2011.
19. CEN. EN 81-70:2018—Safety Rules for the Construction and Installation of Lifts—Accessibility to Lifts for Persons Including Persons with Disability; CEN: Brussels, Belgium, 2018.
20. Xia, B.; Jiaxuan, E.; Chen, Q.; Buys, L.; Susilawati, C.; Drogemuller, R. Impact of the built environment on ageing in place: a systematic overview of reviews. Buildings **2024**, 14, 2355.
21. Rashidi, P.; Mihailidis, A. A survey on ambient-assisted living tools for older adults. IEEE J. Biomed. Health Inform. **2012**, 17, 579–590.
22. Komninos, N.; Philippou, E.; Pitsillides, A. Survey in smart grid and smart home security: Issues, challenges and countermeasures. IEEE Commun. Surv. Tutor. **2014**, 16, 1933–1954.
23. Berridge, C. Breathing room in monitored space: the impact of passive monitoring technology on privacy in independent living. Gerontologist **2016**, 56, 807–816.
24. Ghorayeb, A.; Comber, R.; Gooberman-Hill, R. Older adults' perspectives of smart home technology: Are we developing the technology that older people want? Int. J. Hum.-Comput. Stud. **2021**, 147, 102571.
25. Wang, Y.; Li, M.; Chen, N.; Hou, W.; Zhang, Y.; Zhu, M.; Tang, X. Older Adults' Perspectives on Adopting Smart Home Technology for 'Proactive Health': A Qualitative Study. J. Adv. Nurs. **2026**, 82, 606–616.
26. Skinner, M.W.; Winterton, R. Rural ageing: Contested spaces, dynamic places. In Geographical Gerontology; Skinner, M.W., Andrews, G.J., Cutchin, M.P., Eds.; Routledge: London, UK, 2017; pp. 136–148.
27. European Commission. Broadband Coverage in Europe 2019; Publications Office of the European Union: Luxembourg, 2020.
28. International Organization for Standardization. ISO 45001: Occupational Health and Safety Management Systems—Requirements with Guidance for Use; ISO: Geneva, Switzerland, 2018.
29. International Organization for Standardization. ISO 31000: Risk Management—Guidelines; ISO: Geneva, Switzerland, 2019.
30. International Organization for Standardization. ISO/IEC 27001: Information Security Management Systems—Requirements; ISO: Geneva, Switzerland, 2013.
31. Dvojmoč, M.; Verboten, M.T. Cyber (In) security of personal data and information in times of digitization. Med. Law Soc. **2022**, 15, 287–303.

 doi:10.20944/preprints202603.1596.v1

32. Dvojmoč, M. Corporate intelligence as the new reality: The necessity of corporate security in modern global business. J. Crim. Justice Secur. **2019**, 2, 205–223.
33. Carrere, J.; Reyes, A.; Oliveras, L.; Fernández, A.; Peralta, A.; Novoa, A.M.; Pérez, K.; Borrell, C. The effects of cohousing model on people's health and wellbeing: A scoping review. Public Health Rev. **2020**, 41, 22.
34. Bigonnesse, C.; Mahmood, A.; Chaudhury, H.; Mortenson, W.B.; Miller, W.C.; Martin Ginis, K.A. The role of neighborhood physical environment on mobility and social participation among people using mobility assistive technology. Disabil. Soc**. 2018**, 33, 866–893.
35. Cerin, E.; Nathan, A.; Van Cauwenberg, J.; Barnett, D.W.; Barnett, A.; Council on Environment and Physical Activity (CEPA)–Older Adults Working Group. The neighbourhood physical environment and active travel in older adults: a systematic review and meta-analysis. Int. J. Behav. Nutr. Phys. Act. **2017**, 14, 15.
36. van Hoof, J.; Marston, H.R. Age-friendly cities and communities: State of the art and future perspectives. Int. J. Environ. Res. Public Health **2021**, 18, 1644.
37. Peek, S.T.M.; Wouters, E.J.M.; van Hoof, J.; Luijkx, K.G.; Boeije, H.R.; Vrijhoef, H.J.M. Factors influencing acceptance of technology for aging in place: a systematic review. Int. J. Med. Inform. **2014**, 83, 235–248.
38. Marikyan, D.; Papagiannidis, S.; Alamanos, E. A systematic review of the smart home literature: A user perspective. Technol. Forecast. Soc. Change **2019**, 138, 139–154.
39. World Health Organization. Decade of Healthy Ageing 2020–2030; WHO: Geneva, Switzerland, 2020.
40. International Organization for Standardization. ISO 31700-1: Consumer Protection—Privacy by Design for Consumer Goods and Services—Part 1: High Level Requirements; ISO: Geneva, Switzerland, 2023.
41. Steels, S. Key characteristics of age-friendly cities and communities: A review. Cities **2015**, 47, 45–52.
42. Condado, P.A.; Lobo, F.G. Security and privacy concerns in assisted living environments. J. Smart Cities Soc. **2023**, 2, 99–121.