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Designing Age-Friendly Smart Cities: Challenges and Innovations in Australia, India, the United Kingdom, and the United States with Reference to Japan and Scandinavia

Lavanyakumari Thondavada[1], Amit Tahil[2]

[1]Indian Management School & Research Centre, Navi Mumbai, India
[2]Geriatric Society of Trinidad and Tobago, Port of Spain, Trinidad and Tobago
Email: ttgeriatrics@gmail.com

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Abstract

Globally, the structure of urban societies is reshaping due to the demographic transitions, with around 22% of the world's population becoming senior citizens by 2050 (United Nations Department of Economic and Social Affairs). This transformation signifies certain unprecedented challenges related to the community's design and sustainable living among the existing and emerging cities. Despite having many international frameworks, there are significant gaps persisting in shaping the senior citizens inclusive smart city development. This study explores and understands the challenges and the need for developing the age-friendly smart cities across the USA, the UK, Australia, and India, while studying the efforts in Japan and Scandinavia as the benchmarks. Adapting a comparative, cross-national and combined methods design of study, distinct factors like the policies, subject matter expert views, the responses from the senior citizens (n = 380), to understand the gaps and development of the Age-Friendly Smart City Framework (AFSCF). This framework is about integrating key domain aspects like the infrastructure, mobility, digital health, digital inclusion, social participation, and governance models as policy alignment. Findings from the study signify convergences in identifying the aging as a policy priority and towards divergences shaped by the governance models, and resource availability. The study concludes that age-friendly smart city development is imperative for the economic and social sustainability of the new age cities.

Keywords

Age-Friendly Cities, Smart Cities, Urban Gerontology, Digital Inclusion,

Comparative Urban Policy, Older Adults, AFSCF

1. Introduction

Increasing trends of global demographic transitions are paving the way to the pace of age-friendly cities, as integral to the international societal development paradigm. Global Age-friendly cities framework [1] [2] by WHO dwells upon eight imperative aspects like the social participation, communication, transportation, respect and inclusions, community health services, outdoor space and buildings management, and housing as critical for evaluating the elder-supportive environments. Despite that the framework by WHO has global resonance, operationally there are gaps in terms of how rapid urbanization is adapting the framework and the context driven scenarios.

In addition of the initiatives of the WHO, the SDG 11 (The United Nation's Sustainable Development Goal 11) [3] also emphasize the need for making the existing and emerging cities inclusive, friendly for the aged-living population. The SDG 11 categorically highlights the need for sustainable development by 2030, in terms of accessibility, to the vulnerable groups, people who are differently abled, and to the senior citizens of the community. Also, the UN-Habitat 2016 (The New Urban Agenda) [4] also emphasizes the universal design, integration of urban health strategies and participatory planning as integral need for the sustainable aging societies. The other societal body MIPAA (2002) [4] also emphasize to the nations, the pressing need for the restricting or development of feasible inclusions to focus on the aging concerns into the urban governance process.

Considering the healthcare economics, it is pragmatic need to integrate the age-friendly features into the infrastructure in the cities and towns. The healthcare expenditure on the older adults is sizeable portion of the total healthcare expenditure, as the hospitalization of older people due to the falls, issues emerging due to poor mobility infrastructure resulting in accessibility issues to the older people. The case studies from OECD countries reflect on how effectively the hospital admissions can come down by having appropriate range of age-friendly interventions in the infrastructure, which can also reduce long-term care costs [5]. While the studies on the measures implemented in some cities show positive impact, there are only certain fragmented sets of studies available regarding the diverse governance and cultural ecosystems related age-friendly cities development.

This paper explores the gaps by focusing on the key findings from the doctoral study assessing the age-friendly smart city development across the USA, the UK, Australia, and India, in benchmark comparison against the Scandinavia and Japan. Age-Friendly Smart City Framework [6] is the central output discussed in this paper. AFCSF is a comprehensive, cross-national adaptable planning model. In the further sections of this paper, the related work as literature review, followed by the research methodology, key finding, and the discussions on the AFSCF

framework [2]. The last section of this paper presents the conclusions and recommendations.

2. Literature Review

2.1. Gerontology and Urban Aging Evolution

Gerontology is the scientific study of aging, has evolved from the scope of biomedical focus to a multidisciplinary, psychological, environmental dimension oriented, policy-relevant approach [7]. The field's institutionalization—through the Gerontological Society of America (1945) and the Journal of Gerontology (1946) has transpired from fundamentals to the current dynamics like the social, environmental and the concept of urban gerontology. The urban gerontology is profoundly about the cities considered for determinant of aging trajectories [8]. Environmental gerontology has led to interesting subject of "aging in place" referring to the ability of older adults to manage independently in their communities [9].

The introduction of the Active Ageing Policy Framework [10] from WHO, and the Global Age-Friendly Cities Framework [2] has led to the cross-studies development gerontology with urban studies, leading to rights and capabilities-based approach spanning to interconnected domain. Some other important frameworks like the New Urban Agenda [11] and the MIPAA (2002) has reinforced the need for inclusion of the aging factors within the urban planning and the participatory governance, which is part of SDG11. The combination of these frameworks refers to the agreement among the global policy makers towards the need to include the aging factors within the design and governance of the cities.

2.2. Smart Cities and Aging Populations

Contemporary advancements like the ICTs (information and communication technology), AI (artificial intelligence) [12] big data has enabled the smart city paradigm, and towards optimization of services and governance to the urban aging [6]. The advancements of technology and digital infrastructure like the AI driven care platforms, wearable devices used in health monitoring, telemedicine solutions are enabling the stakeholders with better healthcare practices, leading to reduction in the hospitalization [13]. However, the other argument highlighted as against to the above positives are about how some of the smart city projects are more focused on technology enablement rather than people centered measures which could lead to digital exclusion for the older adults with issues of digital divide or the literacy or affordability for technologies as a critical impact factor [14] [15].

The smart cities pioneer countries like the Scandinavia and Japan demonstrate how inclusive the new age smart cities can be for the elderly citizens. For example, the Japan's framework like "Society 5.0" includes telehealth, AI based healthcare, robotics into the systemic eldercare. Scandinavian welfare models consider the factors like the participatory governance, universal design aspects within the digital innovation ecosystem [16]. The studies highlight the need for transpiring the smart cities concept into the smart age-friendly cities concept [17], wherein ger-

ontological principles respected by also including the universal design standards and the digital innovations that can benefit the elderly care.

2.3. Governance, Culture, and Health-Economic Perspectives

The development trajectory of the age-friendly smart cities has impact of the governance structures. Japan's centralized systems stand an example of how the coordinated national eldercare strategies can result in better outcomes, whereas the shortcomings in the Federal systems like the USA and India is due to its fragmented structure wherein the responsibilities divided between the state and central governance levels [16]. Exemplary developments like the Municipal leadership by Manchester's WHO Age-Friendly City Membership, or the Melbourne's action plans prioritize the elderly care despite the resource constraints and austerity measures, impacting the service offering scalability [11].

The other influencing factor on the Age-Friendly smart cities growth is the impact of cultural norms. The Collectivist societies like the India and Japan culturally embrace the elder care within the extended family structures. The rise of nuclear family structures in the recent decades is impacting the elder care cultural system in these countries [18]. However, in the case of the individualist societies like the Global North, the priorities are towards formal market = based care, resulting in the senior citizens facing the affordability and housing crisis [19]. The health-economic literature reflects on the need for age-friendly design as a sustainable integration to the preventive healthcare, digital healthcare, accessible housing leading to sustainable independent living for the elderly, and, as a measurable fiscal savings to the governments [5] [20] [21].

2.4. Research Gaps

Many of the studies that has focused on the gerontology subject has highlighted distinct aspects integral to the study topic. However, there are three interlinked gaps which are evident from the studies. They are

- Conceptually, majority of the smart city plans remain technological emphasis, and miss the integration of gerontological principles, and the preferences for the senior citizens.
- From an empirical perspective, there are very few studies that focus on the cross-national comparative studies to assess the diverse governance and cultural systems operationalizing frameworks, categorically from the Global North and Global South Contexts.
- Very few studies have focused on the mixed-methods kind of design for studies that can help in understanding the bridging policy analysis, experiences of the senior citizens and the elderly care.

3. Methodology

3.1. Research Design and Philosophy

The study adopted focusing on the pragmatist paradigm and biased to critical-

realist ontology, has chosen the comparative, cross-national, and mixed-methods design [22]. Considering the scope of understanding the issues from the methodological lens, for better understanding of the complexity of smart cities with age-friendly integration to its development, Pragmatism is chosen to garner actionable insights. The design has supported in systematic comparison of distinct cultural contexts and governance factors, while the theoretical frameworks in empirical realities could be assessed.

3.2. Country and City Selection

The theoretical sampling method selects four countries to better understand their paths of urbanization, cultural practices, assorted styles of governance, and welfare systems [23]. The countries focused on the study are as follows (see **Table 1**).

Table 1. Theoretical sampling in selected countries.

Country	Purpose
India	rapidly urbanizing, resource-constrained, intergenerational cultural norm
United States	federal system, technological innovation, significant inequality
Australia	developed welfare state, strong local planning traditions
United Kingdom	pioneer in WHO Age-Friendly Cities networks, constrained by fiscal austerity
Japan	As Global Benchmarks
Scandinavia	As Global Benchmarks

The study focused on cities such as Melbourne in Australia, Bengaluru in India, New York City in the USA, and London in the UK.

3.3. Data Collection

The data collection methods employed in the study are

- Policy and documentation analysis from distinct international frameworks and local governance.
- City-level case studies referring to the municipal reports, secondary and other kind of literature available.
- Focused interviews with subject matter experts including the urban planners, policy makers, local governance authorities, and gerontology scholars.
- Structured survey with senior citizens in the age group of 60+, in approximation of 80 - 100 respondents from each chosen city (four cities mentioned above), and from community centers.

Triangulation of the data from the above-mentioned sources are assessed, which led to more dependable, credible, and effective data findings [24].

3.4. Analysis

Thematic analysis is adapted for qualitative data assessment from the interviews and documents [25]. The information constitutes iterative coding, comparative mapping against WHO domains and the indicators from SDG11. Survey data assessed using the descriptive statistics and the possible cross-tabulations that supported in identifying inequalities across the gender, demographics, and cities. Framework synthesis integration across the distinct data sources supported in garnering insights into the AFCSF framework. Ethical protocols complied with institutional review board requirements, principles of informed consent, data protection laws, protection of vulnerable participants data and the confidentiality protection.

4. Findings

4.1. Policy and Document Analysis

The normative standards offered by the international frameworks like the MIPAA, SDG11, and the WHO Age-Friendly Cities Framework is evident in the national and municipal level service strategies in Australia, the USA, and the UK. Three strategies are evident, of which, the first is the global frameworks offer aspirational guidance but rely more on the voluntary adoption, and the location implementation which is highly variable. Secondarily, the municipal leadership at times deliver the national commitments, as in the case of the Manchester and New York Cities which has inclusive approach to the WHO principles. The final one is that of the India's Smart Cities Mission (2015), which refers to a critical gap, wherein it prioritizes certain factors like the surveillance, digital infrastructure, and the transportation considering the growing demands, but there is not adequate importance or significance to the elderly care or the aging population. Thus, there is some kind of structural risk in the Indian smart cities planning that could lead to senior citizens requirements or priorities excluded in the urbanization acceleration.

Japan's planning of the "Society 5.0" constituting the AI, healthcare technologies, and robotics, with social policy, and the kind of welfare driven frameworks adopted by Scandinavian countries reflect the elevated levels of alignment with international policy frameworks for the elderly care and the aging population care in the smart cities frameworks.

4.2. Case Study Findings

Benguluru demonstrate the issues impeding the carefree living of the senior citizens, due to the exclusion of the aging population factors into the smart city agenda. Only 32% of the surveyed participants from the city find the infrastructure accessible, and sustainable for their comfort. Respondents have cited the issues like the digital divide issues, pension scheme inclusion or delays, complexities in services of e-governance access, availing the public healthcare services. Social

isolation too is cited as one of the key challenges faced by the senior citizens.

Melbourne city policy frameworks are more in tandem with the international policy frameworks, and around 78% of the surveyed elders reported satisfaction pertaining to the mobility infrastructure, pedestrian-friendly streetscapes, digital literacy services for the senior citizens, and the accessible transportation like the tram networks. Challenges were evident in the case of the healthcare systems services fragmented between state and federal healthcare. Also, the challenges related to the affordability in central areas too discussed.

London demonstrated positive impact of the international frameworks, and how the NHS supported community health programs. Around 65% of the respondents from the city citied satisfactory levels for the mobility independence. However, as the reports reflect, the austerity measures initiated since 2010, has impact of funding and service delivery issues to the senior citizens services. Low-income groups and the ethnic minority elders were impacted with the digital exclusion.

New York City is among the early adopters of the international frameworks and has demonstrated innovation in terms of community programming and the digital healthcare services resulting positive. But from surveys it is evident that only 55% of the elders find the independence of mobility in the city, and the healthcare delays were citied by the 39% of the respondents. Issues pertaining to the inequality, vulnerability during the crisis conditions like the pandemic, and the fragmented healthcare financing evident in the federal governance models. Whereas in the case of the Japan and Scandinavian, the systematic inclusion of the elder's welfare as integral part of the participatory planning ecosystem is evident.

4.3. Expert Interview Findings

From the studies, it is evident that there are five distinct issues as the cross-cutting challenges as

- Fragmented governance without adequate coordination between stakeholders.
- Affordability barriers in the housing.
- Issues pertaining to accessibility to healthcare, and digital divide.
- Policy neglect in the emerging smart city plans.
- Cultural differences and changing societal trends like nuclear family structures.

Experts are of viewpoint that there is some coherence, in the case of the vision for the aging population-oriented planning, in the Melbourne and London, but the policy silos are leading to challenges, across the multi-sector service system. In Benguluru, the experts are of viewpoint that the current smart city KPIs have ignored the needs of the senior citizens as integral to the planning. Whereas in the case of the Japan and Scandinavian countries, the process of city frameworks has imbibed the need for the senior citizens care as integral measure.

In the 2025 UN International Day of Older Persons theme—"Older Persons Driving Local and Global Action: Our Aspirations, Our Well-Being, Our Rights"—as reflective of a necessary paradigmatic shift toward empowerment,

which is a positive but far away goal.

4.4. Survey Findings

Survey findings depict a sharp disparity in the expectations and experiences across the cities for the key aspects (Table 2).

Table 2. Expectations and experiences in the survey.

Parameter/Cities	Benguluru	London	New York	Melbourne
Digital Competence Satisfaction	25%	59%	48%	66%
Mobility Independence Satisfaction	28%	65%	55%	71%
Social Participation satisfaction	38%	55%	49%	71%
Healthcare Access	41%	43%	39%	39%

The survey results refer to distinct outcome, and how the senior citizens are facing the challenges across various key parameters assessed.

5. Discussion

5.1. The Age-Friendly Smart City Framework (AFSCF)

The empirical findings have enabled the structuring of AFSCF into a five-domain setup that can be cross-nationally adaptable planning model. This study focusses on the limitations in the existing framework. The framework identifies the domains in isolation rather than an interdependent system. The emphasis is on the welfare-state contexts, rapid development of the urbanization, and the market-driven conditions. Key advocation in the framework is to surpass the scenarios wherein the senior citizens are seen just as service recipients rather than as the rights-holders and active stakeholders of the urban futures.

There are five interdependent domains in the AFSCFs framework.

- Governance and Policy Alignment
- Health care and Digital health
- Technology and Digital Inclusion
- Social Participation Rights and Empowerment
- Built Infrastructure and Mobility

For effective management of the inclusive policy for the senior citizens in the rapid urbanization, it is essential to have all the above factors inclusive in coherence in the system. Every domain constitutes measurable indicators, context sensitive policy elements that are adaptable across the diverse regional or national scenarios.

The crux of the AFSCF is an integration of distinct critical elements highlighted across various international frameworks reviewed in the study into single operational model, resourceful for diverse range of policy implementation. The framework also highlights how the investments or active integration of one domain can

yield benefit in terms of cross-domain savings among the key elements citied in the framework. For example, social participation being effectively planned can mitigate the mental health expenditure of the respective governments.

5.2. Built Environment, Healthcare, and Digital Inclusion

Interpretation of the survey responses and the other collative information reflect on how the infrastructure development focusing on the senior citizens requirements can also transpire into a public health strategy. Accessible transportation and necessary amendments to the housing internal and external structures as required can mitigate the risks of elderly people facing hurdles, or falls, mitigating the risks of emergency admissions [3].

Certain initiative-taking measures like the Melbourne's universal design policy and the London's transportation subsidies for senior citizens, highlight the fiscal rationality of proactive infrastructure investments. Whereas the issues citied in the case of the Benguluru infrastructure like the inaccessible mobility in many locations, lack of pavements or safe crossing zones elevate the risks for the elderly people.

Preventive healthcare measures and the digital health measures transpire into cost-reduction mechanisms, and sustainable development wherein the senior citizens are seen as inclusive. Japan and Scandinavia in their efforts has shown how the potential and systematic integration of the geriatric and community-based care can do better for the overall societal development. Despite that the digital health policy implementation could run the risk of digital divide and inequality of services in healthcare to extent, working around the challenges and implementing the solutions can do lot good for the smart city development, and reduced costs.

Digital health as a policy instrument has inherent risks and limitations of deepening inequality. For example, in the NHS digital portals, elders without smartphones have limitations to access the information. Digital literacy has become an impediment for the senior citizens to access the pensions schemes serviced online in Benguluru. The risk of "the new urban poverty" is a challenge to address in the case of the digital exclusion. However, it is particularly important to oversee the system for realizing the actual value in terms of cost-saving potential equitably.

5.3. Social Participation, Rights, and Governance

In the well-being of the senior citizens, the social participation aspect stands a determinant and a marker. People participating in the community activities, engaging with the outer world comfortably, and have access to better culture exhibits higher social satisfaction which is inclusive for the senior citizens too. That reduces their cognitive decline, and in turn less stress on the public healthcare system [26]. The data from the studies signify stark differences in the participation rate. Melbourne has around 71% as the community engagement rate, whereas Benguluru has only 38% as the community engagement. Such disparity in the in-

stitutional support, accessible infrastructure, cultural factors, and municipal investments signify the need for some active measures to be adapted in the respective regions.

The mindset changes about framing elders as dependents to the levels of recognizing them as a rights-holders and co-creators is a change in basic assumptions, and the smart cities being planned should imbibe this mindset into the development, planning, and operations of the smart cities. Such inclusion should be treated as an enforceable right rather than a consultative courtesy. Government should play an enabler across its governance structures to support the well-being of senior citizens, for the benefit of all stakeholders.

6. Conclusions

The study has focused on the need and elements of designing age-friendly smart cities as a social need, a rights-based obligation for senior citizens, and an economic need for the nations. It is paramount importance for the nations to focus on the elder-inclusive among infrastructure, digital inclusions, healthcare services, social participation, and the preventive healthcare, to have sustainable inclusion. The objective of the system should be to ensure senior citizens as active co-creators rather than as passive beneficiaries of the local and global action.

The AFCSF proposed contributes to the gerontological, smart city scholarship and the urban studies, wherein the framework is the combination of key elements from the international frameworks into a single framework that can be cross-nationally adaptable. It supports the policy makers with a planning guide, framework that can help better monitoring, context sensitive policy levers. Comparative findings across Australia, the USA, the UK, and India against Japan and Scandinavia, elucidate that no single model suffices, and it is imperative to have cross-national learning and local adaptation for success.

The study acknowledges the limitations related to regional focus, the cross-sectional nature, sample size, or the number of cities chosen for studies etc. In the future research, expanding the coverage of the study to underrepresented regions like Africa too is essential. Critical understanding of the ethical implications for emerging AI, surveillance and technologies in the elder care is imperative.

In conclusion, the future of the cities without inclusion of the senior citizens care is not a promising outcome. Age-friendly smart cities are not a dream, but a structural necessity for sustainable and resilient urban futures. By embedding the critical and key aspects discussed in this study as integral to the planning of smart cities, the sustainable and carefree living of the senior citizens is possible in the smart cities.

Policy Recommendations

Basis the study of the four cities, their current activities/measures for the welfare of senior citizens comfort following are some of the key recommendations from the study (**Table 3**).

Table 3. Policy recommendations.

City	Recommendation
Australia	Need to focus on the expansion of Medicare funded preventive programs and Rural Telehealth.
India	Formalize the elder inclusivity as a criterion in smart cities mission funding. Improve community based digital literacy programs.
UK	Protect the NHS preventive care programs for the senior citizens programs from austerity.
USA	Expand the services of Medicare coverage for preventive and the telehealth services.

At the global level, the emphasis should be to consider the rights of the senior citizens as integral part of the smart cities' development, then considering them as a passive beneficiary.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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