Aging, artificial intelligence, and the built environment in smart cities: Ethical considerations

Yuriko Ryan MA DBioethics[a],*, Gloria Gutman PhD[b]

[a]*Independent Researcher/Healthcare Ethics Consultant, Vancouver, Canada;* [b]*The Gerontology Research Centre, Simon Fraser University, Vancouver, Canada; *Corresponding author: yryan@luc.edu*

Abstract

Increasingly, artificial intelligence (AI) is being utilized in urban planning and integrated into the built environment (BE) of urban centres, creating 'smart cities' (SC). However, the ethical and legal implications of this trend for the growing elderly population in urban areas are often overlooked. While AI-supported SC may offer resource-efficient management and services for older adults, they also risk excluding a significant portion of this demographic. This paper addresses ethical concerns for older adults in AI-supported SC, drawing from an ethics perspective that combines traditional ethical principles (beneficence, non-maleficence, autonomy, justice) with AI ethics (explicability, transparency). Three examples of non-healthcare SC-AI-BE interactions are provided, aiming to generate ethical discussions within the gerontechnology field. The paper concludes with suggested avenues for empirical research and ethical deliberation.

Keywords: artificial intelligence, smart cities, built environment, ethics, older adults

INTRODUCTION

Over four decades ago, Anthea Tinker's *'Old People in Modern Society'*, a classic text in the field of social gerontology, introduced a number of topics related to aging and the built environment (Tinker, 1981). At that time the concept of age-friendly cities had not yet emerged, and policy debates were just beginning on the implications of the intersection of population aging and urbanization, trends that were occurring simultaneously around the world (Buffel & Phillipson, 2016). The rapid development of AI (Artificial Intelligence)-supported urban planning and implementation in the built environment occupied by older adults added another layer to the debate. Strategies to keep older adults socially and digitally connected remain important areas for current public awareness raising and ethical deliberation (Tinker & Ginn, 2015). Rapidly advancing AI technologies that claim to augment human skills are increasingly being incorporated into SC (Smart City) planning and implementation. City planners and engineers, the drivers of development in today's SC (Javed et al., 2022), need to consider the needs of their older population. However, there have been limited discussions of ethical implications for older adults who make up an increasing proportion of urban populations. AI-supported SC not only present opportunities for efficient management of resources and services that shape the current and future BE (Built Environments) for older adults but also pose associated challenges and risks of leaving a large number of older adults behind. AI-supported SC also pose a question as to how they can advance optimal aging processes and foster flourishing and meaningful participation in urban living. In addition, emerging AI technologies have the possibility of replacing social infrastructures and possess intrinsic human-like capacity such as abilities to think, rationalize, feel, and relate. This paper addresses ethical implications for older adults of AI-supported SC and BE. Built on an AI ethics framework that combines the traditional ethics principles (beneficence, non-maleficence, autonomy, and justice) used in biomedical ethics and the additional principles in AI ethics (explicability and transparency), three illustrative examples of non-healthcare SC-AI-BE interactions are presented to generate ethical discussions in the gerontechnology community. The paper concludes by proposing avenues for empirical research and ethical deliberation.

URBANIZATION AND POPULATION AGING

Urbanization is an irreversible trend. By 2050, nearly 70% of the global population will be residing in cities (Ritchie & Roser, 2018). The number of adults aged 65 or older worldwide is projected to more than double over the next three decades, rising from 761 million in 2021 to 1.6 billion, to account for 1 in 6 of the global population (Wilmoth et al., 2023). The numbers aged 80 or older is expected to triple between 2020 and 2050 (WHO, 2022). In many developed counties, older adults living alone tend

to be vulnerable with regard to resources and social isolation (United Nations Department of Economic and Social Affairs, 2020). Urbanization and population aging may unfold in countries at different speeds but they all face the same challenge. They must adapt to having increasing numbers of older persons who live longer than previous generations did, with a wide range of functional limitations, in physical and social environments originally built for much younger populations (Van Hoof et al., 2018).

SMART CITIES (SC), ARTIFICIAL INTELLIGENCE (AI), AND BUILT ENVIRONMENT (BE)

The OECD defines smart cities as cities with a goal to leverage digitalisation, engage stakeholders and improve people's well-being and build more inclusive, sustainable and resilient societies (OECD, 2019). The field of urban planning recognized the potential of integrating physical, social, ecological, and technological infrastructures through SC strategies, which are built on the gamut of new information and communication technologies (OECD, 2020). Increasingly, 'smart' management of urban cities is being accomplished through AI, which refers to *"the ability of algorithms encoded in technology to learn from data so that they can perform automated tasks without every step in the process having to be programmed explicitly by a human"* (WHO, 2021). Domains for AI in SC span healthcare, education, governance, mobility and transportation, living and infrastructures, economy, and environment (Herath & Mittal, 2022). AI now permeates the BE of older adults living in SC.

The BE can contribute to optimal physiological and psychological aging as well as social engagement and community building that stimulates the sense of belonging among older people, and among the generations (Van Hoof et al., 2018). AI-supported SC present many opportunities and associated challenges for fostering dignity and promoting flourishing of older adults. However, literature on SC applications to improve BE for older adults are either descriptive or conceptual. Given the unprecedented pace of AI adoption in SC, there is an urgent need to understand how AI-powered SC impact the BE for older adults and to discuss how we can achieve integration of the expertise and experiences of stakeholders in the BE for older adults.

WHAT IS A GOOD AI-SUPPORTED SC FOR OLDER ADULTS?
Human ethics and machine ethics
In 2018, the AI4People Scientific Committee, an interdisciplinary group comprised of 12 academic scholars from Europe and an industry-led research lab from the U.S. synthesized findings on the opportunities and associated risks that AI offer and the principles that should sustain the adoption of AI (Floridi et al., 2021). The Committee created an ethical framework for a good AI society that includes the four principles of bioethics (beneficence, non-maleficence, autonomy, and justice) and an additional principle: explicability, defined as the ability of AI system to explain its decision-making process in a way that is understood by humans. In 2019, health ethics researchers in Switzerland published a scoping review of 84 existing ethics guidelines for AI globally, reporting that transparency and explainability are the most prevalent principles (Jobin et al., 2019). There is an urgent need for an intersectional ethical framework to analyze issues involving SC-AI-BE for older adults.

Explicability and accountability for older adults
For many older adults, the digital divide has been an ethical challenge from a justice perspective (Choi & DiNitto, 2013). AI-supported SC further widen the existing inequities due in part to the limited explicability of the ability of algorithms encoded in technology. Explicability has two components: intelligibility (as an answer to the question: how does it work?) and accountability (as an answer to the question: who is responsible for the way it works?). While ethical issues of beneficence, non-maleficence, autonomy, and justice for older adults have been discussed in some SC domains it has been mostly concerning healthcare; little empirical research is being conducted on explicability, intelligibility, and transparency principles that should sustain the adoption of AI in SC for older adults in other BE domains such as housing and transportation, and with respect to the economy, and civil engagement.

AI and moral agency
Literature on AI-supported SC often presents futuristic scenarios and speculative discussions on artificial super intelligence (ASI) that supposedly surpasses human intelligence by manifesting cognitive skills and developing thinking skills of its own or artificial narrow intelligence (ANI) to solve specific problems. It is critical to examine the ethical issues associated with currently used AI technologies in SC and their unexpected consequences for older adult populations.

The emerging ethical debate on AI presents questions and concerns about the behavior of humans who design and use AI systems and the behavior of machines. The moral agency of older adults with cognitive limitations is an overlooked topic in many domains of the BE. It is prudent to discuss whether AI technologies behave morally or acquire moral values from humans, or humans can teach AI systems moral right from wrong. Such discussions on moral agency incorporating the knowledge of human ethics and machine ethics will inform stakeholders of a good

AI-supported SC for older adults.

Three illustrative examples of non-healthcare SC-AI-BE interactions are presented below to generate further ethical discussions in the gerontechnology community.

Digital payment laundry machine
Smartphone apps with their tracking capabilities and *'Pay by Phone'* are an irreversible trend in urban living. Even old high-density housing complexes where older adults have lived for years are experiencing this technology transition. A recent letter to the editor published in the Vancouver Sun newspaper (2023) provided an example of smart economy strategies becoming a form of elder abuse. The persons of concern were women in their 80s and 90s who have lived independently in their apartments for years, and have used coin-operated laundry machines. Recently, their landlord replaced these with an e-payment laundry system. If the women are not capable of using a smart phone and apps due to health reasons (e.g., severe arthritis, macular degeneration, dementia) or reluctant to use the laundry app because of security concerns, lack of trust in technology or lack of financial resources to purchase a smart phone or pay for monthly services, this situation may become a threat to their desire for independent living and aging in place (autonomy concerns). Although this particular e-transition may be convenient and efficient for younger residents, the building manager, and the landlord, it may act as a silent eviction notice for these women.

Moving to a new apartment, in turn, likely means losing their current affordable rent, as well as familiarity with their own unit, building, neighbours, and the surrounding neighbourhood. Doing laundry is an important activity of daily living for older adults, and is part of functional and cognitive status assessments. Forced use of a 'smart' e-payment laundry machine may add unnecessary complexities to their previously perceived simple routine activity. Even experienced smart phone users may not always understand how smart phone apps work, or what kind of personal data has been collected and shared with third parties through Pay-by-Phone. For some older tenants, digital payment laundry machines lack explainability and transparency. This is ethically problematic given the well-documented, frequent financial abuse of older adults.

Smart park bench
Smart benches in parks have been implemented globally for the last two decades. In some leading SC like Toronto, the tech-first approach has antagonized the citizens recently, resulting in the cancellation of a major SC sidewalk project (Jacobs, 2022). A smart park bench has the ability to collect data from Bluetooth connection points and IoT (Internet of Things) and security cameras and communicate alerts to the general public. Many of their futuristic features are built *'from the Internet up'*. Smart benches serve multiple purposes: they contribute to urban planning, collecting behavioural data concerning users, and can track them through built-in AI-cameras which can be connected to larger public surveillance systems.

Although one may argue that smart park benches are justifiable for beneficence-based facility improvement reasons and even non-maleficence purposes (removing unsafe conditions), their potential harmful effects (threats to privacy and autonomy interests of citizens) are significant. Think of older adults with dementia living in SC. Their everyday walks to nearby parks and behaviours in public spaces may be surveyed through smart park benches, without their knowledge. Such data may be useful if they get lost (e.g., silver alert systems). An article published in the New York Times entitled *'Where a Thousand Digital Eyes Keep Watch Over the Elderly'* (The New York Times, 2022) challenges our notion of SC-AI-BE interactions for rapidly increasing aging sub-populations comprised of older adults with dementia. Is it ethical to collect digital data from unsuspecting older adults without informed consent? When will smart park benches become an Orwellian and dystopian overreach that target the vulnerability of older adults with dementia? Is there a less invasive way of keeping a closer watch over the segment of elderly populations who may get lost? Regardless of their cognitive and functional status and disabilities, older adults are moral agents. They have the right to know that they are being monitored and that their data may be used for public surveillance and alert systems.

Digital conversational agents and virtual civic engagement
Many municipalities, transportation, communication and service-sector corporations are already using digital conversational agents and chat bots for a wide range of customer support services such as booking and scheduling appointments and online shopping. Even digital-savvy younger generations may not easily tell if they are dealing with real persons or machines. Algorithms and decision-trees behind the development of such virtual agent services may be complex, even for the humans who train the AI-technologies (explainability and accountability concerns). Digital conversational agents may be useful for task-oriented conversations but social-oriented conversation agents may require a certain level of digital literacy and trust in the integrity of services provided from service users. Think of older

adults living in SC where digital agents conduct a user survey on municipality services. They have genuine interests in making their city more inclusive for older adults. They receive AI-supported automated calls and provide verbal responses through phones. The elderly person believes and trusts the digital agent is a real human, they engage in conversations with the machine, believing that their civic engagement needs have been met. Their municipalities save money and human resources. But will this help optimize aging processes and foster older adults' flourishing and meaningful participation in the communities they live in? There may be some contexts (e.g., simple voice assistance, information gathering for office hours) that may be conducive to older adults interacting with digital conversation agents (Chattaraman et al., 2019). Further ethical discussions should focus on the impact of social-oriented conversations between digital conversational agents and older adults and its implications for older adults' civic engagement.

Conclusion

Ethical principles for AI-supported SC for older adults have been debated for more than two decades, primarily in the field of healthcare. The ethical considerations presented in this article make us rethink how policy makers, engineers, and citizens can and should rigorously apply the basic ethical requirements such as nonmaleficence (avoid harming others), beneficence (promote the wellbeing of others when possible), justice (equality, equity), autonomy, and transparency/ explainability in relation to urban aging and BE discussions.

City planners and engineers may assume that unexplainable algorithms are intrinsically superior to simpler, explainable technology (e.g., digital payment for laundry machine versus cash payment for laundry machine). However, such assumption can be biased and may serve as a new form of elder abuse. AI-powered SC not only pose significant risks of leaving a large number of older adults behind but also threatening autonomy interests of many older adults in various BE settings. The intended outcomes of efficiency, resource stewardship, sustainability, and social innovation in SC strategies should be achieved without perpetuating and exacerbating the existing socio-economic inequities experienced by current and future older adults.

AI-supported SC must be designed to support the intrinsic capacity of older adults and maintain their dignity and autonomy simultaneously. The large language learning models (LLM) such as ChatGPT, which claim to augment human skills, are being incorporated into SC strategies. Digital conversational agents, especially for socially-oriented conversations, present ethical and moral risks of treating older adults as uninformed participants in the emerging social experiment of LLMs. What will the social experiment of using digital conversation agents and technologies that augment human skills mean for older adults? Will older adults in SC become more engaged citizens with the aid of digital conversational agents and chatbots? Further ethical analysis and empirical research are needed to understand how such emerging digital conversational agent technologies behave morally and whether they acquire good human moral values.

References

Buffel, T., Phillipson, C. (2016). Can global cities be 'age-friendly cities'? Urban development and ageing populations. Cities, 55, 94-100. https://doi.org/10.1016/j.cities.2016.03.016

Chattaraman, V., Kwon, W. S., Gilbert, J. E., Ross, K. (2019). Should AI-Based, conversational digital assistants employ social-or task-oriented interaction style? A task-competency and reciprocity perspective for older adults. Computers in Human Behavior, 90, 315-330. https://doi.org/10.1016/j.chb.2018.08.048

Choi, N. G., DiNitto, D. M. (2013). The digital divide among low-income homebound older adults: Internet use patterns, eHealth literacy, and attitudes toward computer/Internet use. Journal of Medical Internet Research, 15(5), e93. https://doi.org/10.2196/jmir.2645

Floridi, L., Cowls, J. (2022). A unified framework of five principles for AI in society. In S.Carta (Ed), Machine learning and the city: applications in architecture and urban design (pp.535-545). https://doi.org/10.1002/9781119815075

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., Vayena, E. (2021). An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations. In: Floridi, L. (Eds) Ethics, Governance, and Policies in Artificial Intelligence. Philosophical Studies Series, vol 144. (pp.19-39). Springer, Cham. https://doi.org/10.1007/978-3-030-81907-1_3

Herath, H. M. K. K. M. B., Mittal, M. (2022). Adoption of artificial intelligence in smart cities: A comprehensive review. International Journal of Information Management Data Insights, 2(1), 100076. https://doi.org/10.1016/j.jjimei.2022.100076

Jacobs, K. (2022, June 29). Toronto wants to kill the smart city forever. MIT Technology Review. Retrieved from https://www.technologyreview.com/2022/06/29/1054005/toronto-kill-the-smart-city/

Javed, A. R., Shahzad, F., ur Rehman, S., Zikria, Y. B., Razzak, I., Jalil, Z., Xu, G. (2022). Future smart

cities: Requirements, emerging technologies, applications, challenges, and future aspects. Cities, 129, 103794. https://doi.org/10.1016/j.cities.2022.103794

Jobin, A., Ienca, M., Vayena, E. (2019). The global landscape of AI ethics guidelines. Nature Machine Intelligence, 1(9), 389-399. https://doi.org/10.1038/s42256-019-0088-2

OECD. (2019). Enhancing the contribution of digitalization to the smart cities of the future, OECD, Paris, Retrieved from https://www.oecd.org/cfe/regional-development/Smart-Cities-FINAL.pdf

OECD. (2020). Measuring smart cities' performance: Do smart cities benefit everyone? OECD, Paris. Retrieved from https://www.oecd.org/cfe/cities/Smart-cities-measurement-framework-scoping.pdf

Ritchie, H., Roser, M. (2018). Urbanization. Our World in Data. Retrieved from https://ourworldindata.org/urbanization?source=content_type%3Areact%7Cfirst_level_url%3Aarticle%7Csection%3Amain_content%7Cbutton%3Abody_link

The Vancouver Sun (2023, June 20). Technology has become a form of 'elder abuse.' Letter to the Editor. Retrieved from https://vancouversun.com/opinion/letters/letters-to-the-sun-b-c-ndp-expropriates-use-of-seniors-and-families-second-homes

The New York Times (2022, February 9). Where a thousand digital eyes keep watch over the elderly. Retrieved from https://www.nytimes.com/2022/02/02/business/japan-elderly-surveillance.html

Tinker, A. (1981). Older people in modern society. Addison Wesley Longman. First Edition.

Tinker, A., Ginn, J. (2015). An Age Friendly City: How Far Has London Come? London: King's College London. Retrieved from https://data.londonsport.org/download/e1xlk/ssb/LSR180%20King's%20College%20London%20-%20An%20Age%20Friendly%20City%20-%20How%20Far%20Has%20London%20Come.pdf

United Nations Department of Economic and Social Affairs, Population Division (2020). World population ageing 2020 highlights: Living arrangements of older persons (ST/ESA/SER.A/451). Retrieved from https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/undesa_pd-2020_world_population_ageing_highlights.pdf

Van Hoof, J., Kazak, J. K., Perek-Białas, J. M., Peek, S. (2018). The challenges of urban ageing: Making cities age-friendly in Europe. International Journal of Environmental Research and public health, 15(11), 2473-2489. https://doi.org/10.3390/ijerph15112473

WHO. (2021). Ethics and governance of artificial intelligence for health: WHO guidance. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/341996/9789240029200-eng.pdf

WHO. (2022). Ageing and health. Retrieved from www.who.int/news-room/fact-sheets/ageing-and-health

Wilmoth, J. R., Bas, D., Mukherjee, S., Hanif, N. (2023). World Social Report 2023: Leaving No One Behind in an Ageing World. UN. Retrieved from https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2023/01/2023wsr-fullreport.pdf