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Case Studies of Legal Inclusive Design and Policy in Compliance with the AI Act: Amplifying Older Adults' Voices in AI-Enabled Robotics through a Fundamental Rights-Based Design

Shabahang Arian[1], Mehrnoosh Abouzari[2]

[1]Postdoctoral Researcher at University of Tehran, Faculty of Law and political Sciences.
[2]Assistant Professor at University of Tehran, Faculty of Law and Political Sciences.
*Shabahang Arian.

Abstract

Assistive robotics are emerging as promising technological solutions that enhance both the physical and social well-being of older adults, promoting autonomy, dignity, and independent living. While much of the existing literature primarily focuses on the risks posed by AI and robotics—particularly around issues such as emotional vulnerability, privacy concerns, and threats to human dignity—this article adopts a more balanced approach. It acknowledges the inherent risks associated with socially assistive robotics (SARs), but also emphasizes the potential of these technologies to safeguard and promote the rights of older adults through fundamental rights-based design. To that end, the article aims to amplify the voices of older individuals in the design, implementation and regulation of SAR technologies. It underscores the critical need for "fundamental rights-based", "inclusive" "legal" design model that safeguards digital inclusion, privacy, social and cultural participation, safety, and dignity of older adults. By offering exemplary legal design models that align with key standards such as the Charter of Fundamental Rights of the European Union (CFR), the General Data Protection Regulation (GDPR), and the Artificial Intelligence Act (AIA), it demonstrates how legal design can ensure compliance with existing legal frameworks while promoting innovations. Beyond legal frameworks, the article also calls for robust "social policy measures" that support inclusion and accessibility in AI-assisted care. By addressing both the legal and social dimensions, this research contributes to the ongoing discourse on the legal design and deployment of AI-enabled assistive technologies to create more just, inclusive and human-centered future for older adults' care through automation.

Keywords: AI- Enabled Socially Assistive Robotics, Older Adults Care, Legal Protection by Design, Fundamental Rights-Based Framework, Inclusive Design.

Introduction

1. An Overview of Current Robotic Applications in Aged Care

Robotics technologies are proving to be effective in providing mobility assistance for older adults. (Sawik et al. 2023) According to various studies, 35% of adults aged over 70 and 72% of people over the age of 80 experience mobility limitations and functional muscle decline. (Penteridis et al. 2017) Mobility is essential for maintaining independence in daily life, while loss or declining mobility and balance in older age can seriously increase the risk of falling, hospitalization, or premature death. (Murofushi et al. 2024 & Albert et al. 2014) In this context, robotic technologies are offering promising solutions to support functinal performance and promote independent living of older adults. As an example, robots such as Pearl provide important assistance for senior citizens with upper and lower limb impairments in terms of navigating their surroundings safely and effectively. (Pollack et al. 2002)

In addition to physical challenges, many older adults may also experience feelings of loneliness and isolation due to the loss of loved ones or the decline of social networks. In this connection, companion robots are a great support to tackle the psychogeriatric and loneliness issues of aging and encourage the elderly to re-engage in society.[1] One important way for older adults to stay connected with friends and family is through access to the internet and the ability to engage on social media and digital platforms. (Mohan et al. 2024) Recognizing this, the ElliQ robot, for example, has been specifically designed to help older adults overcome barriers to digital access, ensuring they can fully participate in the digital world. (Loterina 2017)

1.1 Case Studies of Legal Design in Aged Care: Robotic Applications

1.1.1 Application of the ElliQ Robot

Assistive robotic technologies play a crucial role in improving accessibility for individuals with physical impairments. One such example is the social robot ElliQ, which is designed to assist users in accessing the web and digital services. Similar to the Amazon Echo, ElliQ employs a voice-activated interface to help users engage with social media, online news, movies, and other web-based activities. While generally its functionalities are particularly beneficial for people with disabilities (PWDs), ElliQ has been especially valuable for individuals with visual impairments. By offering a hands-free, intuitive way to navigate the digital world, ElliQ enhances the independence and social inclusion of these users, breaking down barriers that have traditionally limited their access to online resources. (Dormehl 2017) ElliQ is a HIPPA-certified device and complies with the requirements of the Health Insurance Portability and Accountability Act (HIPAA). Intuition Robotics provides notice of privacy practice (NPP) to inform users about how a company uses and discloses personal health information about them and describes their rights with respect to such data. [2]

1.1.2 Application of the Smart Robotic Walker for Both Mobility and Visual Impairment

For mobility assistance, intelligent robotic systems have been developed to aid elderly individuals in maintaining their independence. One such innovation is the smart robotic walker, designed to assist with walking and improve overall mobility. These robots are designed to navigate both indoor and outdoor environments, utilizing advanced mobility capabilities that allow omnidirectional movement. They are equipped with various sensing technologies, including ultrasound-based sensors, infrared depth cameras, and RGB cameras integrated with sophisticated computer vision processing. (Mostofa et al. 2021, Di et al. 2011) A notable example is the Guido walker robot, which provides walking assistance through advanced navigation and obstacle-avoidance technologies, ensuring safer and more confident movement for elderly users. (Rentschler et al. 2008)

2. Fundamental Rights- Based Legal Design

As robotic technologies continue to advance at a rapid pace, their profound impact on human users is undeniable. Socially Assistive Robotic (SAR) are increasingly being integrated into various sectors, including healthcare and elder care. This growing integration underscores the urgency of ensuring that the development and deployment of these technologies adhere to fundamental human rights principles, safeguarding against any potential adverse effects on individual rights and human dignity.

To mitigate the risks posed by AI and robotic systems, Europe has spearheaded regulatory efforts aimed at creating a human-centric approach to technology.[3] These regulations are aligned with the European Union's core values and fundamental rights. The goal is to ensure that AI-driven robotic products do not present high risks to human users but instead contribute positively to the well-being and flourishing of individuals and society as a whole. This

[1]Meet ElliQ. Available at: https://elliq.com/

[2] ElliQ Privacy Policy. Available at: https://elliq.com/pages/elliq-privacy-policy

[3] European Commission (2018) Communication from the Commission to the European Parliament on Artificial Intelligence for Europe, COM (2018) 237 final.

means that any assessment of AI systems and robotic technologies must prioritize fundamental rights and human values, ensuring these technologies do not infringe upon individual rights or negatively affect society.[4]

Recognizing that social rights are an integral component of fundamental rights, this article seeks to highlight and emphasize social fundamental rights and principles that are often overlooked yet are critical to acknowledge and address. The recognition of these fundamental rights deserves greater attention since they are essential for ensuring the dignity and well-being of all individuals within society.

Thus, to ensure shaping the development and the use of robotic technologies are according to the principles that protect the fundamental rights of the users and prevent irreversible adverse effects on humans' rights and society, it is essential to create a robust regulatory framework that balance two key goals: 1) allowing citizens to benefit from technological advancements, as outlined in Article 15(b) of the International Covenant on Economic, Social and Cultural Rights (ICESCR)[5], and 2) protecting fundamental rights, human dignity, and core societal values from being compromised by technological innovations.

In light of these challenges, the article strongly advocates for the adoption of "the Legal Protection by Design (LPbD) model", first introduced by Mireille Hildebrandt. (Hildebrandt 2019, Hildebrandt 2011) This model provides a legal framework to ensure their socially assistive robotic (SAR) products comply with established laws, legal norms, and fundamental rights, with the primary aim of protecting the fundamental rights and freedoms of individuals. (Hildebrandt 2019) Hence, according to LPbD approach, the present article aims to establish the legal basis for the legitimate use and design of such technologies by drawing on international and supranational conventions, as well as EU constitutional frameworks. The study highlights instances where the design and deployment of robotic systems is not only justifiable but also instrumental in protecting the rights of older adults. By promoting the integration of legal protections into the design of SAR technologies, this research underscores the need to prioritize human rights and societal well-being in the ongoing development of assistive robotics.

This approach reflects the broader idea, as articulated by Oliver Wendell Holmes Jr. in his seminal lecture *The Path of the Law,* in which he argues that the law has a dual nature: it is undoubtedly product of social forces, but it must also serve to achieve social ends. (Wendell Holmes 1897) In viewing law through its social function and practical application, we recognize the need for regulatory frameworks that not only regulate innovation but also effectively promote human dignity, inclusion and equality in the age of technological advancement.

Thus, this article addresses the societal challenges posed by socially assistive robotics (SAR) and provides guidance for policymakers in determining appropriate regulatory measures. It calls for the implementation of sound social policies that protect the social rights of individuals, ensuring that SAR deployment aligns with the greater public good and respects the dignity and rights of all citizens.

3. Protection of Fundamental Rights and Principles of Older Persons

Among the various treaties addressing human rights, the International Covenant on Economic Social and Cultural Rights (ICESCR)'s General Comment no. 6 provides a comprehensive account of the economic, social, and cultural rights of older persons. The General Comment not only outline older adults' rights but also aligns them with key principles including "independence", "participation," "care," "self-fulfillment," and "dignity" which were adopted by the general assembly in the Implementation of the Plan of Action on Ageing.[6]These principles encourage States to incorporate elderly rights into their national policies and programs.

General comment No.6 also delineates the rights of older persons within the framework of the International Covenant on Economic, Social and Cultural Rights. These rights are as follows: 1. Equal rights of men and women

[4] European Commission (2021) Proposal for a Regulation of the European Parliament and of the Council laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain union legislative acts. COM/2021/206 final. Brussels, European Commission, (henceforth AIA)

[5] The International Covenant on Economic, Social and Cultural Rights (ICESCR) 16th December of 1966. Available at: https://www.ohchr.org/Documents/ProfessionalInterest/cescr.pdf

[6] UN Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 6: The Economic, Social and Cultural Rights of Older Persons. (8 Dec 1995). E/1996/22. Available at: https://www.refworld.org/pdfid/4538838f11.pdf

(Article 3); 2. Rights relating to work (Articles 6 & 8); 3. Right to social security (Article 9); 4. Protection of the family (Article 10); 5. Right to an adequate standard of living (Article 11); 6. Right to education and culture (Articles 13 & 15). In 2012, the Report of the High Commissioner for Human Rights to the Economic and Social Council found General Comment no. 6 to be "the most comprehensive guidance on older persons on rights such as the right to health and an adequate standard of living including social care and social security".[7]

3.1 Right to Rehabilitation and Benefit from Assistive Technologies (ATs) and Computer-Based Technologies (CBTs) Rehabilitation Products and Services

The human right to health is recognized in a number of international instruments, with the primary recognition being in the Universal Declaration of Human Rights (UNDHR), and afterward in the International Covenant on Economic, Social and Cultural Rights (ICESCR). Article 25 of the UNDHR asserts that "everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing, medical care, and necessary social services." [8]This right is further reinforced in Article 12 of the ICESCR, which guarantees the "highest attainable standard of physical and mental health" and mandates that States take steps to achieve full realization of this right through legislative, judicial, and administrative means. [9]

According to the preamble of the World Health Organization (WHO) Constitution, the right to health is not only concerned with the absence of disease (WHO, Preamble) but also encompasses broader socioeconomic factors necessary for well-being, including access to safe food, clean water, adequate housing, and a healthy environment.[10] General Comment 14 of the ICESCR emphasizes that the right to health also takes into account an individual's biological and socioeconomic conditions, as well as the resources available within a State, underscoring the principle that health is affected by a wide range of determinants.[11]

It is important to emphasize that the right to health must not be perceived as a right to be "healthy"; rather, the right to health entails freedoms and entitlements. These freedoms include the right to have autonomy over one's own health and body, and ensuring the individuals are free from interference and have the liberty to pursue their personal wishes and aspiration. On the other hand, the entitlements associated with the right to health involve access to a system of health protection that offers equal opportunities for all people to enjoy the highest attainable level of physical, social and mental well-being. [12]

In this context, assistive technologies (ATs) play a crucial role in recognizing and upholding these rights and significantly enhancing the quality of life for older adults by facilitating their rights to independence and participation in society. Assistive technologies, including assistive robotics (AR), fall under the broader category of health technologies (HTs) and are recognized as essential tools for improving the functional capabilities of older adults. These technologies encompass a wide range of tools- from mobility aids such as walkers and robotic assistants, to devices that support communication, facilitate monitoring, and promote socio-emotional interaction. The importance of ATs is further reinforced by the EU Accessibility Act, which highlights their crucial role in empowering older adults to lead dignified, autonomous lives while fully participating in the workforce, educational pursuits, and various social activities. Through their continued development and implementation, ATs are reshaping the landscape of aging, ensuring that older adults can remain active and engaged members of society.

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[7] Report of the United Nations High Commissioner for Human Rights (E/2012/51), April 2012, p6. Available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/G12/420/71/PDF/G1242071.pdf?OpenElement

[8] Universal Declaration of Human Rights (1948) 217 A(II). Available at: https://www.ohchr.org/sites/default/files/UDHR/Documents/UDHR_Translations/eng.pdf

[9] The International Covenant on Economic, Social and Cultural Rights (ICESCR) 16th December of 1966. Available at:https://www.ohchr.org/Documents/ProfessionalInterest/cescr.pdf

[10] The Constitution of the World Health Organization (WHO), 17 November 1947, available at: https://www.who.int/governance/eb/who_constitution_en.pdf Accessed 07 OCT 2024.

[11] IESCR Committee (2000) General Comment No 14: The Right to the Highest Attainable Standard of Health, U.N. Comm on Econ., Soc. & Cult. Rights, 22nd Sess., U.N. Doc. E/C.12/2000/4 (Aug. 11, 2000).

[12] The International Covenant on Economic, Social and Cultural Rights (ICESCR) 16th December of 1966. Available at:https://www.ohchr.org/Documents/ProfessionalInterest/cescr.pdf, para 7.

The right to health is a fundamental right that ensures a person can access healthcare services without facing financial hardship. This right extends to access to health technologies, including essential medical devices, which must be available to all without discrimination. International human rights framework such as the Universal Declaration of Human Rights(UNDHR) (Art. 25), International Covenant on Economic, Social and Cultural Rights(ISCESCR) (Art. 12.1), and United Nations Covenant on Rights of Persons with Disabilities (UNCRPD) (Art. 25 & 26), as well as the Charter of Fundamental Rights (CFR) (Art. 25 & 35).

According to the International Network of Agencies for Health Technology Assessment, health technologies are defined as "any intervention that may be used to promote health, to prevent, diagnose, or treat disease,or for rehabilitation or long-term care". [13] Assistive technologies (ATs) as a subcategory of health technology are "any item, piece of equipment, service, or product system including software that is utilized to increase, maintain, substitute, or improve functional capabilities of persons with disabilities or is deployed for alleviation and compensation of impairments, activity limitations, or participation restrictions" (EU Accessibility Act, para 37).[14] Assistive technologies and products are designed to provide functional improvements and well-being for older adults, and to allow them to remain productive, independent, anddignified and facilitate their participation in the labor market, educational opportunities, and social activities.[15]

Assistive robotics (AR) fall under the broad umbrella term of health technologies (HTs) and are included in the domain of Assistive Technology (AT) products. It is important to note that AT applications, as defined by the International Standard Organization's ISO 8373:2012, are classified as "service robots". According to ISO, a service robot is "an actuated mechanism, programmable in two or more axes, with a degree of autonomy, capable of moving within its environment and performing useful tasks for humans or equipment, excluding industrial automation applications.[16] Socially assistive robots (SARs) share the same overarching goal as assistive robotics: providing assistance for convalescence, rehabilitation, and learning. However, SARs focus on delivering this assistance primarily through social interaction with human users, offering emotional and social support in addition to functional aid. [17]

In general, assistive technologies (AT) and assistive robotics (AR) can provide older adults with crucial support in various areas, including mobility and physical assistance, daily living tasks, and even occupational support. These innovations enable older individuals to maintain greater independence, helping them navigate both their personal and professional lives with ease and dignity.

This highlights the pressing need for increased accessibility and affordability of these technologies, underscoring the importance of ensuring that access to robotic health technologies must be universal and non-discriminatory. Making assistive technologies (ATs), including assistive robotics (AR), affordable and widely accessible is crucial to empowering older adults with disabilities and impairments to fully exercise their rights. By breaking down financial and systemic barriers, we can enable PWDs to benefit from these innovations, allowing them to lead more independent, dignified lives and participate more fully in society.

Furthermore, the design of assistive technologies should be inclusive, involving input from PWDs to ensure that their specific needs are met. By promoting the development and availability of assistive technologies, states can fulfill their obligation to protect the right to health for all individuals, including the older persons with disability.

[13] HTA Glossary. International Network of Agencies for Health Technology Assessment and Health Technology Assessment International. Available at: http://aaz.hr/resources/pages/55/INAHTA%20Health%20Technology%20Assessment%20(HTA)%20Glossary.pdf

[14] Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services (Text with EEA relevance).PE/81/2018/REV/1

[15] World Health Organization (WHO) (2018) Improving Access to Assistive Technology. Available at: https://apps.who.int/gb/ebwha/pdf_files/WHA71/A71_21-en.pdf. para 2.

[16]International Standard Organization's ISO 8373:2012.

[17] International Federation of Robotics (IFR) (2021). Topics and Definitions. Available at: https://ifr.org/service-robots.

3.2 Fundamental Right of Older Adults to Live Independently

The right of older adults to live independently and free from interference is embodied in the "independence principle," which acknowledges the fundamental need for adequate food, water, healthcare, and support from family and community.

This principle asserts that older individuals should have the resources and freedom to support themselves, empowering them to live with autonomy and dignity. For persons with disabilities, this extends to the right to meaningful work, access to education and skill development, and the opportunity to live in safe, adaptable environments that align with their personal preferences and evolving needs. Importantly, it includes the ability to remain in their own homes for as long as possible, surrounded by a community that respects and supports their independence.[18]

The European Convention on Human Rights enshrines the right to liberty and security for all individuals under Article 5(1), affirming that "no one shall be deprived of his liberty." Similarly, the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) recognizes independent living as a fundamental human right in Article 19. This article affirms the right of persons with disabilities, including older adults with physical impairment, to choose their place of residence and to decide freely with whom they live, enjoying equality with others and without compulsion to reside in any specific institution or facility. Additionally, Article III on Autonomy and Participation asserts that older persons "are entitled to lead their lives in independence, in a self-determined and autonomous manner", underscoring the importance of autonomy and self-direction in all aspects of life.[19]

The right to live independently is also embedded within certain national legislations. For example, the UK's Care Act 2014 emphasizes that health and social care services must be delivered with full regard for the "well-being" of recipients, explicitly recognizing and respecting their right to live independently. This legislative framework underscores the importance of autonomy and self-determination in healthcare, ensuring that individuals are supported in leading lives that align with their personal choices and dignity.[20] Deinstitutionalization upholds the right of individuals with functional limitations to exercise choice and control in their lives. This approach reflects society's responsibility to provide the support necessary for individuals to exercise their freedoms and fully participate in community life.[21]

Addressing the need for independence and dignity among older adults requires a supportive infrastructure and a range of tailored services, with a long-term commitment to building a barrier-free society. (Barnes 2014) Living autonomously outside of institutional settings becomes achievable when essential technical aids and personalized assistance are made available to older adults with disabilities.[22] In societies where older adults have equitable access to healthcare services and assistive products, the right to independent living is fully realized.

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[18] UN Principles of Older Persons. Available at : https://www.olderpeoplewales.com/en/about/un-principles.aspx

[19] Recommendation CM/Rec(2014)2 of the Committee of Ministers to member states on the promotion of the human rights of older persons, supra note 15, Article III.9.

[20] Department of Health (United Kingdom), Guidance: Care and Support Statutory Guidance (Updated 24 February 2017)(accessed 5/05/2017); Care Act (England) 2014 Ch. 23 Pt 1 s 1; see also — Social Services and Well-being (Wales) Act 2014 anaw 4.

[21] Council of Europe Commissioner for Human Rights (2012) The Right of People with Disabilities to Live Independently and Be Included in the Community. Comm DH/Issue Paper. Strasbourg. Also See: Council of Europe; and UN General Assembly (2014) Thematic Study on the Right of Persons with Disabilities to Live Independently and be Included in the Community. A/HRC/28/37

[22] United Nations (2003) Ad Hoc Committee on a Comprehensive and Integral International Convention on Protection and Promotion of the Rights and Dignity of Persons with Disabilities. Available at :https://www.un.org/esa/socdev/enable/rights/a_ac265_2003_crp9.htm

Over recent decades, significant efforts have been made to develop socially assistive robots (SARs) to support older adults in leading independent lives. (Abidi et al. 2024 , Cooper et al. 2021) Consequently, robotic-assisted living (RAL) and ambient-assisted living (AAL) have emerged as new fields within the robotics industry, enabling older adults to live independently and receive care within the comfort of their own homes. RAL and AAL technologies offer valuable contributions to long-term care by potentially reducing the need for extended stays in residential or nursing facilities. (Bedaf et al. 2015) AAL systems encompass a variety of services, including mobility support, personal care, household assistance, telepresence, fetching and carrying items, and rehabilitation assistance. (Werner et al. 2015) Bedaf et al. illustrate how AAL robots assist with a wide range of daily activities, such as walking, stair climbing, feeding, bathing, hoisting, meal preparation, laundry, and home accesibility adaptations. (Bedaf et al. 2015)

As defined by ISO 8373, these robots are autonomous, programmable mechanisms capable of performing intended tasks based on sensory inputs without direct human intervention.[23] Examples include Domestic Robots (DoRo) and Condominium Robots (CoRo), developed as part of the EU-funded FP7 ROBOTERA project, which aims to create user-friendly, service-oriented robotic systems for older adults. (Di Nuovo et al. 2018) Other examples of AAL robots are assistive telepresence robots, such as the RP7, which monitor older adult users' health at home, measure their vital health signs, and send the information to the relevant healthcare professionals. (Yaxin et al. 2024, Tsai et al. 2007) These robots can also remind individuals to take medications, schedule medical appointments, deliver prescriptions, and even contact emergency services in the event of a fall or other incidents.

Together, these advancements underscore the potential of AAL and RAL technologies to significantly enhance the quality of life and autonomy for older adults, offering safe, effective home stay support tailored to their unique needs. Additionally, through videoconferencing systems, older adults are able to communicate with caregivers, family members, and healthcare professionals in a remote environment. The robots can also remind elderly to take medications, schedule doctor appointments, deliver medications, and call emergency services in the case of an incident such as falling. (Koceska et al. 2019)

Telepresence robots usually involve a network of sensors and actuators for tasks such as fall detection and monitoring a set of vital signs. In the case of an incident, these robots can automatically send an alert notification to health providers. (Loza et al. 2019) Moreover, in an ambient intelligent home system, telepresence robots can connect to, and communicate with, smart sensors (e.g. biometric wearable bracelets) and smart objects (smart coffee makers), gathering comprehensive data about users and their environment. Information about a patient's health is often stored in a cloud-based infrastructure and clinicians and caregivers are notified when there is a possible health risk. (Frontoni et al. 2017) The alarm integration technology of these systems is able to warn caregivers if something unusual happens within the household for example, notifying them if the front door remains open for an extended period or if no movement is detected for a specific duration, thus preventing potential risks. (Grguric et al. 2019)

The major challenge for SARs for elderly care, however, lies in the amount of data they can collect, as well as the security and protection of these data. Various information about users (e.g. geolocation, biological data, etc) can be collected by robots' biosensors, monitoring, and GPS tracking system. (Beach et al. 2009) The data might include very personal and private and sensitive information, such as the time the user visited his/her daughter, the kind of meal the user had for lunch, or what kind of medicines the user takes.

Further, in smart home environments, telepresence robots can navigate the space and collect data about the users and their surroundings, and communicating this information to other smart devices. The huge amount of data collected about the users can be easily accessed and manipulated by companies and other stakeholders. This data stored in cloud services, (Deng et al. 2011, Fosch Villaronga & Millard 2019) may also be accessible by insurance companies and related health centers, or can be hacked by malevolent agents. (Calo 2012)

Most users and caregivers are unaware of such data collection systems and data transmission. (Feil-Seifer & Matarić 2011)In particular, data processing of social robots can be challenging for persons with cognitive

[23] ISO 8373:2021. Robotics- Vocabulary. Available at: https://www.iso.org/obp/ui/#iso:std:iso:8373:ed-3:v1:en

disabilities such as persons with dementia. Telepresence robots are capable of monitoring and constant video surveillance of the elderly (as well as people around them and visitors), record and collect very sensitive information about the users, for instance, recording the elderly when they dress themselves or take a shower. Those with dementia may not fully comprehend the data processing system of social robots and their underlying functions or be aware that social robots are recording them or that they are being watched remotely. (Tanimu & Abada 2025, Denning et al. 2009) It is, therefore, imperative that these devices are designed to comply with all applicable EU privacy regulations, such as the General Data Protection Regulation (GDPR), and especially privacy by design. For persons with dementia, Ienca et al. proposed that the collection and use of visual information from elderly people with dementia must be transparent, with a legitimate purpose, and be proportional. (Ienca et al. 2016) In regard to the latter, she argues that the video-monitoring is disproportionate when it is not used for the therapeutic purpose, but instead, it is used unjustifiably to videotape the elderly for matters not consistent with the purposes that robots are supposed to serve. (Ienca et al. 2016)

Under the European regime, the data recorded as a result of interaction with SARs could potentially fall under the GDPR personal data, which defines personal data as "*any information related to an identified or identifiable natural person*" (GDPR, Art. 4.(1)). All users' data (health and nonhealth related) collected by care robots must comply with the general grounds set out in Article 5 of the GDPR, including *lawfulness, fairness, transparency, purpose limitation, data minimization, accuracy, limited storage, integrity, confidentiality, and accountability*. However, the personal health information (PHI) of the users is considered "sensitive data," which are covered under Articles 9 and 6 of the GDPR, (Pesapane et al 2021, Kuner et al 2020, Custer et al. 2019, Bussche et al. 2017) respectively. As a general rule, Article 9 stipulates that processing of data concerning health must be prohibited; however, para 2(a) allows such processing if "the data subject has given *explicit consent*." According to Article 4(11), consent is "*freely given, specific, and unambiguous of the data subject's wishes.* (Kosta 2013, Mantovani & Quinn 2013) Article 6 (1) also affirms that data subjects must be informed of "*the fact and the extent to which consent is given.*"

To comply with GDPR, two key principles must be adhered to when processing health data: first, ensuring the lawfulness of data processing, including minimizing the data collected and restricting its use to a specific purpose; and second, obtaining valid consent from users who are competent to give it. For those with severe cognitive impairments, consent may be given through a proxy or via advanced directives created when the user was fully autonomous.

In order for the elderly to have control over their choices and be fully informed, Körtner (2016) suggests these systems should be transparent, and the elderly should also be provided with a basic understanding of robotic technology and storage systems. (Körtner 2016) However, it should be noted that a regulatory gap still exists regarding storage security and who can access data on cloud servers. (Ienca M. & Fosch Villaronga, E. 2019, Fosch Villaronga E. et al. 2018b, Millard C. 2013)

Furthermore, telepresence robotic technologies designed for home use require specific regulatory attention, and in particular, must follow standards that might be different to their use in other settings, such as in hospitals or nursing homes. The portability and mobility of these robots' present risks to users and others in the household, as these devices may cause injury or property damage due to defective design, software malfunctions, or mechanical failures. Therefore, "safe care" results from "safety of these products," and manufacturers (developers in this case) must ensure that these products meet appropriate safety standards for use by vulnerable people at home. A good safety reference for the safety of these devices is ISO 134832: 2014[24], which provides a comprehensive set of guidelines for the design and deployment of mobile servant robots and personal robots. The standard of care has already been established in soft law such as the ISO or IEEE technical standards.[25] There is a duty on producers to comply with existing safety standards, and identify and minimize future risks in the design phase. (Gheraibia

[24] ISO 13482: 2014 Robots and Robotic Devices- Safety Requirements for Personal Care Robots.
[25]European Union (2019) Expert Group on Liability and New Technologies New Technologies Formation, Liability for Artificial Intelligence and Other Emerging Digital Technologies

et al. 2020) According to the EU's existing product liability rule, producers are only liable for risks that that were unforeseeable at the time the product was put into circulation. [26] (Article 7(e))"

According to the AI Act, AI systems that pose a significant risk of violating user privacy, breaching confidentiality, or impacting health, safety, and fundamental rights are classified as high-risk systems.[27] (AI ACT 6 & Annex III, Recitals 27, 35) These systems, which include those equipped with biosensing technologies that collect sensitive data such as health records and biometric information, are subject to stringent regulatory requirements. These include robust measures for risk management (article 9), transparency (article 13), human oversight (article 14), and data governance (article 10). Given the extensive range of data collected by such systems, particularly in home environments, it is crucial to establish comprehensive guidelines to ensure the responsible and ethical use of robots in domestic settings.

3.3. Principle of Participation and Right to Inclusion and Participation in Social, Cultural, Recreational, and Sports Activities

Older adults should actively engage in activities that impact their well-being, as their participation is also vital to society. Society can progress more efficiently when older people's knowledge, skills, and experiences are shared and transferred to younger generations, and they work together in a solidarity manner to thrive and flourish, fostering intergenerational solidarity. As such, the Turin Charter: Towards Active Aging (2000) acknowledges that "older people are an asset to society" that need to "have the opportunity to develop and use their potential to lead active, independent, and fulfilling lives.[28] Participation in societal life is a fundamental aspect of human identity, as human we find their identity and meaning through society, and hence, belonging to a community and contributing to it fulfills a core human need. (Baumeister & Leary 1995)

However, aging can lead to marginalization as retirees face loss, health challenges, and sometimes disabilities, which may isolate them from society. (Graneheim & Lundman 2010) As children have grown up and have families of their own, the elderly find themselves alone at home or in geriatric facilities. Reduced mobility and increased dependency can make older individuals especially vulnerable to social exclusion.

The right to inclusion was previously proclaimed in the Universal Declaration of Human Rights, the ICESCR, as well as the UNCRPD; however, the UNCRPD affirmed the right with respect to persons with disabilities. The right to inclusion of persons with disabilities (here, older persons with disabilities (oPWDs) is stipulated as one of the core principles of the UNCRPD in Article 3, but technically, the right to full inclusion and participation is described in the stand-alone provision of Article 19 of the CRPD (CRPD Art. 3 &19).

Article 19 of the CRPD recognizes the right of PWDs, including oPWDs, to full inclusion and participation as equal to others, and requires states to take effective and appropriate measures outlined in para. (a)(b)(c) to facilitate the inclusion of PWDs and oPWDs in the community. In this way, by affirming the right to inclusion and equal choices for PWDs, the treaty established a very fundamental right for PWDs, especially since choice, freedom, and inclusion are the cornerstones of exercising any other rights. (Bantekas et al. 2018)To elaborate further, it can be argued that the right to inclusion is also linked to other rights such as social and cultural rights, family life, recreation, employment, education, and so on.

The significance of Article 19 of the CRPD is that it highlights the paradigm shift in the view of disability from being merely a medical-rehabilitation issue to becoming a social and human rights issue in which PWDs are

[26] Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31985L0374&from=EN

[27] European Commission (2021) Proposal for a regulation laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative acts. COM/2021/206 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206

[28] The Turin Charter: Towards Active Aging (2000) In G8 Labor Ministers Conference. Turin, Italy. http://www.g7.utoronto.ca/employment/labour2000_ageing.htm

entitled to enjoy social rights as human rights under the big umbrella of human rights. In other words, according to Article 19, in order to fully include PWDs and oPWDs into society, their needs must be identified as an "integral part" of the society and placed in every economic and social order. [29] (UN OHCHR 2010)

At EU regional level, according to Article 3 of the Treaty on the Functioning of the EU (TFEU), the Union must take into account the requirements of "guarantee the adequate social protection," "fight against social exclusion," and "high-level protection of human health" in defining and implementing its policies and Statemembers must implement those objectives into their own national laws, under the subsidiarity principle (TFEU Art. 3).

It must also be mentioned that in order to combat with social exclusion of older adults, the Recommendation on the Human Rights of Older Persons stipulates that older people should interact with other members of the society and participate fully in social, cultural, and educational activities(Article III).[30]

Every person has a right to freely participate in the cultural life of the community (UNDHR Art. 27; ICESCR Art. 15(1)(a)). UNESCO defines "culture" as "all forms of expression, thought, and action peculiar to a given community". It further notes that culture also includes "the beliefs, institutions, and techniques that impose the same style of living on the member of a society" [31](UNESCO 1970-p.28). Thus, culture as indicated in the treaties not only refers to artistic and intellectual activities and products but also underlines "society's pattern of thinking and way of life", or in other words, society's "collective memories". (Chow PK. 2014) General Comment no. 21 of the CESCR clarifies that "culture" for the purpose of Article 15(1) encompasses, inter alia, ways of life, language, oral and written literature, music and song, nonverbal communication, religion or belief systems, rites and ceremonies, sport and games, the arts, customs and traditions, etc. It further notes that culture gives individuals and groups "meaning to their existence" and "a way to express their humanity.[32]

Culture also encompasses undergoing a transformation of society (UNESCO, 1970) in today's digital world where future digitalization is a thematic everyday topic, the right of disabled persons to the web and Internet is a fundamental right. As every person has a right to pursue cultural pursuits in the mainstream media such as books, magazines, etc., access to digital technologies and the Internet plays a major role in the right to culture and information in contemporary world. Studies show that there is a sort of discomfort and anxiety among older adults when using digital technologies due to the complexity of digital systems. (Kim, Freddolino & Greenhow 2023) Peter Blank has tackled this issue under eQuality where he claims that the right to enjoy digital knowledge and social interaction on media for PWDs, particularly for persons with cognitive disabilities, must be guaranteed and must not be subject to discrimination as a consequence of disability. (Blanck 2017, Blanck 2014) This right must be heavily emphasized as every aspect of the contemporary world relies and depends very much on digital technologies from access to public services (e.g. retirement, insurance, social services, etc) to shoppping, banking and even social interaction.

To this end, the robot ElliQ- a voice assistant designed specifically for older adults- serves as a good tool to help seniors with vision and hearing impairments access online contents, navigate social media, and interact with others

[29] UN Offie of the High Commissioner for Human Rights (OHCHR) (2010) Monitoring the Convention on the Rights of Persons with Disabilities: Guidance for Human Rights Monitors. 17. United Nations.

[30] Recommendation CM/Rec 2 of the Committee of Ministers to Member States (2014)on the Promotion of the Human Rights of Older Persons. Article III.10.

[31] United Nations (1970) Cultural Right as Human Rights: UNESCO Studies and Documents on Cultural Policies . United Nations Education, Scientific and Cultural Organization (UNESCO)

[32] UN Committee on Economic, Social and Cultural Rights (CESCR), General comment No. 23 (2016) on the Right to Just and Favourable Conditions of Work (article 7 of the International Covenant on Economic, Social and Cultural Rights), 7 April

2016, E/C.12/GC/23, available at: https://www.refworld.org/docid/5550a0b14.html. para 3.2. Also see, UN Committee on Economic, Social and Cultural Rights (CESCR), General comment no. 21, Right of everyone to take part in cultural life (art. 15, para. 1a of the Covenant on Economic, Social and Cultural Rights), 21 December 2009, E/C.12/GC/21, available at:
https://www.refworld.org/docid/4ed35bae2.htmlpara 13(a

via virtual spaces. (Haselton 2018, Taratola 2017) By facilitating access to the web and digital technologies, ElliQ empowers older adults to stay connected, informed, and actively engaged with their communities, promoting meaningful social interactions and supporting independence in the digital world. (Broadbent et al. 2024) While ensuring older persons' equal access to the digital world is crucial for promoting cyber inclusion, it is equally important to protect them from the unique cyber vulnerabilities they face. A prime example of effective privacy protection is ElliQ, a socially assistive robot designed to support older adults. ElliQ adheres to the Health Insurance Portability and Accountability Act (HIPAA) and follows transparent privacy practices to protect its users. The company clearly informs users about the data it collects, how it is used, and to whom it may be disclosed.[33] ElliQ is a HIPPA-certified device and complies with the requirements of the Health Insurance Portability and Accountability Act (HIPAA). Intuition Robotics provides Notice of Privacy Practice (NPP) to inform users about how Personal Health Information (PHI) is used and disclosed, and what rights users have in relation to their personal health data. [34]

Recreation, leisure, and sports are also indispensable components of popular culture[35] (General Comment 21, para 32). In some communities and groups, these activities are further considered part of their heritage. Article 30(5) affirmed the equal right of PWDs to participate in sport. According to the Report on Physical Activity and Sports, sports encompass a wide range of activities, including 'physical play, recreation, dance, organized, casual, competitive, traditional, and indigenous sports and games in their diverse forms.[36](OHCHR 2021). Sport and physical activity are fundamental human rights[37] (Art. 1(1)) and play a vital role in fostering both physical and mental well-being. This importance is underscored by the European Sports Charter, which emphasizes the significant benefits of engaging in sports and physical activities for individuals. [38]

SARs play a major role in providing access to culture for older persons. Robotic applications such as the Guido walker, for instance, increase the mobility of older persons with visual and locomotion impairments, enabling them to engage more fully with cultural, recreational, and public spaces, including theaters, cinemas, concert halls, parks, art galleries, museums, and libraries. (Rentschler et al. 2008) To maximize their effectiveness, however, it is essential that SAR technologies are not only accessible and affordable but also designed to be functional. Furthermore, these technologies must be personalized to meet the specific needs of older populations.

A study by Smarr et al., involving 21 independently living older adults aged between 65 and 93, found that older adults generally prefer social robot assistance over human help for tasks involving chores, object handling, and accessing information. However, when it comes to personal care, leisure, and social activities, they favor human assistance. (Smarr et al. 2014)

While socially assistive robot (SAR) technology holds promise for addressing the needs of older adults and promoting their independence, it is essential that these robotic technologies do not restrict older adults to their homes or diminish human interaction. For example, an emerging area in Human-Robot Interaction (HRI) research currently focuses on developing robots to promote physical activity among older adults, supporting the concept of "active aging". Physical activity is widely recognized for its significant benefits to older individuals, including improvements in physical health, emotional well-being, and social connectedness. Researchers are investigating how robots incorporated into exercise programs can enhance physical activity among this population.

[33]ElliQ Privacy Policy. Available at: https://elliq.com/pages/elliq-privacy-policy
[34] Id. Annex A 1. Scope and Applicability
[35] UN Committee on Economic, Social and Cultural Rights (CESCR), General comment no. 21, Right of everyone to take part in cultural life (art. 15, para. 1a of the Covenant on Economic, Social and Cultural Rights), 21 December2009, E/C.12/GC/21, available at: https://www.refworld.org/docid/4ed35bae2.html
[36] OHCHR (2021) Report on Physical Activity and Sports Under Article 30 of the Convention on the Rights of Persons with Disabilities. A/HRC/46/49
[37] UNGA Res 67/17 (28 November 2012)'The Right of Everyone to the Enjoyment of the Highest Attainable Standard of Physical and Mental Health: Sport and Healthy Lifestyles as Contributing Factors. Para 4. 23 A/HRC/RES/26/18
[38] Recommendation CM/Rec (2021) of the Committee of Ministers to Member States on the Revised European Sports Charter. Available at: https://rm.coe.int/recommendation-cm-rec-2021-5-on-the-revision-of-the-european-sport- cha/1680a43914.

In this context, a study conducted to compare the effects of one-on-one and group exercise interactions between older adults and an autonomous socially assistive robot revealed some key insights. While socially assistive robots can foster a sense of social presence, they fall short in areas where human coaches excel, particularly in perceived warmth and competence. The study concluded that robots may serve best as assistants to human caregivers, rather than as replacements. (Shao et al. 2023, Čaić et al. 2020) This is because group physical activities with human peers involve a dynamic range of complex interactions—emotions, gestures, motor skills, and physical contact—that robots currently struggle to replicate. These human elements are essential in fostering the comprehensive physical and psychosocial benefits that contribute to healthy aging. This is because human group physical activities involve a range of complex elements—emotions, gestures, locomotor skills, and physical contact—that contribute to its overall health benefits. (Harvey 2020) Additionally, National policies, strategies, and action plans should be implemented to ensure that older adults retain meaningful human social interactions, even as they receive assistance from robotic systems.

The Revised Social Charter requires states to take measures to ensure that older adults "remain full members of society" for as long as possible, supporting their active participation in public, social, and cultural life. The Explanatory Report of the Additional Protocol to the European Social Charter clarifies that being a "full member" of society means older adults should not face exclusion due to their age. This includes the right to participate in various societal activities, regardless of retirement status, vocational activity, or legal capacity limitations (*diminutio capitis*).[39] To uphold this right in an era of increasing robotic assistance, states must develop social policies and regulations that protect the social inclusion of older persons.

3.4. Principle of Self-fulfillment and Right to Development

The principle of self-fulfillment emphasizes that older individuals should have access to the educational, cultural, spiritual, and recreational resources available in their societies to fully realize their potential. This right is recognized in the European Charter of Rights of Older Persons, which highlights that, in a spirit of intergenerational solidarity, older adults should be given opportunities to engage in social life according to their interests and abilities. [40] This ensures that they can continue to contribute meaningfully to society while pursuing personal growth and development.

It is worth mentioning that the right to inclusion and participation in culture, recreation, sport, and leisure is closely linked to the right of persons with disabilities to development as stipulated in Article 30(2). This article calls on States to take appropriate measures "to enable persons with disabilities to have the opportunity to develop and utilize their creative, artistic, and intellectual potential, not only for their own benefit, but also for the enrichment of society" (Art. 30(2) CRPD). Maximizing the development and use of these capacities helps promote equal opportunities for all, ensuring that everyone has the chance to lead a meaningful and fulfilling life, as emphasized in Rule 10 of the Standard Rules on the Equalization of Opportunities for Persons with Disabilities (Rule 10 of the Standard Rule).

There remains an ill stereotype that views the aging population as no longer productive or contributive to society. However, it is important to recognize that many of history's most influential figures accomplished remarkable their masterpiece in their old age. Michelangelo completed his architectural plans for the Church of Santa Maria degli Angeli at the age of 88 and Winston Churchill became prime minister at 66, making critical political decisions at this age. Therefore, by aging, the creativity of older adults will not be diminished but it may change to more sculpted creativity. (Karpf 2014)

[39] Explanatory Report to the Additional Protocol to the European Social Charter. (1988). ET No 128 https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016800cb346. para. 54.

[40] European Charter of the Rights and Responsibilities of Older Persons in Need of Long-Term Care and Assistance, 2010. Article 6.1.

Furthermore, older adults are an excellent source of culture and wisdom to pass on to future generations. A study by Abadie et al. reveals that while the verbatim memory of episodic events may be decreased in older age, the gist memory—focused on the essential meaning and substance—actually strengthens. (Abadie et al. 2021) This indicates that older persons' memory may decline in terms of remembering concepts word for word or unit by unit, however their gist memory, their capacity to retain essential meaning and substance, often referred as "wisdom", rooted in tacit knowledge and experience, grows with age. (Karpf 2014) Additionally, although the cognitive and complex memories of the elderly may worsen by aging, their bodily, emotional, and artistic skills and memories are often still intact and acute. For instance, in 2019, the video a 92-year-old pianist who was suffering from dementia went viral when she played Beethoven's Moonlight Sonata and was able to remember all the notes. [41]

Assistive technologies, in this context, play an essential role by facilitating older adults' participation in society and change this perspective from viewing older adults as recipients of care to those who can still participate in, and contribute to, the society. To achieve this, it is crucial that these technologies are not only accessible but also affordable for older individuals. Beyond providing access to Socially Assistive Robots (SARs), a broader range of social policies must be implemented to ensure that older adults have the opportunity to remain engaged and contribute meaningfully to their communities. (Klimczuk 2015)

An example of a successful social strategy is the implementation of community-based intergenerational programs that foster connections between elders and young people. These initiatives not only bridge the generational divide but also cultivate meaningful relationships that benefit both age groups. Evidence shows that combining daycare and nursing home is one social policy that may be beneficial to fill the loneliness gap of the aging population and has positive impacts on the socioemotional development of children. (Camp & Lee 2011, Lee et al. 2007, Femia et al. 2008)

In alignment with this approach, the Council of Europe Parliamentary Assembly in Recommendation 1428 (1999) highlighted the value of promotion of intergenerational exchanges and the transmission of knowledge and know-how from older to younger generations. [42] In addition, Recommendation CM/Rec (2009) encourages states to provide older persons with opportunities for active participation in all aspects of society where their life experience and knowledge can be respected.[43] This vision of active citizenship is essential for social fabric of , while at the same time, it contributes to improve the intellectual, social, and physical health of older people. [44]

There are some projects that support the cultural and artistic development of older people as well as the aging creativity. Creative and artistic activities play a critical role in promoting social interaction among older people. This approach to aging policy emphasizes the importance of nurturing the creative potential of older individuals, preparing both them and their communities for the aging process. The programs are designed to engage elderly meaningful participation through various forms of art. (Klimczuk 2016) One notable initiative is the Artists for Alzheimer project where artists make their arts accessible for people with dementia. [45] Such policies seek to reframe aging by shifting the focus from the "challenges of aging" to "promoting the potential" of older adults. (Klimczuk A. 2015) Research further underscores the importance of social engagement in reducing loneliness, which is closely linked to the risk of developing Alzheimer's disease. (Guarnera et al. 2023, Wilson et al. 2007)

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[41] 92-year-old Woman with Dementia Performs 'Moonlight Sonata' on Piano. Available at: https://abc7ny.com/woman-dementia-piano-beethoven-moonlight-sonata-tiktok-92-year-old/7869709/#:~:text=%2D%2D%20A%2092%2Dyear%2Dold,movement%20from%20Beethoven's%20famous%20work.

[42] Council of Europe, Parliamentary Assembly, Recommendation 1428 (1999) The Future of Senior Citizens: Protection, Participation and Promotion, para. 16.8.

[43] Recommendation CM/Rec (2009) on Ageing and Disability in the 21st Century: Sustainable Frameworks to enable Greater Quality of Life in an Inclusive Society. Appendix to Recommendation, 1.8.

[44] Explanatory Memorandum of Recommendation CM/Rec 2 of the Committee of Ministers to member states (2014) on the promotion of human rights of older persons. 21.

[45] The MoMA Alzheimer's Project: Making Art Accessible to People with Dementia.Available at :https://www.americansforthearts.org/by-program/reports-and-data/legislation-policy/naappd/the-moma-alzheimers- project-making-art-accesible-to-people-with-dementia

Social engagement of individuals can improve the overall well-being of older people, but it also decreases the risk of incident dementia. (Monteiro et al. 2024, Saczynski et al. 2006)

In summary, social policies that promote the integration of older citizens into society play a crucial role in alleviating isolation and loneliness, issues that disproportionately affect this age group. These efforts highlight the importance of addressing both social inclusion and the creative capacities of the elderly, ensuring their full participation in society.

3.5. The Superior Fundamental Right of Human Dignity of Older Adults

The United Nations' principle of dignity for older persons emphasizes the fundamental right of every older adult to live in dignity and security, free from any form of exploitation or physical and mental abuse (para 17). This principle further underscores the importance of treating older persons with fairness and respect, irrespective of their age, disability, or other personal circumstances. (para 18). Despite being an abstract notion and controversial in the philosophical debate (Duwell et al. 2014, Kateb 2011), human dignity is a legal value (Barak 2015) that is explicitly implied in international law[46] and EU constitutional frameworks (Art. 1 of the CFR, Art. 1 of the ECHR), as well as in the constitutions of Member States. [47] Nevertheless, in substance, human dignity is an overarching concept. Human dignity is a fundamental right itself but also a principle of every right (Gewirth 1996), yet it is "inviolable" and has a higher ranking status among all other fundamental rights, which means no other rights can be used to harm human dignity. (Barak 2015)

The use of social robots in aged care can present a complex duality, sometimes leading to concerns that the design or application of such technology may infringe upon the human dignity of older adults. While other forms of technology, such as ICT and functional robotics (service robots), offer a more positive potential.

These service robots, primarily used for rehabilitation and to assist older individuals with various tasks—such as lifting, carrying, mobility, eating, and cleaning—are specifically designed to enhance both the dignity and autonomy of elderly persons. By alleviating the physical and emotional burden on caregivers, these technologies promote independent living and support deinstitutionalization, allowing older adults to remain in their own homes and enjoy their fundamental freedom. Additionally, they create greater opportunities for older individuals to participate in society, access healthcare, engage in cultural and recreational activities, and stay connected to the digital world. In this way, technology becomes a "means to an end", serving to enhance human dignity and well-being, while empowering older adults to be included in society and exercise their fundamental and constitutional rights. (Bertolini & Arian 2020, Sharkey 2014, Sparrow & Sparrow 2006) All of these above-mentioned functions of robots, to a great extent, protect the rights of the elderly to autonomy and independent living.

However, social robots may significantly affect fundamental rights if fails to ensure human dignity and autonomy of older adults. The AI Act emphasizes the protection of fundamental rights as a key factor in determining whether a system is high-risk. "long-term home care" and "a long-term HRI experience" require further investigation, particularly with regard to the right of the elderly to autonomy and dignity, since robots capable of monitoring and tracking can restrict elderly people's personal autonomy and decision-making in every facet of everyday life. (Gross Horst-Michael & et al. 2011)

The deployment of robots in eldercare may undermine the autonomy of users through algorithmic decision-making. Throughout the course of interaction with users, particularly commitment-type robots, persuade users to engage in activities ranging from health-related pursuits (e.g. for therapy and rehabilitation) (Keay & Silicon Valley Robotics 2017) to changing users' behaviors, habits, and attitudes (food recommendations, changing social behaviors, or lifestyle). (Tae et al. 2021, Martinez-Martin & Karola 2018, Sax et al. 2018, Timmer et al. 2015,

[46] For instance see: the Universal Declaration of Human Rights (1948) referred to the human dignity in its Preamble as follows "Whereas recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world…."

[47] Art. 1 CFR states "Human dignity is inviolable. It must be respected and protected". Similarly, art. 1 of the German Constitution, whereby "The dignity of man is inviolable. To respect and protect it is the duty of all State authority".

Spahn 2012) Mabu and Pria are two typical robotic applications of this type that track, monitor, and manage medication usage. In order to improve the health conditions of the users, these robots provide coaching and instruction regarding healthy diets and lifestyles.[48]

By pressing the "agree" button, users give consent to intervention of robot for managing their medications, therapies, or wellness, but this contains the authorization to the robot to, automatically and constantly, monitor, collect, and record information. Intensive data collected by robots augment the AI system, and through machine learning, the system becomes more autonomous and over time, changes the algorithm patterns. As the AI system learns and adapts, it may introduce new recommendations or therapies, potentially beyond what the user originally agreed to. Algorithmic decision-making often occurs in a "black box", making it difficult for users to fully understand or challenge the decisions being made on their behalf. (Etzioni & Etzioni 2016)

As a result, care robots will introduce a wider range of advice and therapy methods and goals that older adults had not previously acknowledged or consented to. (Schermer et al. 2014) Algorithmic decision-making is always invisible to the users and occurs in a black box. (Id.) Nevertheless, users often ignore their own autonomy and follow the decisions made by robots for two reasons. Firstly, users often trust algorithms and do not think robots' advice, feedback, or diagnosis is inappropriate or unnecessary. (Loosman 2020) Secondly, they do not disregard the decisions made by robots because an override could cause a robot (such as Pria) to take action that could have a negative impact on the users' or others' lives. For instance, Pria and Mabu are connected to health centers and insurance companies; if the users do not follow the instructions provided by the robots, they may send automatic and unneeded alert notifications to caregivers or health authorities who are responsible for the users' health, and as a consequence the whole system can be disrupted. (Id.)

Social robots may also influence the decisions of users on everyday life matters, such as what kind of food to eat or what movies or songs to watch or listen to. Because persuasive robotic technologies are often used on a long-term basis rather than on a time-to-time basis, they could widely violate the right to autonomy and dignity of older individuals. In cases where robots interact with vulnerable individuals, such as the elderly, scholars argue that re-evaluation and re-consent mechanisms should be mandated, particularly for long-term care situations. The risk that AI systems may use "dark patterns" to manipulate behavior is a concern that warrants legal safeguards, ensuring that users retain control over their decisions and autonomy. Particularly for therapeutic purposes, some scholars recommend that there should be an expiry date for the consent (Custers 2016) and there is a need for re-evaluation and re-consent. (Loosman 2020, Budin Ljøsne et al. 2017, Custers 2016, Ploug & Søren 2013, Manson & O'Neill 2007) This is because algorithm patterns of AI system are capable of changing, and dark patterns powered by machine learning can use data to control the behavior of users. (Kinnaird 2020)

In addition, the user's goals and decisions can change during the process, and the previous consent may no longer be valid. Therefore, the legal framework should require that AI and robotic system design include an expiration date for the consent and an opportunity for users to re-consent or refuse to continue the service. Algorithmic decision-making is the biggest challenge in the interaction of humans with robots. The danger occurs when the machines diminish human autonomy, free will, and intellectual capacity. (Pfadenhauer & Dukat 2015, Trynacity 2015, Roger et al. 2013)

In fact, the use of available ICT and robotic technologies is essential to protect the elderly's right to health and adequate assistance. SARs, in particular, maintain optimal levels of physical, mental, and emotional well-being, enhancing their autonomy, and utilizing the appropriate levels of protection and rehabilitation in the case of impairments and sickness. However, this requires careful assessment of these technologies in aged care to ensure that the assistance provided by robots respects the dignity and welfare and the degree of care and assistance that are necessary for older persons. According to the AI Act, systems interacting with vulnerable persons, including the older adults, are subject to special scrutiny because of the potential for misuse, harm, or exploitation. If the

[48]Robots Aim to Improve Medication Management Tasks for Caregivers. Available at: https://www.roboticsbusinessreview.com/news/robots-aim-to-improve-medication-management-tasks-for-caregivers/.

robot makes critical decisions related to health, social care, or daily activities, this heightens the risk of negative outcomes.

In addition, it is important to note that although providing access to healthcare and enhancing capabilities for the elderly is virtuous, the use of technology should not overlook the need of vulnerable users for "social interaction". Therefore, the central goal of healthcare robotics should be to remove social inclusion barriers for marginalized groups and not leave the elderly with no social interaction. Thus, it is imperative to ensure that some level of human supervision and interaction with older adults and human peers takes place while robots are used for assisting the elderly. (Bertolini & Aiello 2018)

Robots are instruments that can greatly enhance the dignity of older persons (Zardiashvili & Fosch-Villaronga 2020) and create the opportunity for this population to be connected, and to feel visible and wanted, and not feel on the margin and unacknowledged by others. (Anderson et al. 2000, Ulla & Berit 2010) In this respect, SARs should act as mediators for older people to be integrated into society, and enjoy social contact and the company of others as well as to access other kinds of therapy including peer support[49], or have friends and family visit while living independently, join civic clubs, and take part in social and cultural activities with the support and assistance of SARs.[50]

To this end, these products must be accessible for older persons so that they can uphold their right to healthcare and adequate assistance. Accessibility to robotic and ICT solutions is a fundamental right of older persons with disabilities and "a precondition for persons with disabilities to live independently and participate fully and equally in society[51]. Older persons often suffer multiple forms of discrimination and inequality in exercising their most basic fundamental rights, such as freedom of movement and access to infrastructure, healthcare services, and employment as well as access to the web and media. Accessibility is an umbrella principle that allows the exercise of other fundamental rights (e.g. personal mobility (Art. 20), employment (Art. 27), and health (Art. 25)). (Foggetti N. 2012) Hence, it is essential that older persons have access to appropriate forms of assistance and support, as well as access to information and communication technologies and systems.[52]

Generally speaking, fundamental principles underpin the Jean-Jacques Rousseau idea of all men are created equal and free, (Rousseau 2002) therefore, all individuals are equally entitled to enjoy their inalienable rights inherited from the creation time. (Rubin 2008, Kass 2008) This equality attaches to all individuals, not because of their merit and status, but merely because of being human beings. (Collins 2003) In ine with Kant's doctrine, since human beings are born equal, they must be treated with fairness, dignity and respect as they indeed are "ends in themselves". (Kant 1998)

Human rights are not only a number of principles but they are supported by international and domestic laws. For instance, to uphold these rights, Article 1 of the Universal Declaration of Human Rights in a legally binding document affirms that all human beings are "free and equal in dignity and rights". This document calls upon not only governments, but all fellow citizens, companies, institutions, and every organ of society, to respect these rights and take progressive measures to secure their universal and effective recognition under any jurisdictional territories (UDHR Preamble).

Moreover, according to General Comment 20 of the International Covenant on Economic, Social and Cultural Rights (ICESCR), any 'distinction, exclusion, restriction, or preference' that results in differential treatment based on prohibited grounds constitutes discrimination (para 7). This includes State actions or omissions that undermine the equal recognition, enjoyment, or exercise of Covenant rights. For instance, any State measure that excludes

[49] UN Committee on Economic, Social and Cultural Rights (CESCR), General comment no. 21, Right of everyone to take part in cultural life (art. 15, para. 1a of the Covenant on Economic, Social and Cultural Rights), 21 December2009, E/C.12/GC/21, available at: https://www.refworld.org/docid/4ed35bae2.html.
article 26(1) CRPD
[50] Article 35 CFR and Article 19 CRPD
[51] Committee on the Rights of Persons with Disabilities (2014) General Comment No. 2—Article 9: Accessibility. UN Doc CRPD/C/GC/2 (11 April 2014).
[52] CRPD Article 9, para. 2 (e) (f) (g).

older persons from meaningful care or disregards their dignity can be deemed discriminatory. [53] Consequently, when implementing technology-based care, States have a responsibility to ensure that the fundamental rights and dignity of older individuals are fully upheld and not infringed upon. The recent Artificial Intelligence Act (AIA), also prohibited use of AI systems that perpetuate historical patterns of discrimination, for example based on age or disabilities, "and have a significant impact on persons' livelihood and may infringe their fundamental rights, such as the right to social protection, nondiscrimination, human dignity, or an effective remedy"(para 37).[54]

On the other hand, social welfare policies should encourage the use of (functional-type) assistive technologies that are specifically designed to meet the unique needs of older citizens, fostering independence and well-being. These technologies, although often costly, can be a game changer, offering a significant boost to the quality of life for older adults. By enabling active, independent living, such technologies uphold the dignity of older individuals. It is therefore essential that governments ensure these products are made available, accessible, and affordable for all senior citizens.

SAR technology has a significant role in preserving the dignity of older adults, allowing them to live independently, where their choice, freedom, and autonomy are respected and protected. Through access to these technologies, the elderly can enjoy their human rights -whether that means participating in public life, accessing healthcare, engaging in cultural and social activities, or enjoying opportunities for physical activity, vocational training, and sports on an equal footing with others. Integrating older adults more fully into society enhances not only their quality of life but also benefits society as a whole—culturally, socially, and economically.

Inequitable access to SAR technology, however, can infringe the rights of older adults on many levels. unequal access can create a new form of discrimination, exacerbating the divide between those who can afford assistive technologies and those who cannot. This technological divide may ultimately infringe on the rights of older adults, making it imperative for social policies to address and rectify disparities in access to these life-enhancing technologies.

Conclusions

In conclusion, the integration of technological solutions, including socially assistive robotics, represents a critical advancement in addressing the complex needs of older adults. The advent of assistive technologies has opened new opportunities for older adults to maintain autonomy, dignity, and active participation in society. Mobility assistance robots, in particular, have proven essential for preserving personal independence by supporting older individuals in carrying out daily activities, thereby enhancing their dignity and quality of life and promoting functional performance.

However, the deployment of these technologies must be accompanied by a pragmatic and legally sound approach to legal design. The adoption of the Legal Protection by Design (LPbD) model is crucial in ensuring that the fundamental rights of users remain at the heart of technological innovation. This approach emphasizes the need for States to incorporate the core principles of elderly rights—independence, participation, care, self-fulfillment, and dignity—into national laws and policies. These principles should not only guide governmental action but must also be respected and upheld by all members of society, including businesses, corporations, institutions, and other stakeholders. The commitment to protecting these rights is vital in ensuring that older adults can exercise their autonomy and enjoy full participation in public life, healthcare, cultural activities, and social engagement on an equal footing with others. The article reviewed two examples of good practice and relatively legal design of robots for older adults or for persons with disabilities.

[53] UN Committee on Economic, Social and Cultural Rights (CESCR), General comment No. 20: Non-discrimination in economic, social and cultural rights (art. 2, para. 2, of the International Covenant on Economic, Social and Cultural Rights),2 July 2009, E/C.12/GC/20, available at: https://www.refworld.org/docid/4a60961f2.html

[54] European Commission (2021) Proposal for a Regulation of the European Parliament and of the Council laying down harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain union legislative acts. COM/2021/206 final. Brussels, European Commission

As such, a legal design and use are essential for achieving a balance between two key objectives: allowing citizens to benefit from technological advancements while their human dignity, fundamental rights, and societal values are not compromised by these innovations. The responsible development and use of socially assistive robots (SARs) is of particular importance in this regard. SAR technology not only supports the independence of older adults but also safeguards their dignity by respecting their choices and promoting self-determined living. By enhancing access to these technologies, older adults can re-engage to society and maintain meaningful connections. The technologies can foster older adults' social engagement participation in various aspects of life, from healthcare and education to recreational and social activities. In this way, technology plays a dual role in enhancing both the physical and emotional well-being of elderly individuals, offering holistic support that extends beyond basic functionality.

To achieve this end, ensuring universal and equitable access to assistive technologies, including robotics, is a pressing concern. The right to health, which encompasses broader socioeconomic factors must also include and interpret as to access to essential health technologies. Making assistive technologies affordable and widely available is crucial to empowering older adults, especially those with disabilities, to lead dignified and autonomous lives. A more inclusive society where older individuals can fully exercise their rights and fully participate in the workforce, educational opportunities, cultural life, and physical activities, requires breaking down financial and systemic barriers to these innovations,

The role of social policies in promoting intergenerational solidarity and the exchange of knowledge and skills between older and younger generations cannot be overstated. This fosters a sense of community and mutual support that enriches society in an AI era, as a whole, both culturally and economically.

Furthermore, the design of assistive technologies must be inclusive and consider the specific needs of persons with disabilities (PWDs). Engaging older adults and PWDs in the design process is essential to ensure that these technologies are truly human-centered and responsive to the users' unique needs. By doing so, we can develop technologies that not only meet the functional needs of users but also support their personal growth, self-fulfillment, inclusion and citizenship in society. In this spirit, the best practice legal protection design facilitates access to the web, internet pages, and social media, ensuring that older adults can fully exercise their right to culture and information. By providing equal access to digital technologies, these technologies play a pivotal role in breaking down the barriers that have historically limited older persons with disability engagement with online resources while allows older adults to stay digitally connected, informed, and actively engaged with their communities.

At the same time, it is important to not overlook the potential risks posed by the increasing use of companion robots. The risk of providing emotional support through this technology, need for careful risk-based assessment. Empathy provided by machines is high-risk practice that diminish human connection or lead to unintended consequences and human deception. Establishing a clear liability framework is also critical to address potential harms and ensure that the rights and well-being of users are fully protected.

In short, shaping technology policy with a focus on fundamental rights and socio-technical regulation is key to fostering an inclusive society where older adults can lead fulfilling, autonomous lives. the principle of self-fulfillment must guide the social policy, and States must take social policies and measures ensuring that older adults have access to the resources and opportunities they need to realize their full potential. By integrating older individuals more fully into society, we not only enhance their quality of life but also strengthen the social fabric, contributing to cultural, social, and economic progress.

Declarations and Statements section

The authors have no conflicts of interest to declare. We certify that the submission is original work and is not under review at any other publication. The authors have no relevant financial or non-financial interests to disclose. The authors have no competing interests to declare that are relevant to the content of this article. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript The authors have no financial or proprietary interests in any material discussed in this article.

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