



New horizons in digital innovation and technology in dementia: potential and possible pitfalls

Vincenza Frisardi¹ · Pinar Soysal² · Susan D. Shenkin³

© The Author(s), under exclusive licence to European Geriatric Medicine Society 2022

We are witnessing a rapid digitalisation and technology revolution, and the COVID-19 pandemic has catalysed this, highlighting novel opportunities in the delivery of health-care services worldwide [1, 2]. Developments in medical engineering and robotics have provided new opportunities in diagnosis, treatment, and follow-up of patients, especially in surgery and rehabilitation. How will such developments impact people living with dementia (PLwD), their family and friends, and those who provide health and social care for them? There is huge potential, but also the possibility of pitfalls, which must be addressed using a collaborative, multidisciplinary, and above all person-centred approach.

There are several areas where technology may benefit PLwD [3]. Firstly, care; providing good quality supportive care is increasingly challenging, in the context of increasing numbers of PLwD, and an ageing care work force. The development of assistive technology-supported care models could decrease the burden on caregivers and improve the quality of care by helping patients maintain their daily activities and social connections, especially in the early stage of dementia, and could reduce the need for long-term care [3].

Secondly, communication; technological devices (such as phone-calls, chat interfaces, videoconferences) can connect geographically distant patients, caregivers and healthcare professionals, reducing the number of visits to a dementia patient's home or nursing home [4]. In addition to general communication, this technology can also facilitate cognitive-focussed therapeutic interventions, which can be supported

by family members between sessions and show promise for affecting dementia progression [3]. It has the additional benefit of still being deliverable in the event of closure e.g. of a care home due to an infection outbreak.

Thirdly, monitoring and sensing; in PLwD balance-gait disturbances and walking with purpose, and stress and distress related behaviours are common, leading to an increased risk of falls, injury and other morbidities, and mortality. There is therefore a plethora of products for monitoring and sensing movement and falls—such as wearable sensors, video cameras etc., with variable evidence of effect, but some evidence of reduced anxiety for PLwD, and in particular, their families [3]. Technology can enable more freedom e.g., through GPS tracking and prompting with directions, or reminders when specific doors are opened. Technology can also provide visual and vocal electronic reminders, and phone applications that help support activities of daily living (e.g. cooking, washing hands, taking medications) or robot-assisted navigation applications that remind the patient to go to bed at night [5]. However, although these technologies are claimed to increase functionality, they may be very complex for PLwD and there are few examples of robust ‘real-life’ evaluations [3, 6].

Fourthly, inputs from monitoring and sensing can lead directly to environmental controls, such as maintaining a safe ambient temperature, shutting off gas or water valves if required, or motion-activated lighting to prevent falls and to respond if a fall is detected [4]. Furthermore, technology can support therapeutic interventions, allowing non-pharmacological approaches, such as the use of robots to reduce stress and distress [6]. It is not yet known how realistic and useful human-like socially assistive robots developed for the continuation of social communication are. Technological devices can also support cognitive stimulation interventions [3], cognitive rehabilitation interventions (conducting daily living activities in virtual settings) or psychosocial interventions (e.g. reminiscence, multisensory therapy, therapy

✉ Susan D. Shenkin
Susan.Shenkin@ed.ac.uk

¹ Geriatric Unit, Neuromotor Department, AUSL-IRCCS, Reggio Emilia, Italy

² Department of Geriatric Medicine, Faculty of Medicine, Bezmialem Vakif University, Istanbul, Turkey

³ Ageing and Health Research Group, and Advanced Care Research Centre, Usher Institute, University of Edinburgh, Edinburgh, UK

based on social robots) are other examples of digitalization that can be used in dementia patient care [3–5].

However, despite the proliferation of digital and technological products aimed at PLwD, many healthcare professionals are reluctant to recommend such technologies, and PLwD and their families may be reluctant to adopt them. Reasons for this reluctance include lack of knowledge and skills related to digital health, ethical considerations, lack of appropriate infrastructure, fear that technology will weaken the care relationship, and insufficient financial resources [4, 7]. In addition, as dementia progresses use of technology may be more challenging, meaning that caregiver input needs to increase, and technology may need to adapt. Introduction of technology requires a personalised approach taking into account many factors including the stage of dementia, technology preferences, level of support, as well as financial considerations. Currently, many digital innovations start with technological innovation rather than the needs of the PLwD in mind, and there is a need for more innovation that is co-created from inception with the equitable input of PLwD and their families, to ensure it fills a real need, and is usable in practice, in the context of the health and social care system and culture of the relevant country.

The future of technological development in dementia care requires comprehensive knowledge about the real needs of PLwD matching the goal of ensuring their well-being and quality of life and preserving autonomy as long as possible. Policies to protect vulnerable people from misuse or risk of abuse must be addressed.

Getting a timely diagnosis of dementia is fundamental, and we know that dementia is still under-diagnosed, and this varies across Europe [8]. Digital decision making tools could help clinicians, caregivers, and patients to improve communication, and develop personalized care and action plans. However, digital innovations could have a paradoxical effect: for example, people who lack confidence with digital technologies may have worsening of behavioural and psychological symptoms of dementia triggered by performance anxiety, and it may increase disparities of access to services.

The COVID-19 pandemic has led to rapid adoption of telehealth services [1] but this has demonstrated disparities in telehealth use across communities, and countries [9]. Digital literacy is generally low among older people (though many are willing and able to learn with appropriate support) and some people, e.g. migrants, in poor socio-economic circumstances, are at higher risk [1] to be marginalized from digital benefits. There is now a need to implement and integrate trans-sectorial e-inclusion policy. Telemedicine has the potential to increase inclusivity and reduce waiting lists, though future work will need to assess which appointments can be done remotely, and which still need face-to-face consultations [10]. People living far from clinical centres with no private means of transport or without social support are at high risk of not receiving the best and most timely diagnosis and care planning.

There are several intriguing opportunities where digital innovation could support wider societal issues for PLwD. For example, the potential for driverless cars could, with appropriate safeguards, support older people who tend to move from urban to rural areas, and may be unable to drive [11] (e.g. by programming travel routes remotely by caregiver). Alternatively, the development of new platforms, such as mobile phone apps, could support safe public transportation specifically for PLwD. Also, technological safeguards may help to limit vulnerability to frauds etc.

As more people use technology, which can track changes over time, there is the potential for early detection of changes in behaviour or cognition, even in the absence of a spouse or family member. Digital self-assessment tools linked to healthcare centres or primary care should be assessed as to their potential to identify people with cognitive impairment; but appropriate and sensitive follow-up would be essential.

Technology including digitalization can help to tackle dementia-related stigma, promoting a new way of living, and allowing disabilities to be minimized or overcome. Many practical (i.e., managing finance), and physical tasks become harder to manage as new digital progresses occur in our society (e-commerce, e-banking, e-book, e-games, e-government, etc.). On the other hand, with investment in digital literacy, and as a new generation more familiar with technology ages, innovation and technology could support PLwD to be more independent.

The digital revolution has challenges as well as positives. PLwD and those who care for them are rarely involved in the design of novel technologies. Outside the research community, end-users generally have little awareness of the existence of these technologies [12], and adoption rates remain low for various barriers (awareness, translational, effectiveness, ethical, and structural-based, costs) [4, 7]. There is a risk that devices will be lost or destroyed (accidentally or intentionally) especially if their function is not recognized. There is the potential that serious game or mobile applications could increase behavioural disorders (i.e., addiction, social apathy, delusion) [13]. More studies focusing on these aspects are needed.

The main potential for technological innovation is likely to be when these are not seen as ‘other’, for PLwD, or disabilities, but are integrated into the homes of all those who want them: the concept of ‘smart homes’ where we can control heating, lighting, security etc. at the touch of a button. This concept could evolve to that of smart cities, where urban design ensures that new structures and buildings are accessible for everyone, including PLwD, and support the maintenance of cognitive and physical health [14].

Technological innovation provides an opportunity for us to reconsider the role of the dyadic relationship structure between PLwD and their caregivers [15]: what tasks and support can be provided or augmented by technology, and which uniquely require human input? What infrastructure and resource is required for digital and non-digital

(hardware) technological advances, and how can these best be integrated into daily life without stigmatisation, and while ensuring appropriate ethical, governance and privacy issues?

Despite technological opportunities proliferating rapidly, clinical applications are sporadic and their potential remains inadequately translated into dementia care. This editorial aims to stimulate debate about the potential importance and challenges of including digitalisation in dementia care. There is great potential to reduce the impact of cognitive disability but with this potential, comes responsibility. We need to improve the evidence base for technological assisted living strategies for PLwD. Well-powered trials that include PLwD at a range of severities, and co-morbidities, and are co-designed with clinicians, technologists, and PLwD and their families/carers, in different settings, are essential.

How we can close the gap between technological innovation and real-world adoption? We need to invest now in improving digital literacy across all ages, and ensure equity of access. Assistive technologies need to be developed that are accepted into widespread use (like wearable fitness trackers and digital assistants), and not limited to stigmatized ‘other’ groups. Providing opportunities for collaborations between end-users and interdisciplinary stakeholders, and supporting the development and commercialization of clinically effective, affordable, usable technologies for dementia care could be the starting point for realigning research innovation and real world impact and utility.

Acknowledgements All authors are members of the EuGMS Dementia Special Interest Group (SIG). The ACRC is funded by Legal and General PLC as part of their corporate social responsibility (CSR) programme. The funder had no role in the preparation of this editorial, and the views expressed are those of the authors.

Declarations

Conflict of interest The author(s) declare that they have no competing interests.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent is not required.

References

- Graham H, de Bell S, Flemming K, Sowden A, White P, Wright K (2020) Older people's experiences of everyday travel in the urban environment: a thematic synthesis of qualitative studies in the United Kingdom. *Ageing Soc* 40:842–868. <https://doi.org/10.1017/S0144686X18001381>
- Jørgensen BB, Gregersen M, Pallesen SH, Damsgaard EM (2021) A group-based real-time videoconferencing telerehabilitation programme in recently discharged geriatric patients: a feasibility study. *Eur Geriatr Med* 12(4):801–808. <https://doi.org/10.1007/s41999-020-00444-6>

- Pappadà A, Chattat R, Chirico I, Valente M, Ottoboni G (2021) Assistive technologies in dementia care: an updated analysis of the literature. *Front Psychol* 12:644587. <https://doi.org/10.3389/fpsyg.2021.644587>
- Lorenz K, Freddolino PP, Comas-Herrera A, Knapp M, Damant J (2019) Technology-based tools and services for people with dementia and carers: mapping technology onto the dementia care pathway. *Dementia (London)* 18(2):725–741. <https://doi.org/10.1177/1471301217691617>
- Daly Lynn J, Rondón-Sulbarán J, Quinn E, Ryan A, McCormack B, Martin S (2019) A systematic review of electronic assistive technology within supporting living environments for people with dementia. *Dementia (London)* 18(7–8):2371–2435. <https://doi.org/10.1177/1471301217733649>
- Jøranson N, Pedersen I, Rokstad AM, Ihlebæk C (2015) Effects on symptoms of agitation and depression in persons with dementia participating in robot-assisted activity: a cluster-randomized controlled trial. *J Am Med Dir Assoc* 16(10):867–873. <https://doi.org/10.1016/j.jamda.2015.05.002>
- Ienca M, Fabrice J, Elger B, Caon M, Scoccia Pappagallo A, Kressig RW, Wangmo T (2017) Intelligent assistive technology for Alzheimer's disease and other dementias: a systematic review. *J Alzheimers Dis* 56(4):1301–1340. <https://doi.org/10.3233/JAD-161037>. Erratum In: *J Alzheimers Dis* 2017;60(1):333 (PMID: 28222516)
- Lethin C, Rahm Hallberg I, Renom Guiteras A, Verbeek H, Saks K, Stolt M, Zabalegui A, Soto-Martin M, Nilsson C (2019) Prevalence of dementia diagnoses not otherwise specified in eight European countries: a cross-sectional cohort study. *BMC Geriatr* 19(1):172. <https://doi.org/10.1186/s12877-019-1174-3>
- Bhaskar S, Bradley S, Chattu VK, Adisesh A, Nurtazina A, Kyrykbayeva S, Sakhamuri S, Yaya S, Sunil T, Thomas P, Mucci V, Moguilner S, Israel-Korn S, Alacapa J, Mishra A, Pandya S, Schroeder S, Atreja A, Banach M, Ray D (2020) Telemedicine Across the Globe-Position Paper From the COVID-19 Pandemic Health System Resilience PROGRAM (REPROGRAM) International Consortium (Part 1). *Front Public Health* 8:556720. <https://doi.org/10.3389/fpubh.2020.556720>
- Davies AR, Honeyman M, Gann B (2021) Addressing the digital inverse care law in the time of COVID-19: potential for digital technology to exacerbate or mitigate health inequalities. *J Med Internet Res* 23(4):e21726. <https://doi.org/10.2196/21726>
- Graham H, de Bell S, Flemming K, Sowden A, White P, Wright K. A systematic review of qualitative studies of older people's experiences of everyday travel. https://phrc.lshtm.ac.uk/assets/uploads/files/PHRC17_Final_Report_Graham_et_al_revised_FINAL_1.pdf
- Gibson G, Dickinson C, Brittain K, Robinson L (2015) The everyday use of assistive technology by people with dementia and their family carers: a qualitative study. *BMC Geriatr* 15(1):89. <https://doi.org/10.1186/s12877-015-0091-3>
- Wang JL, Sheng JR, Wang HZ (2019) The association between mobile game addiction and depression, social anxiety, and loneliness. *Front Public Health* 7:247. <https://doi.org/10.3389/fpubh.2019.00247>
- Rohra H, Mann J, Rommerskirch-Manietta M, Roes M, Kuliga S (2021) Wayfinding and urban design from the perspective of people living with dementia: a call for participatory research. *J Urban Des Ment Health* 7:4. <https://www.urbandesignmentalhealth.com/journal-7-wayfinding.html>
- Braun M, Scholz U, Bailey B, Perren S, Hornung R, Martin M (2009) Dementia caregiving in spousal relationships: a dyadic perspective. *Aging Ment Health* 13(3):426–436. <https://doi.org/10.1080/13607860902879441>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.