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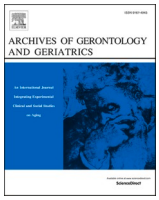

Editorial

Gerontechnology and artificial intelligence: Better care for older people

COVID-19 pandemic caused inconceivable public health impacts to the world, especially in the vulnerable groups, e.g. frail older people or nursing home residents; and the social isolation related to lock down also resulted in strong concerns to health of older people (Lim et al., 2020). Although some countries were relatively less influenced by the COVID-19 pandemic, community activities, home and community long-term care services were ceased for several months that generated profound adverse effects on older adults (Rowe et al., 2020). Without appropriate alternative programs, older adults eventually experienced greater risk for functional declines, loneliness, depression, cognitive impairment, social isolation and other health risks (Lim et al., 2020). On the other hand, health and social care professionals also experienced moral and psychological distress facing the deadly and contagious disease (Berg-Weger & Morley, 2020; Morley et al., 2020). It has been widely proposed that telehealth services or other technology solutions should be developed and implemented to care services and the needs would become stronger in the post-COVID-19 era (Zubatsky et al., 2020). During the pandemic, care providers suddenly realized that they were short of solutions when community activities or outdoor activities were highly regulated and the mid-to-long term adverse effects may be another public health challenge after the pandemic (Bouillon-Minois et al., 2020). The adverse impact of stresses in bio-psycho-social dimensions may last longer after the pandemic in older adults. The lifestyle and senior services may never resume, so developing new services with more technology innovation is taking place and will certainly accelerate in the post-COVID-19 era. Moreover, the characteristics of older adults is also changing that current and older adults in the near future would be much more familiar with applications of technology (Park et al., 2019).

Gerontechnology is defined as an interdisciplinary field linking existing and developing technologies to the aspirations and needs of aging and aged adults. Gerontechnology supports "successful aging", and is a response to the combination of the aging of society and rapidly emerging new technologies (van Bronswijk et al., 2009; (Lee, Peng, Lin, Loh, & Chen, 2020). In particular, the rapid development and success of artificial intelligence (AI) may reshape care services for older adults, like many other professions and enterprises. In recent years, health care has become one of the major fields being extensively investigated to explore the roles of AI applications in changing the future (Chen, 2018). Despite of all technological advancement, the "human touch" of medicine and healthcare remained to be strong concerns because care is highly person-centered and people-focused instead of simply manufacturing.

In addition to AI, wearable devices, robotics, and assistive technology were all important approaches to meet with the needs in senior services, which have gained extensive attentions in the world (Nevedal et al., 2019). Recent issues of Archives of Gerontology and Geriatrics have published some articles that evaluated the efficacy, implications, risk and attitudes towards the development and implementation of gerontechnology-based services, as well as other related agendas. A study has shown short-term benefits of increasing physical activities of older adults via using wearable devices, but the effects in oldest-old population were inconclusive and the long-term effect was unclear (Liu et al., 2020). Using wearable devices to improve physical activities is inspiring and the pursuit of long-term effects in all populations should continue. It has been reported that multidomain intervention programs substantially improved physical function, cognitive performance, depressive mood and nutritional status among community-dwelling older adults. However, the effects decay as the intervention gradually shifted from group-based to home-based programs, and study also indicated that using simple pedometer improved the adherence to the home activities (Chen et al., 2020). Hence, the results clearly highlighted the potentials of using wearable devices to improve the efficacy of healthy aging programs. Moreover, Dolatabadi et al., reported the feasibility to longitudinally track gait in a dementia inpatient setting (Dolatabadi et al., 2019). Tracking the gait of older people with dementia is an important task to ensure their safety, which may also facilitate to early identify behavioral and psychological symptoms via more in-depth AI-based analysis. Although authors indicated the potential applications in assessing functional declines and risk of falls, however, gait and wandering patterns may play important roles in assessing cognitive impairment, as well as the behavioral and psychological symptoms of people with dementia and may be applied to community-dwelling older adults to predict future cognitive declines (Chen and Arai, 2020; Huang et al., 2019).

A recent study compared hypothesis-driven and data-driven approaches to establish the multimorbidity frailty index in predicting adverse outcomes of older adults, which showed some differences of machine learning model in variable selections and outcome predictions (Peng et al., 2020). This study clearly demonstrated the strength of AI-based approach in data analysis and outcome prediction, but it is still challenging for clinicians to apply these findings into clinical practice. However, AI-based approach not only captured important outcome-predicting variables, but also modified the survival analysis to ensure best prediction outcomes. To some extent, these findings may modify further data analysis to improve the differentiation between people with different entities of health risks. On the other hand, applying robotic technology in care services is also of great importance due to the universal lack of care-giving workforces internationally (Chen, Sumioka, Shiomi, Ke, & Chen, 2020) Currently, most available evidences were focused on the effectiveness of robopets in comforting

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behavioral and psychological symptoms of dementia and roles of social robots for people with depression (Abbott et al., 2019; Chen et al., 2018). Despite all the previously reported success, communications between older people and robots remained to be a challenging task if older people were not capable of robot operations. A recent study showed that gesture commands substantially helped older adults to interact with bathing robots, which improved communication between older adults with functional impairment and robots (Werner et al., 2020). Gradually, robots designed for the specific task or multiple tasks to facilitate activities of daily living of older adults may become an important part of the care services in the near future.

Despite all progresses and promises of AI and gerontechnology in elderly care, some concerns and risks associated with AI applications in health care have been proposed, including the depersonalization of care through algorithm-based standardization, the discrimination of minority groups through generalization, the dehumanization of the care relationship through automatization, and the disciplination of users through monitoring and surveillance (Rubeis, 2020). Nevertheless, these potential risks also highlighted the needs and challenges to overcome in developing AI and gerontechnology-based services. In all scenarios related to new technology implementation, users' perspectives, awareness and understanding to these new services are of great importance, which remained the same in gerontechnology-based services (García-Soler et al., 2018; Vandemeulebroucke et al., 2018).

Currently, engineers have designed devices, equipment or algorithms to improve seniors care in different scenarios, however, the successful products or services are heavily dependent on the expertise and experiences of healthcare professionals and care providers. Although computer technology may substantially improve the efficiency of administrative process and reduce workloads for care providers, game-changing products and services that modifies or even changes the process of care is even more important to re-construct the ecosystem of senior care. For example, some studies have shown the potentials of using emotion facial expressions (Jiskoot et al., 2020), voice signals and language (Al-Hameed et al., 2019) to early identify people with potential risks for neurodegenerative disorders or dementia, which may change the common understanding of disease diagnosis and may be extended in health and social care settings. Working with engineers, older adults and their care-givers to come out with best solutions to fill the gaps in health care services and even to re-construct the care ecosystem with innovative thinking becomes a new normal now and the near future.

References

Abbott, R., Orr, N., McGill, P., Whear, R., Bethel, A., Garside, R., … Thompson-Coon, J. (2019). How do "robopets" impact the health and well-being of residents in care homes? A systematic review of qualitative and quantitative evidence. *International Journal of Older People Nursing, 14*(3), e12239. https://doi.org/10.1111/opn.12239.

Al-Hameed, S., Benaissa, M., Christensen, H., Mirheidari, B., Blackburn, D., & Reuber, M. (2019). A new diagnostic approach for the identification of patients with neurodegenerative cognitive complaints. *PloS One, 14*(5), e0217388. https://doi.org/10.1371/journal.pone.0217388.

Berg-Weger, M., & Morley, J. E. (2020). Editorial: Loneliness and social isolation in older adults during the COVID-19 pandemic: Implications for gerontological social work. *The Journal of Nutrition, Health & Aging, 24*(5), 456–458. https://doi.org/10.1007/s12603-020-1366-8.

Bouillon-Minois, J. B., Lahaye, C., & Dutheil, F. (2020). Coronavirus and quarantine: Will we sacrifice our elderly to protect them? *Archives of Gerontology and Geriatrics, 90*, Article 104118. https://doi.org/10.1016/j.archger.2020.104118.

Chen, L. K. (2018). Artificial intelligence in medicine and healthcare. *Journal of Clinical Gerontology and Geriatrics, 9*(3), 77–78. https://doi.org/10.24816/jcgg.2018.v9i3.01.

Chen, L. K., & Arai, H. (2020). Physio-cognitive decline as the accelerated aging phenotype. *Archives of Gerontology and Geriatrics, 88*, Article 104051. https://doi.org/10.1016/j.archger.2020.104051.

Chen, L. K., Hwang, A. C., Lee, W. J., Peng, L. N., Lin, M. H., Neil, D. L., … Taiwan Health Promotion Intervention Study for Elders research group. (2020). Efficacy of multidomain interventions to improve physical frailty, depression and cognition: Data from cluster-randomized controlled trials. *Journal of Cachexia, Sarcopenia and Muscle, 11*(3), 650–662. https://doi.org/10.1002/jcsm.12534.

Chen, L. Y., Sumioka, H., Shiomi, M., Ke, L. J., & Chen, L. K. (2020). Effects of teleoperated humanoid robot application in older adults with neurocognitive disorders in Taiwan: A report of three cases. *Aging Medicine and Healthcare, 11*, 67–71. https://doi.org/10.33879/AMH.2020.066-2001.003.

Chen, S. C., Jones, C., & Moyle, W. (2018). Social robots for depression in older adults: A systematic review. *Journal of Nursing Scholarship : an Official Publication of Sigma Theta Tau International Honor Society of Nursing, 50*(6), 612–622. https://doi.org/10.1111/jnu.12423.

Dolatabadi, E., Zhi, Y. X., Flint, A. J., Mansfield, A., Iaboni, A., & Taati, B. (2019). The feasibility of a vision-based sensor for longitudinal monitoring of mobility in older adults with dementia. *Archives of Gerontology and Geriatrics, 82*, 200–206. https://doi.org/10.1016/j.archger.2019.02.004.

García-Soler, Á., Facal, D., Díaz-Orueta, U., Pigini, L., Blasi, L., & Qiu, R. (2018). Inclusion of service robots in the daily lives of frail older users: A step-by-step definition procedure on users' requirements. *Archives of Gerontology and Geriatrics, 74*, 191–196. https://doi.org/10.1016/j.archger.2017.10.024).

Huang, C. H., Peng, L. N., & Chen, L. K. (2019). Muscle strength predicting health outcomes of older adults: A narrative review. *Aging Medicine and Healthcare, 10*, 96–99. https://doi.org/10.33879/AMH.2019.1916.

Jiskoot, L. C., Poos, J. M., Vollebergh, M. E., Franzen, S., van Hemmen, J., Papma, J. M., … van den Berg, E. (2020). Emotion recognition of morphed facial expressions in presymptomatic and symptomatic frontotemporal dementia, and Alzheimer's dementia. *Journal of Neurology*. https://doi.org/10.1007/s00415-020-10096-y, 10.1007/s00415-020-10096-y. Advance online publication.

Lee, W. J., Peng, L. N., Lin, M. H., Loh, C. H., & Chen, L. K. (2020). Determinants and indicators of successful ageing associated with mortality: a 4-year population-based study. *Aging, 12*(3), 2670–2679. https://doi.org/10.18632/aging.102769.

Lim, W. S., Liang, C. K., Assantachai, P., Auyeung, T. W., Kang, L., Lee, W. J., … Arai, H. (2020). COVID-19 and older people in Asia: Asian Working Group for Sarcopenia calls to actions. *Geriatrics & Gerontology International, 20*(6), 547–558. https://doi.org/10.1111/ggi.13939.

Liu, J. Y., Kor, P. P., Chan, C. P., Kwan, R. Y., & Sze-Ki, D. (2020). The effectiveness of a wearable activity tracker (WAT)-based intervention to improve physical activity levels in sedentary older adults: A systematic review and meta-analysis. *Archives of Gerontology and Geriatrics, 91*, Article 104211. https://doi.org/10.1016/j.archger.2020.104211.

Morley, G., Sese, D., Rajendram, P., & Horsburgh, C. C. (2020). Addressing caregiver moral distress during the COVID-19 pandemic. *Cleveland Clinic Journal of Medicine*. https://doi.org/10.3949/ccjm.87a.ccc047, 10.3949/ccjm.87a.ccc047. Advance online publication.

Nevedal, A. L., Ayalon, L., & Briller, S. H. (2019). A qualitative evidence synthesis review of longitudinal qualitative research in gerontology. *The Gerontologist, 59*(6), e791–e801. https://doi.org/10.1093/geront/gny134.

Park, Y. H., Chang, H. K., Lee, M. H., & Lee, S. H. (2019). Community-dwelling older adults' needs and acceptance regarding the use of robot technology to assist with daily living performance. *BMC Geriatrics, 19*(1), 208. https://doi.org/10.1186/s12877-019-1227-7.

Peng, L. N., Hsiao, F. Y., Lee, W. J., Huang, S. T., & Chen, L. K. (2020). Comparisons between hypothesis- and data-driven approaches for multimorbidity frailty index: A machine learning approach. *Journal of Medical Internet Research, 22*(6), e16213. https://doi.org/10.2196/16213.

Rowe, T. A., Patel, M., O'Conor, R., McMackin, S., Hoak, V., & Lindquist, L. A. (2020). COVID-19 exposures and infection control among home care agencies. *Archives of Gerontology and Geriatrics, 91*, Article 104214. https://doi.org/10.1016/j.archger.2020.104214.

Rubeis, G. (2020). The disruptive power of artificial intelligence. Ethical aspects of gerontechnology in elderly care. *Archives of Gerontology and Geriatrics, 91*, Article 104186. https://doi.org/10.1016/j.archger.2020.104186.

van Bronswijk, J. E. M. H., Bouma, H., Fozard, J. L., Kearns, W. D., Davison, G. C., & Tuan, P.-C. (2009). Defining gerontechnology for R&D purposes. *Gerontechnology, 8*(1), 3–10. https://doi.org/10.4017/gt.2009.08.01.002.00.

Vandemeulebroucke, T., Dierckx de Casterlé, B., & Gastmans, C. (2018). The use of care robots in aged care: A systematic review of argument-based ethics literature. *Archives of Gerontology and Geriatrics, 74*, 15–25. https://doi.org/10.1016/j.archger.2017.08.014.

Werner, C., Kardaris, N., Koutras, P., Zlatintsi, A., Maragos, P., Bauer, J. M., & Hauer, K. (2020). Improving gesture-based interaction between an assistive bathing robot and older adults via user training on the gestural commands. *Archives of Gerontology and Geriatrics, 87*, Article 103996. https://doi.org/10.1016/j.archger.2019.103996.

Zubatsky, M., Berg-Weger, M., & Morley, J. (2020). Using telehealth groups to combat loneliness in older adults through COVID-19. *Journal of the American Geriatrics Society, 68*(8), 1678–1679. https://doi.org/10.1111/jgs.16553.

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