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Applying Information and Communication Technology to Promote Healthy Aging in Older People: Japan's Challenges and Perspective

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Abstract: Population aging is a global trend. Among rapidly aging countries, Japan has the highest aging rate, as well as a critical shortage of human and financial resources in the medical and nursing care fields. Another major challenge is that older people after retirement tend to lose contact with society and are deprived of opportunities to be active, resulting in a tendency to become confined, leading to a decline in physical and mental functions. The coronavirus disease 2019 (COVID-19) pandemic has accelerated social isolation, especially in older people, which can promote the progression of frailty and disability, causing further pressure on medical and care finances. One solution to these problems is the

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digitization of medical and care fields. Digital health is a field of knowledge and practice related to the development and use of digital technologies for health promotion, which is expected to develop further with the spread of the Internet environment and electronic devices. In this chapter, we describe the implications and applications of digital health for older people and introduce new initiatives in digital health and healthy longevity in Japan.

Keywords: aging society; COVID-19; digital health for older people; information communication technology; rehabilitation

INTRODUCTION

The aging of the population due to increasing life expectancy and decreasing fertility rates is occurring on a global scale (1). According to the 2021 White Paper on Ageing Society (2), the ratio of the population aged 65 years and over to the total population (aging rate) in Japan is 29.1% and the ratio of the population aged 25–64 years to the population aged 65 years and over, defined as the "potential dependency ratio," is one of the lowest in the world, according to the United Nations Department of Economic and Social Affairs. As Japan enters a super-aging society unparalleled worldwide, the anticipated shortage of human resources and finances in the medical and nursing care fields is critical. Therefore, systemic reform of the medical insurance and social security systems to respond to social changes and function sustainably is necessary. However, the challenges include not only the future labor shortage due to the declining birthrate and aging population but also the increasing number of older people living alone due to the shift to nuclear families and the uneven distribution of medical and care services due to urban concentration. Although older people who have retired from work are in good physical and mental health, they lose contact with society and are deprived of opportunities to be active, resulting in a tendency to become confined. The decline in physical and mental functions leads to frailty and disability. To address these problems, digitalization in the medical and care fields is attracting attention and the development and diffusion of digital technology are being promoted. Herein, we describe digital health and introduce Japan's digital health and healthy longevity initiatives as it faces the challenge of aging ahead of the rest of the world.

WHAT IS DIGITAL HEALTH?

Digital health is a field of knowledge and practice related to the development and use of digital technologies for health promotion, which has developed along with the advancement of information communication technology (ICT) and artificial intelligence (AI) devices. Digital health expands the concept of e-health to include digital care programs and technologies that connect health, medicine, life, and society to improve the efficiency of healthcare delivery, as well as

consumers with smart devices and connected devices (3). Digital health is also a broad concept that includes the use of digital technologies such as the Internet, AI, big data, and robotics to facilitate the understanding of health problems and issues faced by people receiving medical care, and to find solutions through individualization and refinement (4). As a multidisciplinary field, digital health involves clinicians, researchers, and scientists with wide ranges of expertise in medicine, engineering, social sciences, public health, health economics, and data management (5), and also includes both hardware and software solutions and services such as telemedicine, wearable devices, augmented reality, and virtual reality (3).

DIGTAL HEALTH IN JAPAN

Compared to other countries, Japan has a high level of infrastructure development such as the Internet, which is necessary for digital applications, but has lagged far behind in many areas related to the use of digital technology. However, all possible measures must be taken to ensure the sustainability of social security, including improving efficiency and productivity, while aiming to improve the quality of services in the medical and nursing care fields, which are becoming increasingly busy due to a decrease in human resources. To address these issues, the Japanese government (Ministry of Health, Labour and Welfare) launched the "Headquarters for the Promotion of Data Health Reform" in January 2017 and promoted ICT in the fields of health, medical care, and nursing care to allow individual citizens to make effective use of their own medical and other data, as well appropriate use of healthcare sites and related industries (6). In addition, after building a foundation for data health reform, such as the introduction of an online eligibility verification system, the government has promoted (i) health record sharing, (ii) emergency medical information sharing, (iii) personal health record (PHR) and health scoring, (iv) data health analysis, (v) health information for infants and school children, (vi) scientific nursing care data provision, (vii) cancer genomics, and (viii) AI (7). In addition, the spread of the coronavirus disease 2019 (COVID-19) led to a review of regulations regarding the use of digital technology in the medical field and administrative procedures for infection prevention. In February 2020, the Japanese Cabinet declared that "from the perspective of preventing the spread of infection, we will promote remote response in all areas of society while utilizing IT technologies, such as telework, to advance the transformation of the future at a stroke" (8). During the COVID-19 pandemic, the use of remote work and online classes spread rapidly due to the need to avoid person-to-person contact; in the medical field, deregulation permitted some online medical treatment on a limited or exceptional basis. In the future, examination and improved reduction of the risks of serious illnesses and missed opportunities that may arise from online medical treatment is required; however, many academic conferences and training sessions have gone online, and numerous innovations have been made in online health counseling and health promotion projects.

DIGITAL ASSISTIVE DEVICES FOR HEALTH AND LONGEVITY

The functions of medical and nursing care robots are diversifying to support a variety of complex areas. At our facility, we have been using various robots for treatment and research to support the rehabilitation and daily life of older people. Exercise therapy using HAL®, BEAR (Balance Exercise Assist Robot), Wellwalk WW, etc. for improving walking ability (9–11); and Reo Go therapy systemTM (Reo Go) and In-Motion robots for upper limb functional training; and other devices with evidence of training effectiveness are being used in clinical settings worldwide (Figure 1) (12, 13). Furthermore, we attempted to verify the feasibility of the use of treadmills with virtual reality technology and group training with human-like robots (14). In addition, "nursing-care robots," devices that use robot technology to support user independence and reduce caregiver burden are divided into applications such as transfer support, mobility support, toileting support, and dementia monitoring (15). All of these are expected to reduce the physical and mental burdens of care workers and help realize high-quality nursing care to improve patient quality of life (QOL). The government is building a platform for the development, demonstration, and dissemination of nursing care robots and promoting the acceleration of the flow of nursing care robots from development to practical use in the community (16).

Figure1. Robots and New Technologies in Rehabilitation. A, Rehabilitation assist robot "Welwalk WW®". **B,** Balance Exercise Assist Robot (BEAR). **C,** Recreation at Nursing Home by Humanoid Robot "Pepper®". **D,** Robot-aided upper limb rehabilitation with "In Motion ARM®". **E, F,** Motion analysis technology.

THE CHALLENGE OF COVID-19 DISASTERS IN AN AGING SOCIETY

COVID-19, with the first confirmed case in December 2019, has transformed our society and our lives. While COVID-19 has a significant number of asymptomatic pathogen carriers, it has also been associated with severe acute pneumonia, acute respiratory distress syndrome, and thrombosis, leading to severe illness and death. High fatality rates have been reported in older people and complicated populations (17, 18). Thus, older people and people with underlying diseases refrained from activities and stayed indoors, avoiding the three Cs (closed spaces, crowded places, and close-contact settings). The Japanese Geriatrics Society and the National Center for Geriatrics and Gerontology were quick to sound the alarm about the progression of frailty and the need for nursing care due to inactivity among older people (19), and measures to protect the health of older people has become an important issue in the medical care of older people (20). In a survey of 148 patients (70 men and 78 women; age range 51–99 years, median 77 years; 56.1% certified as needing nursing care) undergoing outpatient or home rehabilitation, 70% refrained from activities that involved contact with others, such as shopping and socializing with friends (21). The WHO guidelines on physical activity (22) provide evidence that balance and physical function training reduce the risk of falls in people aged 65 years and older. Moderate physical activity, including balance, strength, endurance, gait, and functional training, should be performed at least three times per week. However, it is difficult for older people to engage in active physical activities as recommended due to restrictions that prevent them from going out to participate in outpatient rehabilitation and gymnastics classes. Frail older people are particularly susceptible to the negative effects of refraining from exercise. Therefore, urgent measures are needed.

DEVELOPMENT OF THE HOME EXERCISE PROGRAM

In May 2020, we published the "National Center for Geriatrics and Gerontology Home Exercise Program 2020 (NCGG-HEPOP®)" for older people to prevent the deterioration of their physical and mental conditions (23). The NCGG-HEPOP® was developed in collaboration with specialists in geriatrics, neurology, and rehabilitation, as well as dietitians, therapists, and other professionals, so that anyone at home can easily implement exercises and activities based on expert advice. A questionnaire survey of older people conducted beforehand regarding the method of dissemination showed that only 20% could gather information from the Internet themselves, and only a few percent of them had actually obtained information on exercise from the Internet during the pandemic. Therefore, to disseminate the information widely, we made the NCGG-HEPOP® available for anyone to view and download free of charge from the NCGG's website (https://www.ncgg.go.jp/english/index.html), and printed and distributed booklets so that people without access to the Internet could also check the content through newspapers, television, or municipal newsletters (Figure 2). In addition, we made a video of

Always HEPOP! Inactivity Prevention Package

10 minutes basic exercise

Precautions for exercise If possible, continue to exercise every day.

1. Stop exercising if you feel strong pain or stress in your body.
2. Exercise slowly while taking breaks according to your physical condition.
3. While exercising, breathe naturally and do not hold your breath.

Stretching the quadriceps and front of the hip

Refrain from this stretch if you have had hip surgery.

Left and right sides, **30** sec each

- Sit sideways in a chair with your legs parallel to the backrest.
- Place the foot of the front leg on the floor behind you.
- Open your chest, push your hips forward, and stretch the thigh of the extended legs.

If you have pain in your back, lower back, or knees, be careful not to make it worse.

Full body stretch

Refrain from this exercise if you have a past history of compression fractures of the spine.

30 times **2** sets

Stand against a wall.

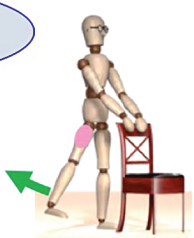
- Stand up straight and put your entire back against the wall.
- Lift your hands above your head and stretch your back.

If you have pain in your shoulders, back or spine, be careful not to make it worse.

Hip abduction exercise

Left and right sides, **20** times **3** sets each

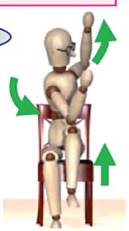
- Lightly hold a stable table or chair.
- Raise one foot slowly to the side. Slowly return to the original position.



Twist exercise

Left and right sides, **30** times

- Open your chest and both shoulders and raise your elbows to shoulder level with your fingertips facing up.
- Lift your left keep and twist your body so that your right elbow and left knee touch. Repeat with the other leg.



If you have pain in your back or knees, be careful not to make it worse.

Drawing circles with the feet

Left and right sides, **10** times **2** sets each

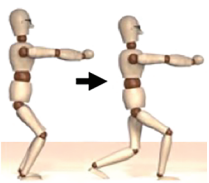
- Lightly hold a stable table or chair.
- Move your leg as if to draw a circle with your toes on the floor.
- Repeat with the other leg.

Keep your leg straight.

Monkey-walking

3 meters **10** times

- Squat slightly and keep your knees bent. Clasp your hands and lift your arms up in front of you.
- Walk slowly while dropping your hips and keeping your knees bent.



If you have pain in your knees, be careful not to make it worse.

Figure 2. One of the shortened versions of NCGG-HEPOP, "Always HEPOP!" The home activity guide for maintaining a healthy life at home, at any time, as safely as possible, without the use of special equipment (HEPOP, Home exercise program for Older People; NCGG, National Center for Geriatrics and Gerontology).

the exercises and added explanations (24), uploaded it to YouTube, and made a DVD to distribute to those who wanted to see it. The NCGG-HEPOP® was also translated into English, Chinese, and Russian, and is available on the website. It has also been translated into Thai, Mongolian, and other languages and is used in many countries worldwide. In addition, simplified versions of the NCGG-HEPOP® called "Anytime HEPOP®" and "Anywhere HEPOP®" for young people engaged in remote work are also available on the website, and can be used by anyone, anywhere through the website.

ONLINE SALONE APP

Before the spread of COVID-19, more than 100,000 activity groups existed for older people in "salones" throughout Japan that aimed to prevent disability in older people; however, many of these "salones" refrained from activities and closed to prevent infection. Although some of the groups have recently resumed activities, they have not yet fully resumed their activities, and it was feared that the decline in physical activity would lead to a deterioration in the need for nursing care and a loss of community ties. To address this concern, the NCGG developed and is providing free of charge an application for smartphones, the "Online Salone App," which contributes to the prevention of disability by promoting the activities of older people (25). The application was designed to raise health awareness by providing information on health maintenance to older people who spend more time at home, and to provide activities that complement conventional face-to-face visitation through hands-on content. The main functions of the system include the automatic creation of walking courses to promote going out, assignment of points for going out, and visualization of the amount of activity, which are designed to increase physical activity by going out. The system also includes "Cognicise" (26), a brain-activating game, and the NCGG-HEPOP to prevent dementia as activities that can be done at home, so that users can freely browse and use the exercise programs they need. A survey of the number of accesses to the website from October 1, 2020, when the website was opened, to November 17, 2021, showed that the website was widely used, with 3,020 accesses from medical, welfare and administrative personnel and 1,200 accesses from general users (539 males, 646 females, and 15 others).

TELEREHABILITATION

The demand for telerehabilitation has increased rapidly in the wake of the COVID-19 pandemic. Studies have also reported on interventions aimed at balancing infection control and rehearsal (27, 28) and the usefulness of methods of rehabilitation by specialists consulting remotely and providing advice to local staff (29). Mukaino et al. developed a telerehabilitation system combining existing commercial equipment and computer applications for patients isolated in private rooms due to COVID-19. They reported that a physical therapist was able to conduct a real-time exercise instruction program via video call without direct

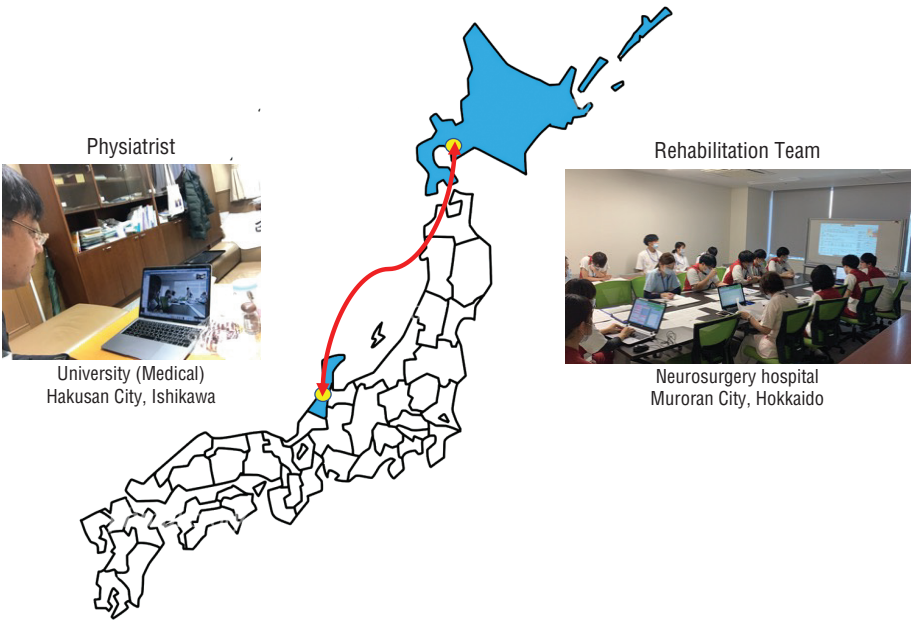


Figure 3. The Remote Rehabilitation Conference. The neurosurgery hospital in Muroran, Hokkaido is located more than 1,000 km away from the university in Hakusan, Ishikawa, where the rehab doctor is located.

assistance (27). Maeshima et al. also reported on the implementation of a remote rehabilitation conference using a web conferencing tool because the pandemic made it difficult to travel between regions by air. The treatment plan and problems of the entire ward were shared through electronic media and the Internet even at a distance of more than 1000 km (Figure 3). The staff also regularly conducted detailed and objective evaluations to share information at a distance, which led to more careful evaluations and treatment. Moreover, staff began to speak more at conferences and participate more actively and voluntarily in discussions regarding patient treatment plans (29).

These telerehabilitation systems have long been considered a countermeasure for uneven distributions of medical specialists and regional medical care in aging societies; however, the changes in social conditions caused by COVID-19 have increased the need for them all at once. Thus, there is a need for early system development and dissemination.

CONCLUSION

This chapter provides an overview of digital health and Japan's efforts to use it to promote healthy aging in older people. The recent COVID-19 pandemic has reminded us of the challenges and prospects of digital health. Moreover, it has

reaffirmed the importance of making tests and treatments available to those who need them when they need them, and quickly collecting and analyzing data. Although one solution to this problem is digital health, the methodology and systems have not yet been fully developed. Many issues need to be addressed, such as infrastructure development and raising awareness of digital health literacy, especially for older people and in low- and middle-income countries. However, the shortage of human resources due to population aging and the shortage and uneven distribution of manpower to respond to the growing demand for medical and nursing care are challenges those other countries are facing. The spread and utilization of digital health are expected not only in medical care and rehabilitation of older people but also in lifestyle guidance and community activities to extend healthy life expectancy. Technology should be developed, and systems introduced and utilized cost-effectively to ensure quality and improve productivity in medical and nursing care settings.

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REFERENCES

1. World Health Organization. Life expectancy and healthy life expectancy data by country. https://apps.who.int/gho/data/view.main.SDG2016LEXv?lang=en (Accessed: December 21, 2021)
2. Cabinet Office Japan. Annual Report on the Aging Society 2021. FY 2021. https://www8.cao.go.jp/kourei/whitepaper/w-2021/zenbun/pdf/1s1s_01.pdf (Accessed: December 20, 2021)
3. Widmer RJ, Collins NM, Collins CS, West CP, Lerman LO, Lerman A. Digital health interventions for the prevention of cardiovascular disease: a systematic review and meta-analysis. Mayo Clinic Proceedings. 2015;90(4):469–80. https://doi.org/10.1016/j.mayocp.2014.12.026
4. World Health Organization. Digital Health. https://www.who.int/health-topics/digital-health#tab=tab_1 (Accessed: December 16, 2021)
5. O'donoghue J, Herbert J. Data management within mHealth environments: Patient sensors, mobile devices, and databases. Journal of Data and Information Quality. 2012;4(1):1–20. https://doi.org/10.1145/2378016.2378021
6. Ministry of Health Labour and Welfare. 8th Data-based Health Management Initiatives. Jun 4, 2021. https://www.mhlw.go.jp/english/policy/health-medical/data-based-health/index.html [in Japanese] (Accessed: December 18, 2021)
7. Ministry of Health Labour and Welfare. 6th Data-based health management initiatives. Sept 9, 2019 https://www.mhlw.go.jp/content/10808000/000613014.pdf [in Japanese] (Accessed: December 23, 2021)
8. The Cabinet Office. Basic policy for economic and financial management and reform 2020. https://www5.cao.go.jp/keizai-shimon/kaigi/cabinet/2020/2020_basicpolicies_ja.pdf [in Japanese] (Accessed: December 23, 2021)
9. Maeshima S, Osawa A, Nishio D, Hirano Y, Takeda K, Kigawa H, et al. Efficacy of a hybrid assistive limb in post-stroke hemiplegic patients: a preliminary report. BMC Neurology 2011;11:1 16. https://doi.org/10.1186/1471-2377-11-116

10. Ozaki K, Kondo I, Hirano S, Kagaya H, Saitoh E, Osawa A, et al. Training with a balance exercise assist robot is more effective than conventional training for frail older adults. Geriatr Gerontol Int. 2017;17(11):1982–90. https://doi.org/10.1111/ggi.13009
11. Takano E, Ozaki K., Satoh, K. et al. Effects of a balance exercise assist robot on older patients with hip fracture: a preliminary study. J Med Biol Eng. 2020;40:783–9. https://doi.org/10.1007/s40846-020-00568-x
12. Takahashi K, Domen K, Sakamoto T, Toshima M, Otaka Y, Seto M. et al. Efficacy of upper extremity robotic therapy in subacute poststroke hemiplegia: an exploratory randomized trial. Stroke. 2016;47(5):1385–8. https://doi.org/10.1161/STROKEAHA.115.012520
13. Miyasaka H, Orand A, Ohnishi H, Tanino G, Takeda K, Sonoda S. Ability of electrical stimulation therapy to improve the effectiveness of robotic training for paretic upper limbs in patients with stroke. Med Eng Phys. 2016;38(11):1172–5. https://doi.org/10.1016/j.medengphy.2016.07.010
14. Takano E, Osawa A, Ueda I, Itoh N, Teranishi T, Kondo I. Trial of activity with a human-shaped robot for care recipients. Geriatr Gerontol Int 18, 1298–9. https://doi.org/10.1111/ggi.13442
15. Ministry of Health Labour and Welfare. What's a care robot? https://www.mhlw.go.jp/file/06-Seisaku-jouhou-12300000-Roukenkyoku/0000210895.pdf [in Japanese] (Accessed: December 21, 2021)
16. Ministry of Health Labour and Welfare. Promotion of the development and diffusion of nursing care robots. https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000209634.html [in Japanese] (Accessed: December 23, 2021)
17. Ruan S. Likelihood of survival of coronavirus disease 2019. Lancet Infect Dis. 2020;20:630–1. https://doi.org/10.1016/S1473-3099(20)30257-7
18. Onder G, Rezza G, Brusaferro S. Care-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. JAMA. 2020;323:1775–6. https://doi.org/10.1001/jama.2020.4683
19. The Japan Geriatrics Society. COVID-19, practice caution for older people. https://www.jpn-geriat-soc.or.jp/en/covid/, Mar 13, 2020. [Accessed: 2021-12-18]
20. Lim WS, Liang C-K, Assantachai P, Auyeung TW, Kang L, Lee W-J, et al. COVID-19 and older people in Asia: Asian Working Group for Sarcopenia calls to action. Geriatr Gerontol Int. 2020;20:547–58. https://doi.org/10.1111/ggi.13939
21. Kawamura K, Kamiya M, Suzumura S, Maki K, Ueda, I, Itoh N, et al. Impact of the coronavirus disease 2019 outbreak on activity and exercise levels among older patients. J Nutr Health Aging. 2021;25:921–5. https://doi.org/10.1007/s12603-021-1648-9
22. World Health Organization. Global action plan on physical activity 2018–2030: more active people for a healthier world. Geneva: World Health Organization, 2018.
23. Osawa A, Maeshima S, Kondo I, Arai H. Balancing infection control and frailty prevention during and after the COVID-19 pandemic: Introduction of the NCGG Home Exercise Program for Older People 2020. Geriatr Gerontol Int. 2020;20:846–8. https://doi.org/10.1111/ggi.13991
24. Kamiya A, Noguchi M, Kibayashi T, Maeshima S, Osawa A, Arai H. Video demonstrating NCGG-HEPOP 2020 exercises for older adults. Geriatr Gerontol Int. 2021;21:871–2. https://doi.org/10.1111/ggi.14241
25. Arai H. Online Passing Places App. https://www.ncgg.go.jp/ri/news/20200605.html. Jun 5, 2020 [in Japanese] (Accessed: December 23, 2021)
26. Shimada H, Makizako H, Doi T, Yoshida D, Tsutsumimoto K, Anan Y, et al. Combined prevalence of frailty and mild cognitive impairment in a population of elderly Japanese people. J Am Med Dir Assoc. 2013;14:518–24. https://doi.org/10.1016/j.jamda.2013.03.010
27. Mukaino M, Tatemoto T, Kumazawa N, Tanabe S, Katoh M, Saitoh E, et al. Staying active in isolation: Telerehabilitation for individuals with the SARS-CoV-2 infection. Am J Phys Med Rehabil. 2020;99:478–9. https://doi.org/10.1097/PHM.0000000000001441
28. Winters JM. Telerehabilitation research: emerging opportunities. Annu Rev Biomed Eng. 2002;4:287–320. https://doi.org/10.1146/annurev.bioeng.4.112801.121923
29. Maeshima S, Tamiya T, Saeki T, Ohkawara M, Osakabe M, Take Y, et al. Remote rehabilitation conferences in the age of SARS- CoV-2. Am J Phys Med Rehab 2020;99:783. https://doi.org/10.1097/PHM.0000000000001498