



The current state and future of internet technology-based hypertension management in Japan

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Abstract

Internet-based information and communication technology is altering our lives. Although medicine is traditionally conservative, it can benefit in many ways from adopting new technology and styles of care. Hypertension is a prime condition for the practical application of digital health management because it is prevalent and undercontrolled, and its primary index, home blood pressure, can be effectively telemonitored. Compared to other conditions that require laboratory measures or the use of drugs with frequent side effects, hypertension can be managed without actual office visits with sufficiently low risk. In this review of hypertension in Japan, we discuss the current and somewhat fragmented state of internet technology and the components and processes necessary for smooth, integrated, and multidisciplinary care in the future. Although further clinical trials are required to show the safety and efficacy of information and communication technology-based care for hypertension, the deployment of telemonitoring and telemedicine in daily practice should be expedited to solve the hypertension paradox. Challenges remain relating to cost, data integration, the redesigning of team-based care, and the improvement of user experience, but information and communication technology-based hypertension management is sure to become pivotal in improving public health.

Keywords Information and communication technology (ICT) · Telemonitoring · Telemedicine (TM)

Introduction

Hypertension is prevalent, underrecognized, and undertreated. Worldwide, 1.13 billion people have hypertension [1], and in Japan, there are an estimated 43 million people with hypertension. Of those, fewer than one in four have their blood pressure (BP) under control [2, 3], and the rate may be even lower when we consider the tightened therapeutic target of less than 130/80 mmHg for most patients [2]. In Japan and around the world, unconventional measures must be taken to solve the “hypertension paradox” [4], and the key to doing so may be digital information and communication technology (ICT).

This change is apparent in the digital transformation occurring in other industries and services. Now, we can smoothly transfer money, purchase goods, or watch

our favorite movies with a tablet/PC. Why can this continuous progress in ICT not be applied to the mounting problem of patients with untreated and undertreated high BP [5, 6]?

Managing BP with ICT is still in the early phase of development, where we have a vague idea of ICT-based BP management, and the necessary components are being tested separately but without a unifying scheme. For example, in all major hypertension guidelines, home blood pressure (HBP) measurement is now preferred over office BP measurement [2, 7, 8]. Reliable, easy-to-use, and automated oscillometric BP sphygmomanometers entered the market during the mid-1980s, and trials on the remote transmission of HBP started as early as the 1990s. However, BP telemonitoring has mostly been used in clinical trials and has not been commonly adopted for regular practice. As of 2020, over 100 apps appear when searching for “BP” (in Japanese) in the Apple App Store. HBP recording apps are becoming increasingly common, but their display formats vary, and the utility of app-recorded HBP is still limited in general clinical practice.

Although the components necessary for ICT-based BP management may still be separate and fragmented, we have reached the prime time for the deployment, implementation,

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and widespread adoption of ICT-based hypertension management. Considering the related social and economic factors and technical and academic concerns is crucial for solving the hypertension paradox through ICT. Patients' actions and choices depend largely on costs, such as those of national health insurance, accessibility, including exposure to the program in internet searches, and the user interface and experience. This review will discuss the current position and future of ICT use for optimizing hypertension treatment, particularly in Japan.

Existing narrative around ICT use to control hypertension

HBP measurement and telemonitoring

Current and future BP management using ICT starts with self-measured HBP. In the out-of-office setting, the self-measurement of blood pressure (SMBP) is valuable for BP assessment to diagnose white-coat, masked, or sustained hypertension. Since the Ohasama study in 1998 first demonstrated HBP as a more reliable predictor of outcomes than screening or office BP [9, 10], clinical evidence has grown on the relationship between HBP and cardiovascular disease (CVD) [11–15]. HBP has also been shown to be very reproducible [16, 17].

HBP is instrumental in following the day-to-day, seasonal, and intervention-responsive BP changes in an individual; however, there are some caveats regarding the measurement and reporting of SMBP [18]. The reliability of HBP measurements depends largely on the patient, as he/she is responsible for device selection, posture, timing, condition, and recording/reporting of the measurements. In the current widespread practice of assessing HBP via patient-recorded diaries, more needs to be done to ensure that patients are using an appropriate upper-arm cuff device in a sitting position to measure HBP in the morning before eating and in the evening, with two or more measurements on each occasion, reporting all recorded values, and calculating the mean BP values from the measurements taken five or more days per week, as recommended. App-based BP telemonitoring can help with and ensure, as well as allows for knowledge sharing about, the correct methods for BP measurement. The date and time of measurements are automatically recorded and transmitted with BP values. We have developed an app that displays instructional slides before every HBP measurement and transmission to remind patients of the recommended measurement methods. With handwritten BP diaries, patients often report the best BP value after measuring several times in one sitting, but with the use of an electronic recording and transmission system, all measured values will likely be reported. Moreover, an ICT-based approach eliminates the

problem of illegible handwriting and produces structured data, increasing the feasibility of downstream analysis.

Technical aspects of BP telemonitoring

Data recording, transmission, and display are essential technical aspects of BP telemonitoring. As technology has advanced, mainstream BP transmission has transitioned from using telephone lines to 3G internet to WiFi Bluetooth connections. An ideal BP telemonitoring device will only need to identify the patient, measure his/her BP, and then transmit the measured values automatically, without the patient needing to press other buttons or take out his/her smartphone. In this respect, an electric sphygmomanometer with fully automated data transfer through a 3G wireless network, HEM-7251G (Omron Healthcare, Kyoto, Japan), provided a nearly ideal patient–device interface, but the service of its BP management system, MedicalLink, ended in March 2019.

With the widespread adoption of smartphones, numerous healthcare-related apps *have become available*. Currently, the functions of most BP-related apps are limited to recording and displaying measured BP values, with some apps having data transmission and server storage functions. BP input methods for apps vary, including keying numbers, uploading photographs of BP values displayed on the device, and the automated transmission of variables using Bluetooth-equipped sphygmomanometers. Some sphygmomanometers can collect and transmit environmental data, such as room temperature, humidity, and luminance, in addition to the essential date, time, and BP values. For example, Omron HEM-7251G recorded room temperature at the time of BP measurement, and the analysis of BP values with room temperature allowed for a clear presentation of the seasonal variation in HBP [19, 20].

Data analysis and output, in addition to the modes of BP input and data transmission, are important factors influencing the utility of measured values. Unfortunately, many current BP recording apps can only display results on the patient's smartphone, requiring caregivers to type in the recorded or app-analyzed values when they want to note the measured HBP. We also surmise that because there is no unified display format, clinical staff often face the challenge of having to decipher the true BP state from an app within the limited time frame of an outpatient interview. Certainly, there will be technological advances in this area, and the upcoming technologies relating to BP recording, transmission, and display will be discussed later.

Current evidence on BP telemonitoring, professional advice, and intervention

SMBP, by increasing awareness and adherence, may improve BP management [21, 22]; moreover, BP telemonitoring, the

appropriate interpretation of HBP, advice on behavioral changes, and intervention may lead to further improvements. Using an individual patient data meta-analysis, Tucker et al. concluded that self-monitoring alone was not significantly associated with lower BP, but self-monitoring combined with cointerventions, such as medication titration, education, or lifestyle counseling, led to a significant reduction in BP [23]. Using a similar method, Sheppard et al. investigated the effects of comorbidities and the intensity of intervention and found that in patients with obesity or possibly stroke, intense interventions were more effective than low-intensity interventions [24].

HBP telemonitoring is an efficient way to obtain essential BP information on which to base other interventions and will be necessary for establishing a practical and sustainable model of hypertension telemedicine (TM). For example, HBP telemonitoring combined with management by a pharmacist achieved better BP control than did usual care (UC), with an ~10 mmHg lower systolic BP in the intervention group than in the control group at 12 months [25]. There have been reports that better BP control was achieved only by combining BP telemonitoring with measures to assist patient behavior. Logan et al. reported that HBP telemonitoring alone did not significantly reduce mean daytime ambulatory systolic BP at 1 year; however, telemonitoring combined with automated self-care support lowered systolic BP by 9.1 mmHg in diabetic patients with uncontrolled systolic blood pressure (SBP), without the use of more or different antihypertensive medications [26].

A combination of telecommunication for lifestyle modification and the telemonitoring of HBP may provide better control of hypertension. Automated, evidence-based clinical algorithms developed by hypertension experts have been demonstrated to improve BP control [27, 28]. However, a few reports mention that remote HBP monitoring has limited value and seems not to be superior to ordinary care in terms of avoiding cardiovascular events [29]. In addition, the TASMINH4 trial showed that SMBP-based practice in subjects with poorly controlled BP led to a significantly lower BP compared to the clinic BP reading, but there was no difference in the BP achieved between the transmission of the SMBP report by mail and that by telemonitoring [30]. Additional studies are needed to provide more reliable information about the effectiveness of HBP telemonitoring in preventing CVD. A recent review discussed the state of evidence on HBP telemonitoring [31].

App- and internet-based approaches to induce changes in behavior

Lifestyle changes, such as improving dietary patterns and exercise, are the mainstay of antihypertensive intervention. The effectiveness of an ICT-based approach for other

metabolic conditions, such as obesity and diabetes, has been reported [32–34]. Apps for smoking cessation are supported by clinical evidence, and there are at least two such apps and a service that are supported by high-quality evidence [35, 36]. In Japan, CureApp Inc. reported that the efficacy of an app delivered, TM-based smoking cessation program was not inferior to that of a standard face-to-face program [37].

For hypertension, there are many apps that offer lifestyle advice [38]. Those with eating habits include DASH Mobile, an app that helps people adhere to dietary approaches to stop hypertension [39]. As a modern drug-adherence solution, Frias et al. reported on the use of digital medicines, which are medications taken with an ingestible sensor, wearable sensor patches to detect medicine ingestion, or a mobile app to manage dose-by-dose feedback [40]. Online video content can also be a source of patient education. Kumar et al. showed that the majority of hypertension-related videos on YouTube were useful; however, 33% of videos were classified as misleading, and videos by individuals with unknown credentials had only a 21% probability of being considered useful; interestingly, useful videos had a significantly lower number of views per day and “likes” [41]. Smartphone apps and content can aid hypertension management [42], but the digital literacy of the patients and the development of apps and systems that can respond flexibly to patients’ diverse support needs are key to fully utilizing the potential of digital technology for self-management of hypertension.

Team-based care

Antihypertensive intervention can be carried out by a variety of health-related professionals. For the telehealth management of hypertension, multidisciplinary, team-based care is most successful [43]. The role of pharmacists in improving clinical outcomes in hypertension has been documented [44, 45]. Randomized controlled trials have shown that HBP telemonitoring combined with pharmacist care lowered BP [25, 46–48]. *It has been reported that HBP telemonitoring paired with care management by nurses improved BP control [49].*

However, the variance in study settings should be noted. For example, in the TASMINH2 trial, participants were willing to self-manage hypertension, which consisted of not only HBP self-monitoring but also self-titration, resulting in a significantly lower SBP in the self-management group [50, 51]. As some of the studies were performed in countries where pharmacists or nurses can recommend or perform changes in prescriptions, the findings may not be immediately applicable to Japan, where, at least currently, changes in medications require consultation with a physician. To achieve the maximum benefit, the intensity and

content of medical staff intervention needs to be optimized for the particular region's state of medical service.

To visit or not to visit—issues of online medicine in Japan in terms of legislation and insurance coverage

The use of TM or online medicine in Japan is influenced by regulations and insurance coverage, and over the last 30 years, there have been incremental changes in online health and TM-related legislation in Japan (Table 1). Basic physician activities in Japan are governed by Article 20 of the Medical Practitioner's Act, which states that “no medical practitioner shall provide medical care or issue a medical certificate or prescription without personally performing an examination.” In 1997, in its “medical examinations applying ICT” notice, the Ministry of Health, Labor and Welfare (MHLW) outlined key points on TM as a “medical examination using TM” The letter described sample cases, and it was assumed that TM would only target clinically stable patients with difficulty accessing clinics, such as those living in remote, isolated areas. In 2015, there was a seminal announcement by the MHLW that the cases described in the 1997 letter were only “examples,” and TM is permitted in other situations. With the Japanese universal national health insurance system at the time, clinics could claim only 730 Japanese Yen (JPY) for re-examination by telephone or other non-face-to-face methods. This led to some clinics charging an expensive “appointment fee,” in part to cover chronic disease management fees that could be claimed on actual office visits.

In 2017, an announcement came that non-face-to-face medical examinations and prescriptions did not violate Article 20 if sufficient information on health status could be collected without direct physical contact, such as for smoking cessation consultations and in cases where the patient's circumstances prevented a face-to-face visit.

In 2018, after a regular biannual medical service fee evaluation by the MHLW, an “online examination fee” was

introduced. Although the online examination fee of 1700 JPY could be claimed for online medicine, this was priced lower than the management fee for an office visit. In addition, strict restrictions were placed on claiming online examination fees: patients should be able to physically reach the clinic within 30 min when necessary; the same doctor needed to see the patient face-to-face for at least 6 months before starting online examinations; and even after starting online examinations, patients needed to visit the clinic at least every 3 months. This hampered the adoption of insurance-covered TM in Japan, and the number of insurance claims for online examinations numbered only several hundred per year nationally.

After the 2017 MHLW announcement, very few clinical trials on hypertensive TM were conducted in Japan, one of which was the paradigm of antihypertensive therapy along with TM, a randomized (POATRAN) trial (in submission). In this study, uncomplicated hypertensive patients were recruited through web advertisements, screened, stratified by office SBP, and randomized into UC and TM groups. The TM group used network-attached home BP monitoring devices, consulted physicians through virtual visits, and received prescriptions by mail for 1 year. The UC group used the same BP monitoring devices but were managed using self-recorded BP, such as recording in diaries, and with actual office visits. In those who completed the 1-year observation period (TM: $n = 48$, UC: $u = 46$), the average SBP during the last week was significantly lower by 6 mmHg in the TM group (125 ± 9 mmHg vs. 131 ± 12 mmHg). Worldwide, there have been many reports describing the advantage of ICT-based hypertension care, including HBP monitoring and TM [52–55].

In Japan, telemedEASE is now providing an all-in-one app that enables video chat and appointment and prescription management and features a cashless payment system to manage hypertension. Future apps should have a system that can respond flexibly to the diverse needs of patients in self-managing their hypertension.

Table 1 Timeline of events related to hypertension telemedicine in Japan

Year	Event
1997	The Ministry of Health, Labor and Welfare (MHLW) outlined key points on telemedicine.
1997–2004	Major guidelines (JNC-VI, JNC-7, WHO/ISH, JSH, ESH-ESC) pointed to the importance of self-monitoring of blood pressure at home.
2012–2019	MedicalLink blood pressure telemonitoring system was provided by Omron.
2015	A letter from the MHLW referred to the 1997 letter and stated that telemedicine to be used in remote areas with scarcity of physicians was an example, essentially allowing the use of telehealth in all areas of Japan.
2017	Online medicine or telemedicine does not violate Article 20 if sufficient health information on the patient's physical or mental status can be gained or actual visit was not possible for reasons on the patient's side.
2020	COVID-19 related changes on insurance-covered online medicine allowed the initial patient-physician contact to be performed online.

Deployment, implementation, and adoption of ICT to control hypertension

From the academic to implementation phase

Meta-analyses, including Cochrane database systematic reviews, have shown that BP telemonitoring improves control [56, 57]. Four out of seven high-quality digital intervention trials have shown significantly greater BP reduction, and overall, digital intervention significantly reduces SBP by -3.74 mmHg [58]. A meta-analysis by Liu et al. included 13 trials and provided evidence of BP reduction with internet-based interventions, such as e-counseling [59].

The current evidence suggests that enough of an academic base has been established to move on to the real-world deployment and implementation phase of anti-hypertensive TM. Similar to postmarketing studies on novel drugs, new services should be put into the market to move through a lean and/or agile product cycle. At this phase, placing systems in action and later performing retrospective analyses may be more fruitful than using extensive resources for designing and conducting prospective studies. With the current pace of digital transformation, that which seems barely feasible now may become the norm in only months.

As discussed, the elements of antihypertensive eHealth have largely been developed separately, and for a system to be embraced by users, it needs to provide the necessary components seamlessly, with the least stress on users. Some of the challenges that must be overcome include technology, cost-effectiveness, data integration among multiple points of care, social systems, health insurance coverage, legal issues, and software development.

Current and future technology

BP is affected by many factors, and information on these factors is necessary to provide optimal hypertension management. Smooth communication among patients and members of the care team and the collection of data from multiple devices are necessary, and technological advancement in these areas is anticipated in the near future. The internet of things (IoT) would allow not only the sphygmomanometer but also devices such as body weight scales, pedometers, and activity monitoring devices to be connected to the internet for integrated data management and interpretation. In an environment with multiple IoT sensor-equipped devices, the installation of an IoT gateway would help simplify the system by collecting data from multiple devices and transmitting the received information to the server. In addition to wired and light-speed internet connections, improved and faster wireless 5G connections

will soon be available in more areas. Patient communication using video chat systems will be improved by faster and higher-volume internet connections, and the transmission of more data from sensors, such as pulse wave data from sphygmomanometers, instead of only analyzed values, may lead to a better understanding and analysis of patient conditions.

Cost-effectiveness analysis

To accelerate the deployment of ICT-based hypertension care, its cost-effectiveness must be addressed. Hypertension management has been shown to be cost effective in reducing cardiovascular mortality and morbidity [60, 61]. The self-monitoring of HBP has also been shown to be cost effective [62], and the cost-effectiveness of ICT-based hypertension care has been examined in several reports [63]. In a randomized controlled trial that compared UC, HBP monitoring alone, and HBP telemonitoring with web-based pharmacist care, web-based care with HBP telemonitoring was shown to be cost effective, with an incremental cost of nearly \$2000 per quality-adjusted life year (QALY) [64]. Using data from the TASMINH4 trial, Monahan et al. investigated the cost-effectiveness of physician titration of antihypertensive medication using telemonitored HBP, self-monitored BP without telemonitoring, or UC [62]. At a willingness to pay £20,000 per QALY, self-monitoring plus telemonitoring was the most cost effective strategy (£17,424 per QALY), but the superiority of telemonitoring or self-monitoring alone depended on the type of analysis and assumptions [62].

It needs to be kept in mind that in the future, the cost of taking internet-based approaches will decrease [65]. IoT devices are supported by low-cost connections for data transmission. The digital transformation of hypertension care may provide substantial value, as the dissemination of technology reduces necessary costs.

BP telemonitoring and hypertension TM in different populations, including developing countries

ICT-based approaches for hypertension can benefit different populations and population subsets worldwide. BP telemonitoring has been shown to be feasible in children [66] and postpartum women [67]. Because reliable office BP measurements are more difficult to take in children than in adults, BP can change dynamically during pregnancy and the postpartum period, and visiting a physician's office can be a great source of stress for children and pregnant/postpartum women; ICT-based hypertension management may especially benefit these population subsets.

Patient demographics can greatly influence the effectiveness of ICT-based care. Differences in response to ICT-

based care have been reported by age [68–72], sex [68, 72], race [71–73], income [71, 72, 74], residential area [29, 74, 75], education [76], and technological literacy [77]. As these factors can lead to dissatisfaction or the discontinuation of treatment, it is important to consider the patient–provider communication gap to tailor service to the needs of patients [68, 73].

Digital transformation in healthcare is now accelerating in many developing countries. The rate of smartphone ownership is generally high, at 74.9% for patients in Ecuador [76]. In South Africa, an automated adherence support program delivered by short message service lowered SBP compared to UC [53]. These ICT-based approaches for controlling hypertension may be effective in low- and middle-income countries [78], and Muller et al. reported that a total of 15 studies conducted in 12 developing countries, Spain, South Africa, India, Iran, China, the Philippines, Turkey, Brazil, Thailand, Pakistan, Malaysia, and Guatemala, demonstrated the effectiveness of ICT-based interventions for controlling hypertension [79]. In some developing countries, digital transformation may come at a faster pace than in developed countries, as technology already exists when the infrastructure becomes available. The mode and speed of deployment, implementation, and adaptation of internet-based technology reflect the culture, legislation, and economy of the region. In the next section, we will take a look at Japan.

Management of health-related data in Japan and future data integration

Previously, we covered some historical background on the Japanese universal health insurance system and TM-related legislation. Another important factor that enables the smooth execution of TM is data flow. To perform TM, a patient's data need to be shared among healthcare service providers and with the patient. During a TM interview, communication is limited to audio and video, and some types of information, such as the patient's manner of walking into the office, are unobtainable. To compensate for these disadvantages and to deliver an optimal clinical decision, it is necessary to collect as much relevant information as possible, such as patient background, the state of comorbidities, medications, and lifestyle. Today, the primary means of collecting information is to have a patient fill out a questionnaire or to directly ask the patient questions during an online session, which can be time-consuming and not necessarily accurate. Although this pertains not only to TM but also to current medical interviews in general, improved health data portability and the evolution of personal-health records (PHRs) would greatly benefit the way in which online medicine is practiced.

A PHR is a health record where data are maintained by the patient. In terms of current hypertension management, BP diaries and medication booklets are examples of paper-based PHRs. PHRs in Japan are evolving, but there is a long road ahead. PHRs need to become electronic, integrated, and, preferably, curated to be truly useful. More precise HBP assessment and management can be achieved if BP data are digital, have been analyzed for the necessary parameters, such as morning and evening averages, and have been integrated into electronic medical records. In the United States, there are systems where a patient's HBP data are incorporated directly into the electronic health records of the clinic or hospital. An example of a patient resource for PHRs (<https://www.mayoclinic.org/healthy-lifestyle/consumer-health/in-depth/personal-health-record/art-20047273>) describes PHRs and patient portals as powerful tools. A patient portal usually has information, such as appointment reminders, medication lists, and appointment summaries, sometimes with associated educational material, secure messaging with the provider, and test results. The transition to electronic PHRs is supported by the US government, as evident given its promotion of the “blue button,” a US government-initiated movement in which a patient can download his/her health data in a usable format. The widespread use of patient portals may be possible in the USA because healthcare providers and insurance companies often comprise an associated health network system, where data and resources are shared, and patients are referred within the system. Patient portals are not yet common in Japan, as setting one up places a financial burden on the clinic.

When discussing PHRs, the portability of health records also comes into play. In the current Japanese healthcare system, healthcare-related data are mainly managed by the medical institution, and it is difficult for the patient himself or herself to obtain such information. When consulting or referring a patient, it is customary to attach some printed data, but it would only be a small subset of the whole picture. The lack of health record portability results in tremendous inefficiency, with duplicate testing, questioning, and prescriptions with overlapping indications. Political leadership may need to address these issues in a timely manner.

Certainly, there are drawbacks to using PHR, patient portals, and portable health data. Data security is one of the primary concerns regarding electronic data management. Security is of utmost importance, but there is no 100% safe system, and it may be about time that we take an acceptable risk to reap the benefits of digital health data portability. When patients have more health-related data at their fingertips, it will likely increase awareness and ease the discussion of options based on the data. There may come a time when a physician will only need to outline the reasons for a referral, and all the relevant data could be supplied by

patients. Nonetheless, an increase in the amount of information can cause stress for both patients and doctors. Patients would need help with correctly interpreting the information, and doctors would need comprehensive but digested summaries of patients that could be grasped within a limited amount of time. For these challenges, team-based care would provide the best solution.

The need for redesigned team-based care as an infrastructure

Team-based care was discussed previously, where we reviewed the results of clinical trials involving nurse- or pharmacist-driven medication management. Recent ideas about the management of chronic conditions encompass the use of a specialized integrated practice unit with non-physician personnel dedicated to specific disease conditions for the full cycle of care [47, 80]. This scheme is in line with the idea of value-based healthcare, a healthcare delivery model that is gaining acceptance worldwide. Value-based healthcare aims to maximize the value of healthcare by encouraging healthcare providers to compete on patient-centered results, and the value of healthcare is defined as health outcomes over associated costs for the whole cycle of care [81]. A digital hypertension management system can be designed to encourage team- and value-based healthcare.

In Japan, telemedEASE is providing service as a hypertension telehealth-specialized team to realize such practices, with nonphysician personnel tending to patients' needs, answering questions, providing educational information, summarizing patients' conditions and, when necessary, alerting physicians to set up supplementary appointments. In the future, online health support provided by care teams dedicated to specific disease conditions may become more common in Japan.

Apps and user experience

The possible functions of apps for hypertension care include HBP telemonitoring, data analysis and visualization, lifestyle management, medication adherence checking, self-titration, text/audio/video communication, and decision support systems for care providers. Apps for TM may also include a billing function. The apps will need to be easy to use for patients and staff, providing smooth, seamless access to the necessary functions.

Caveats for the widespread use of TM

There are certainly risks and caveats associated with ICT-based care. The primary concerns about telehealth are security and privacy, but miscommunication, technical difficulties, unclear placement of responsibility, and suboptimal quality of

care can also be issues. Some worry about patients being charged high fees for uninsured telehealth services. To encourage proper ICT-based care, sharing open and clear information is important because patients need information to select services that provide better care at a lower cost, and the success of these services will benefit both patients and society.

The Berlin Wall in health system regulations

In the beginning of 2020, the world was suddenly faced with the COVID-19 outbreak. Policies for social distancing to prevent the spread of the virus have increased the attention paid to online medicine as a solution. Facing this emergency, the MHLW permitted all hospitals and clinics to issue prescriptions via telephone interviews and online medicine, including initial consultation. Even with these changes, online medicine has not become widespread, partially owing to lower profits for clinics from TM compared to office visits. A call for faster changes due to these social circumstances will likely accelerate the digital transformation of healthcare, prompting the public and medical staff to adapt to new systems. Small family clinics may fear a reduction in their number of patients. It may take some time for legislative and insurance policies to adjust, but the needs of the population and necessary technology are there, and the movement toward digital hypertension management cannot be stopped.

Conclusions

Although further clinical trials are required to show the safety and efficacy of ICT-based hypertension care, the deployment of telemonitoring and TM in daily practice should be expedited to solve the hypertension paradox. There are still challenges associated with cost, data integration, the redesigning of team-based care, and the improvement of user experience, but ICT-based hypertension management is sure to become pivotal in improving future public health.

Compliance with ethical standards

Conflict of interest JY is an executive director of the General Incorporated Association of telemedEASE. MSY and AI have no conflicts of interest to disclose.

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