Digital Health: The Future Model of Detection and the Benefits of Behaviour Change Conversations to Improve Hypertension via Telemedicine

แบบจำลองสุขภาพเพื่อการวินิจฉัยและประโยชน์จากการสนทนาปรับเปลี่ยนพฤติกรรมในผู้ป่วยความดันโลหิตสูง ผ่านการแพทย์ทางไกล

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Abstract

Hypertension is a leading cause of cardiovascular disease, with high morbidity and mortality in adults around the world. During the COVID-19 pandemic, Digital health is a new alternative technology for blood pressure measurement by digital devices, improving the management of hypertension. Several researches have shown the benefit of digital health and behavior modification. This paper reviews the digital health approach in combination with doctor consultations and patient education. The goal is the establishment of effective digital platforms for self-monitoring and tele-monitoring of blood pressure. Patient education should be encouraged, and clinicians need to be supported in the early detection and effective management of hypertension via virtual clinics. The digital health approach, combined with artificial intelligence and behavior modification, can help physicians in the screening, detection and management of hypertension, reducing the risk of serious complications. In addition, wearable technologies or health applications can be used to manage hypertension, empowering people to manage their own condition. This article describes the importance of the aetiology of hypertension and risk factors in the improvement of hypertension. Conversation skills, technologies and knowledge are required to successfully manage hypertension. Digital health can be a novel approach for health promotion in Thailand and is currently available in private hospitals; in the near future, it needs to become more popular across Thailand. However, further research in Thailand is needed to improve technologies and standardize digital health intervention.

Keywords: digital health, hypertension, wearable electronic devices, behaviour modification, telemedicine

บทคัดย่อ

โรคความดันโลหิตสูงเป็นสาเหตุสำคัญของโรคหัวใจและหลอดเลือด มีอัตราป่วยและเสียชีวิตสูงทั่วโลก ในช่วงการระบาดของโคโรนาไวรัส สุขภาพดิจิทัลจึงเป็นเทคโนโลยีทางเลือกใหม่ เพื่อประเมินความดันโลหิตด้วยตนเองโดยใช้อุปกรณ์ดิจิทัล ในการดูแลผู้ป่วยความดันโลหิตสูง งานวิจัยหลายฉบับแสดงประโยชน์จากการใช้สุขภาพดิจิทัลและการปรับเปลี่ยนพฤติกรรม บทความนี้ได้ทบทวนแนวทางด้านสุขภาพดิจิทัล โดยการผสมผสานการให้แพทย์คำปรึกษาและการให้ความรู้แก่ผู้ป่วย เป้าหมาย คือ การจัดตั้งแพลตฟอร์มสุขภาพดิจิทัลที่มีประสิทธิภาพสำหรับการประเมินความดันโลหิตด้วยตนเอง (self-monitoring) และการประเมินผ่านทางไกล (tele-monitoring) ควรส่งเสริมความรู้เกี่ยวกับโรคแก่ผู้ป่วย และบุคลากรทางการแพทย์จำเป็นต้องสนับสนุนให้มีการวินิจฉัยโรคความดันโลหิตสูงเบื้องต้น และการดูแลผู้ป่วยความดันโลหิตสูงอย่างมีประสิทธิภาพผ่านคลินิกออนไลน์ (virtual clinics) แนวทางด้านสุขภาพแบบดิจิทัลที่ผสานกับเทคโนโลยีปัญญาประดิษฐ์ การปรับเปลี่ยนพฤติกรรม ซึ่งสามารถช่วยแพทย์ในการคัดกรอง การวินิจฉัย และการรักษาผู้ป่วยโรคความดันโลหิตสูง เพื่อลดความเสี่ยงจากภาวะแทรกซ้อนร้ายแรง นอกจากนี้ยังสามารถใช้เทคโนโลยีที่สวมใส่หรือแอปพลิเคชันด้านสุขภาพในการดูแลความดันโลหิตสูง ส่งเสริมให้ผู้คนสามารถดูแลสุขภาพด้วยตนเองได้ บทความนี้จะอธิบายถึงความสำคัญของสาเหตุการเกิดโรคความดันโลหิตสูง และปัจจัยเสี่ยงโรค ในการดูแลผู้ป่วยความดันโลหิตสูง ทักษะการสนทนากับผู้ป่วย เทคโนโลยี และความรู้ จึงมีความจำเป็นในการดูแลผู้ป่วยความดันโลหิตสูงให้ประสบความสำเร็จ สุขภาพดิจิทัลอาจเป็นแนวทางใหม่ในการส่งเสริมสุขภาพในประเทศไทย ปัจจุบันมีให้บริการในโรงพยาบาลเอกชน ในอนาคตอันใกล้จะต้องเป็นที่นิยมมากขึ้นทั่วประเทศไทย อย่างไรก็ตาม จำเป็นต้องมีการวิจัยเพิ่มเติมในประเทศไทยเพื่อพัฒนาเทคโนโลยี และสร้างมาตรฐานด้านสุขภาพแบบดิจิทัล

คำสำคัญ: สุขภาพดิจิทัล ความดันโลหิตสูง อุปกรณ์อิเล็กทรอนิกส์แบบสวมใส่ การปรับเปลี่ยนพฤติกรรม การแพทย์ทางไกล

Introduction

Digital health means the use of information and communication technologies in medicine and other health professions to manage illnesses and health risks (Ronquillo, Meyers & Korvek, 2022). Digital technologies are an integral part of daily life, and the world's population has never been more interconnected (Labrique, Agarwal & Tamrat, 2020). To apply digital technologies in hypertension management, a novel way of managing health is needed for hypertension management, such as through screening blood pressure, diagnosis, management, medical records and patient information. For example, during the COVID-19 pandemic, health education was part of a "virtual clinic", including changes in lifestyle practices, knowledge about the disease and health promotion for examples eating healthily including restriction of salt diets and fatty diets, maintaining a healthy weight, taking regular exercise, limit alcohol consumption, do not smoke and get enough sleep. Therefore, in the new era, digital health is an alternative choice for treating hypertensive patients and supports doctors in their consultations (Burnier et al., 2022).

The digital health approach can be used to manage patients and collect and share personal health information by using a range of medical

technology, including mobile health applications, electronic prescribing, electronic health records, telehealth, telemedicine, robotics and artificial intelligence (Hare, Chokshi & Adusumalli, 2021). How these may fit into future models of digital health is summarized in Figure 1.

According to recent reports, the global COVID-19 pandemic disrupted normal life and routine activities, such as doctors´ appointments. Hypertension is an important disease that requires long-term treatment (Tucker et al., 2017). The changing circumstances of the COVID-19 pandemic have resulted in substantial lifestyle changes. With more patients who do not want to bear the risk of traveling to the hospital, there may be some groups who cannot come to the hospital, resulting in less effective treatment and an increased risk for serious cardiovascular conditions (Citoni, Figliuzzi & Presta, 2002). Digital health is a service option that has enhanced the provision of medical services to meet the needs of users in line with the "New Normal" era and improved the management of health conditions, including the provision of health communication for patient convenience.

Understanding digital health

Digital health is a new information system of medical care delivery that uses an array of digital technologies to improve health systems. As global healthcare is currently gaining importance, the benefits of digital health can be used anytime and anywhere (NIHR Evidence National Health Research, 2022). This approach can reduce a number of visits, resulting in a decrease in a decrease in carbon emissions; increase patients engagement with less expensive, leading to empowers people to manage their own conditions (Figure 2).

The digital health approach can boost health and wellbeing and improves the health system. Virtual health care is cheaper than a visit to a face-to-face clinic and allows doctors to share electronic medical records in a private environment in both screening and detecting and controlling hypertension (Wang, Su, Zhang & Li, 2021).

The use of technology and innovation is an important part of enhancing the comprehensive provision of medical services. It relies on collaborations between agencies or organisations based on expertise, in addition to doctors and hospital personnel, such as tech start-ups, universities or research centres, together with stakeholders and government organisations. Above all, unforeseen factors, such as the COVID-19 pandemic, are major drivers of the development of the digital health approach (Australian Institute of Health & Welfare, 2022).

Smart technology as a tool to enhance the delivery of medical services will enhance the efficiency of services and treatments, with the goal of providing convenience and mobility to patients and covering all forms of treatments with the most accurate diagnosis (Kitt, Fox & Tucker, 2020). Examples of innovations and technologies implemented in digital health include improved diagnostic accuracy (Kario, Harada & Okura, 2022). Here, AI plays a role in increasing the accuracy of disease diagnosis. Telemedicine is applied when no doctor can be found. By offering online health consultations and treatments, doctors and patients can communicate in real time without having to visit the hospital.

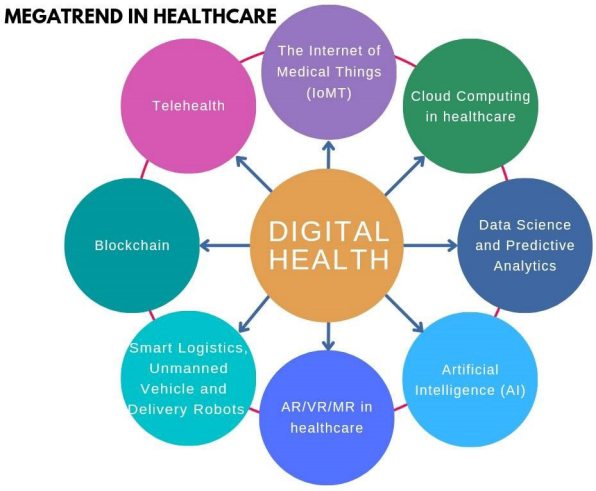

Figure 1. Overview of Megatrend in healthcare that will likely be relevant in the coming years in Thailand healthcare. A novel approach to individual management for hypertension such as The Internet of Medical Things (IoMT), telehealth, blockchain, cloud computing in healthcare, medical data science, and artificial intelligence

Note. From Provider-and Patient-Related Barriers to and Facilitators of Digital Health Technology Adoption for Hypertension Management: Scoping Review. by R. Palacholla, N. Fischer, A. Coleman, S. Agboola, K. Kirley, J. Felsted and K. Jethwani, (2019), *JMIR Cardio, 3*(1), p. e11951. Copyright 2019 by JMIR Publications

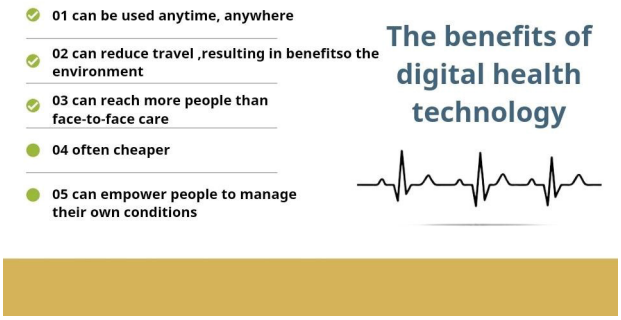

Figure 2. The advantages of digital health technology. The image demonstrates the enormous benefits of digital technology. It is convenient and can be used at any time and from any location. Virtual care can reach more people than face-to-face care and is frequently less expensive. It has the potential to empower people to manage their own conditions and even has environmental benefits, such as reduced travel and emissions. There are online diagnostic tools available, as well as programs that analyse data from medical devices such as blood pressure monitors

Note. From Integrating digital technologies and public health to fight Covid-19 Pandemic: Key technologies, applications, challenges and outlook of digital healthcare, by Q. Wang, M. Su, M. Zhang, and R. Li, 2021, *International Journal of Environmental Research and Public Health, 18*(11), pp. 578-588. Copyright 2021 by MDPI.

Digital health is important in the new era

The Australian Institute of Health and Welfare (2022) demonstrates that when used effectively, digital health can lead to better health and improved outcomes. It can also increase the quality and efficiency of information sharing across the health system, increasing health promotion via data information and services. In the UK, the USA and Japan, the digital health approach was increasingly being used for the management of hypertension during the COVID-19 pandemic.

Hypertension

Hypertension is a leading cause of cardiovascular disease, with high morbidity and mortality in adults worldwide (Kung & Xiu, 2015). It is an important non-communicable disease and the leading cause of death globally (Jagannathan, Patel, Ali & Narayan, 2019). In this condition, the blood pressure is extremely higher than 140/90 mmHg, damaging the blood vessels. The more blood the heart pumps and the narrower the arteries, the higher the blood pressure (Nichols & Edwards, 2001). Hypertension is diagnosed when the systolic blood pressure is equal to or above 140 mmHg and diastolic blood pressure equal to or above 90 mmHg (Williams et al., 2018). Combating hypertension is a key healthcare concern in Thailand, where approximately 21% of adults aged between 30 and 80 suffer from this condition (Aekplakorn et al., 2012). A person with hypertension is at higher risk of succumbing to a heart attack, renal failure, stroke and heart failure and more prone to cardiovascular disease (Botdorf, Chaudhary & Whaley-Connell, 2011). When not treated properly, the risk of developing diseases such as hemorrhagic stroke is increased. It can also result in brain hemorrhage, ischemic heart disease, heart attack, kidney failure, aorta aneurysm, among others (Rosendorff et al., 2007). Most people with high blood pressure are usually unaware of the disease (Theerapuncharoen & Theerapuncharoen, 2016). Once it was realized that most of them were not maintained, partly because most people are affected by asymptomatic causes. With symptoms or complications, attention and treatment begin, sometimes, with poor treatment results. To improve the health of hypertensive patients and prevent the development of cardiovascular diseases, their blood pressure must be kept under control, blood pressure less than 140/90 mmHg (Thaworn & Samruayruen, 2022). Hypertension is primarily a lifestyle disease, with habits such as smoking, excessive consumption of alcohol, poor dieting, physical dormancy, stress and obesity being the leading causative factors (Rai et al., 2017). In Thailand, some of the diet that is fatty, salty and full of cholesterol is common, especially when street food is consumed frequently (Persson & floodmark, 2017). Coupled with the fact that a majority of Thai people rarely exercise, their health is affected, and their quality of life is limited (Durukan et al., 2022).

Some traditional dishes across Thailand, from street vendors to high-end restaurants, have hypertensive effects (Rusmevichientong et al., 2021). Some Thai food is high in salt and sugar due to its many other ingredients, such as fish sauce, fermented fish, crabs with salt, palm sugar and salt-dried shrimp and high in fat (Photi et al., 2021).

A high-salt diet can increase hypertension (Chennet, Jom & Ladda, 2022). Previous studies indicate that behavioural and dietary changes, including salt restriction, quitting smoking, increased physical

exercise, appropriate body weight, a reduction in alcohol intake and lower stress levels, can reduce hypertension (Tan, Oka & Dambha, 2021). During the COVID-19 pandemic, medical experts and healthcare teams used pertinent information to assist hypertensive patients in effective treatment and management and to prevent hypertension in normal people via telemedicine. This can limit the occurrence of serious medical conditions such as a haemorrhage of the cerebral artery or ischemic heart disease, and the likelihood of paresis, paralysis or myocardial ischemia can be reduced by controlling normal blood pressure.

Aetiology of Hypertension

Over a billion people are diagnosed with hypertension. Primary hypertension accounts for 95% of the cases, whereas secondary hypertension is much less frequent. High blood pressure generally occurs without warning signs or symptoms. At least nine million people die each year from undiagnosed hypertension, which is also called "silent killer" because of its asymptomatic presentation. Undiagnosed hypertension patients suffer from risk of heart attack, heart failure, chest pain, strokes, aneurysms, cardiovascular disease and eye conditions. Therefore, early screening is necessary for a good prognosis of the treatment in hypertension patients. During the COVID-19 pandemic, the digital health approach helped to provide information and to make behaviour changes via telemedicine, preventing serious cases of undiagnosed hypertension.

The exact aetiology of primary hypertension remains unknown. However, recent studies demonstrated that several factors, including increased sympathetic nervous system activity, an overreaction of the rennin-angiotensin-aldosterone axis in the kidney and increased sodium retention play important roles in the aetiology of primary hypertension (Riet et al., 2015). In contrast, the aetiology of secondary hypertension is directly caused by other medical diseases, including renal failure, adrenal disease, kidney disease, pregnancy, hyperparathyroidism, sleep apnoea and other factors that affect the cardiovascular system, adrenal glands, kidneys or hormonal imbalance (Li, Heran & Wright, 2014).

Symptoms and Signs of Hypertension

Generally, hypertension is asymptomatic, but symptoms can include headache, facial flushing, dizziness and vision problems due to the damage of the optic nerve in untreated high blood pressure. Sudden dizziness, loss of balance or coordination and trouble walking are all warning signs of a stroke. High blood pressure is a leading risk factor for stroke. When symptoms do occur, they can include early morning headaches, nosebleeds, irregular heart rhythms, vision changes and buzzing in the ears. Severe hypertension can cause fatigue, nausea, vomiting, confusion, anxiety, chest pain and muscle tremors (McDonough, Matura & Carrol, 2011).

Behavioural changes related to practice to improve hypertension by telemedicine

Typical lifestyles risk factors related to hypertension are tobacco use, obesity, stress, unhealthy diet, physical inactivity and alcohol abuse.

1. Consumption of tobacco: Tobacco use increases the risk of high blood pressure. Smoking can

damage the heart and blood vessels, and nicotine raises blood pressure and carbon monoxide intake (Singh et al., 2022).

2. Consumption of alcohol: Alcohol abuse can result in increased blood pressure (Sun, Wang & Terry, 2022).

3. Unhealthy diets, such as excessive salt consumption, a diet high in saturated fat and trans fats, low intake of fruits and vegetables and a low potassium intake, increase the risk of high blood pressure. Potassium is found in many foods, such as bananas, potatoes, beans and yogurt, and consumption of these foods can mitigate high blood pressure (Durukan et al., 2022).

4. Lack of exercise or physical inactivity: Getting regular physical activity keeps the heart and blood vessels strong and healthy, which may help lower your blood pressure. Regular physical activity can also help maintain a healthy weight, which may also help lower the blood pressure (Hanssen et al., 2022).

5. Obesity: Obesity is defined as having excess body fat. Having obesity or being overweight also means the heart must work harder to pump blood and oxygen throughout the body. Over time, this can add stress to the heart and blood vessels (Andrew, Agbaje, Barker & Tuomainen, 2022).

6. Stress: The body releases a surge of hormones when under stress. These hormones cause the heart to beat faster and the blood vessels to narrow, resulting in increased blood pressure (Sparrenberger et al., 2022).

Telemedicine for hypertension during the COVID-19 pandemic in Thailand

Hypertension is mostly preventable and controllable. Without improvement in healthy lifestyle modification and behaviour change suffering from comorbidities, on the COVID pandemic has disrupted preventive care that barrier to management hypertension such as worsening mental health and unhealthy lifestyle, unhealthy eating and decreased physical activities. Behavioural modification and lifestyle changes can prevent and control high blood pressure (Akuiyibo et al., 2022).

Before applying digital health to improve hypertension. In 2020, the World Health Organization–WHO claimed that the World Health Assembly presents a roadmap to link the latest developments in innovation and digital health and put these tools to action to improve health outcomes. Not only virtual clinics and electronic prescription, Digital health can help make health systems more efficient and sustainable, enabling them to deliver good-quality, affordable and equitable care (World Health Organisation., 2020).

These high ideals are challenging to attain, especially for low and middle-income countries. The purpose of the WHO's Global Strategy on Digital Health is to support countries in strengthening their health systems through the application of digital health technologies and achieve the vision of "Health for All". The strategy is designed to be fit for purpose and for use by all member states, including those with limited access to digital technologies, goods and services.

In this sense, digital health is not limited to private or luxury hospitals. Although local and international governments around the world should develop standard digital health systems, cover equality WHO is harnessing the power of digital technologies and health innovation to accelerate global attainment of health and the well-being.

Doctors have an enhanced knowledge through scientific communities of practice: Enabled by new technologies and no longer limited by the need for physical meetings or hard copy peer review journals, the WHO brings together top expert voices on topics of clinical and public health significance, especially in the context of the COVID-19 pandemic.

The role of physicians in controlling blood pressure is the routine screening of blood pressure, the provision of education, the prescription of antihypertensive medication, the screening of stress factors during telemedicine, and the screening for other common comorbidities such as diabetic, cardiovascular conditions and renal conditions by evidence-based practices, along with adequate management, follow-up and, if needed, referral to the hospital.

Implementation of the digital health platform to improve hypertension.

A recent digital health research from the Oxford University demonstrates that digital health technologies, including smartphones and Bluetooth application to self-monitor blood pressure and detect early hypertension can be used to manage these conditions (Kitt et al., 2020). A systematic review of blood pressure self-monitoring, which included 22 trials and 6,522 participants, indicated an improvement of systolic blood pressure with an improved outcome of home BP since 2011 by the NICE guideline for mature hypertension treatment. This review also provided evidence that digital health can effectively manage the health of the general population.

A study performed in 2022 in Nigeria, "The effects of behavioural change communication on hypertension and diabetes related knowledge, attitude and practices in Nigeria" was based on interviews and questionnaires about lifestyle-related screening and awareness risk factors of hypertension, including continuous medication (Akuiyibo et al., 2022). Over 12 months, 824 participants claimed that significant changes in diet, lifestyle and behaviour resulted in a dramatic decrease in blood pressure and a reduction in serious cases of hypertension.

The study by the Oxford University in 2020 report that a low- salt diet and behavioural changes are needed to improve health education related to hypertension, particularly during the COVID-19 pandemic. Physicians and other health professionals can use digital health to collect medical histories of patients and prescribe medication, thereby controlling various diseases. Telemedicine can also be applied in the screening for non-communicable diseases during a pandemic (Kitt et al, 2020).

Regarding the application of international research in Thailand, in the near future, it will be possible to use digital platforms and scientific publications across the country and around the world. Thailand government policies support disease prevention and health promotion in primary healthcare.

Effective telemedicine with patients to reduce risk factors in the virtual clinic

Albury, Hall and Syed (2019) published a recent systematic review of 17,652 studies around the world, including the UK, USA, Canada and Australia. The authors report clinical guidelines to encourage patients to improve their health behaviours and state that weight management,

excessive alcohol consumption, lack of physical activity, overconsumption of salt and smoking are major causes of morbidity and chronic diseases. Regarding the communication with patients about Health Behaviour Change–HBC), the authors recommend that the clinicians should be make conversation by behaviour change talk is smoothly initiated, conducted, and terminated by clinicians and this rarely causes interactional difficulty (Albury et al., 2019). However, initiating conversations by linking a person's current health concern with their health behaviour can lead to resistance to advice, whereas other strategies, such as capitalising on patient-initiated discussions or collaborating through question-answer sequences, may be well received (Miller et al.,1993).

Case studies in this review showed that clinicians use two clear strategies for delivering HBC in both generalised and personalised health behaviour change conversation. These strategies, and the responses they were likely to receive, are explored below.

"Doctor: you smoke?

Patient: yes

Doctor: there are somethings you can do these days that really help with cutting down... with quitting.. cause that is really something you should think about

Patient: [5 sec silence]

Doctor: well.. . so. .. how're you getting along with the Tagamet so far? seems okay?

Patient: seems okay... no problem

Doctor: no problem... good."

(Freeman, 1987)

This review shows that there are different ways through which these conversations can be initiated and carried out, which can mitigate their sensitivity, such as delivering HBC in a general, non-personal way. We found evidence that is mostly consistent with current guidelines, providing further details on how they can be successfully implemented in practice. However, one practice recommended by clinical guidelines, namely initiating discussions by associating a patient's health concerns and their health behaviour, is potentially risky and can prompt patients to resist HBC.

On the other hand, building conversations collaboratively by inviting patients´ views and tailoring discussions through question-answer sequences may be well received and can facilitate patient receptivity (Miller et al.,1993). Clinicians can adapt themselves to the delicacy of giving advice that may have not been asked for by de-personalising it and talking 'in theory' or about people in general.

Clearly, accurate verbal communication can be effective in the management of hypertension, particular via telemedicine (Miller et al.,1993).

Evidence-based practice related to improving hypertension by digital health

Digital health technology tools can be applied to self-monitoring and tele-monitoring by home blood pressure monitor models, combined with telemedicine and behavioural change communication, for the screening and detection of hypertension.

Kitt et al. (2020) provide a guideline on the use of digital health in hypertension management and implementation, including screening, diagnosis, management and monitoring of mobile health

applications via telemedicine and virtual clinics.

A systematic review of the Oxford University and British National Clinical Guideline--NICE showed that the summarise all the process how to fit into future models of care for hypertension in Figure3 and can use a digital health template and telemedicine tools to apply in both screening and management in Thailand during pandemic and apply to local digital health guideline to care of hypertension.

The development of the digital health approach in home diagnosis and hypertension management in Thailand includes the following (Figure 4):

1. Technologies: social media, telemedicine, telehealth, IoMT (internet of medical things), Blockchain, data analysis, wearable, mobile health platforms, electronic medical records, artificial intelligence, big data, connected health, electronic medical records.

Small wearable devices/ Smartphone/ Tablet Apps: Blood Pressure measurement is an essential part of the diagnosis and management of hypertension. In Japan and the UK, small wearable devices for blood pressure monitoring allow an early diagnosis. Similar to the UK, using smartphone apps or Bluetooth to detect blood pressure Ambulatory Blood Pressure Monitoring (ABPM) and/or Home Blood Pressure Monitoring (HBPM) is recommended for the diagnosis of hypertension in major international guidelines. In general, blood pressure tends to be higher in the morning and lower at night. In Thailand, both small wearable devices or smartphone apps can assist the diagnosis of hypertension by clinicians.

Software packages can be used to analyse data from medical devices, improving health care systems.

2. Virtual Clinics: investigation by doctors and patients as well as high levels of adherence to telemonitoring. The use of telemedicine includes the confirmation of diagnosis, treatment, prognosis, disease management and behaviour modification. Along with increased knowledge and education, telemedicine can be used in the screening of renal function, retina, cardiovascular function for signs of target organ damage. By effective technique of conversation, before electronic prescribing and make doctor appointment. Security and privacy are important in the treatment and management tailored for each individual patient.

3. Supporting healthcare teams, inter-professional skills in leadership, conflict resolution, outcomes and patient privacy policy. To improve quality of care, decrease the costs of healthcare services and improve access to healthcare, reducing medication errors. Including computer skills and Information Technology (IT) technique supports for patients and doctors during virtual clinics.

Apply both Japan and the UK establishment of effective digital platforms for self-monitoring and tele-monitoring of blood pressure for the future model of detection and the benefits of behaviour change conversations to improve hypertension via telemedicine in Thailand. Both of these are discussed in more detail below (Figure 4).

In Thailand, telemedicine was used to carry out the three steps for establishing effective digital platforms for self-monitoring and tele-monitoring of blood pressure at home, as well as the guidelines on the use of digital health screening and behavioural modification to control hypertension in both screenings for the early detection and effective management of hypertension. This guideline link between patients, doctors, and patient families uses a combination of small wearable devices, virtual clinics, doctors, and supporting teams.

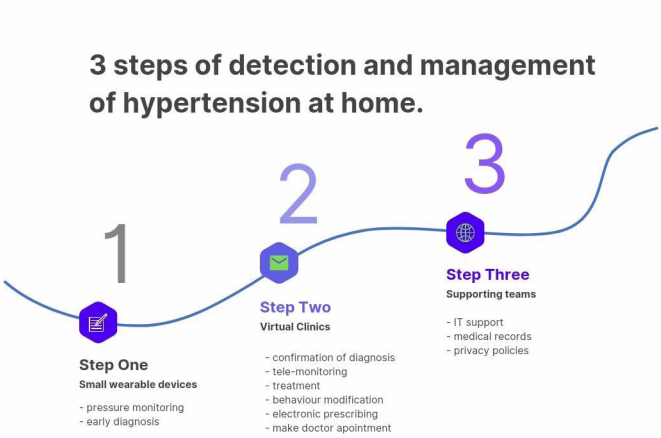

Figure 3. Management of hypertension in the digital era. There are three steps, which include using wearable technologies or health applications for screening, early diagnosis and the management of hypertension at home in the first step. Next, in a virtual clinic in which to confirm the diagnosis and treat hypertension, doctors should provide patient education in both aetiology, risk factors, symptoms, and behavioural modification. Moreover, doctors should have good techniques for conversation, psychotherapy, private consultations, and patient-doctor relationships, all of which are needed to change behaviour, as well as electronic prescribing, telemonitoring blood pressure, and appointment scheduling. Finally, support teams can be supported by IT through accurate medical records. Clinician teams should be encouraged to provide patient education and make home visits if necessary in uncontrolled hypertension cases

Note. From "Digital health: New approaches in Hypertension Management" by J. Kitt, R. Fox and K. L. Tucker, 2020, *Journal of Cardiology and Cardiovascular Sciences, 4*(1), pp. 18-23. Copyright 2020 by Cardiology and Cardiovascular Sciences

The first step is "small wearable devices for blood pressure monitoring and early diagnosis of hypertension." Firstly, hypertension is routinely monitored through self-screening with smartphone apps or automated blood pressure wristbands. Various health applications monitor blood pressure and may alert users if it is abnormal. New digital technologies can be developed for the early diagnosis of hypertension, where patients upload their blood pressure data to devices such as smartphone apps or smartwatches. Smartphone apps or smartwatches can monitor blood pressure. After uploading and reading their blood pressure, individuals can be divided into two groups: the first group consists of those with normal blood pressure; individuals with blood pressure below 140/90 mmHg should be recommended for routine blood pressure measurement using digital devices. In the meantime, supporting teams should be educated on behaviour modification and patient education to prevent hypertension in this group.

The other group would be called the abnormal group, where blood pressure on the first measurement is over 140/90 mmHg, and thus a confirmed diagnosis is required. The next step would be to receive a confirmed diagnosis from clinicians. Generally, Ambulatory Blood Pressure Monitoring--ABPM is regarded as the most accurate

way to confirm hypertension. However, Home Blood Pressure Monitoring--HBPM may be used to confirm a diagnosis of hypertension. For this confirmation, two consecutive measurements are required, at least 1 minute apart, in the morning and evening over the course of 4 days. After the clinician or small wearable devices confirm the diagnosis, the supporting team will schedule a doctor's appointment in the virtual clinic.

Second step for management and monitoring by virtual clinics include confirmation of the diagnosis by a doctor, behaviour modification, treatment, tele-monitoring, electronic prescribing, and making a doctor's appointment for the follow-up on clinical results after treatment. At this step, the doctor should encourage patient education in aetiology, risk factors, and lifestyle modification through effective conversation skills. A functional doctor-patient relationship and medical ethics are prerequisites during the consultation, and a privacy policy is needed in this virtual clinic. Several factors influence high blood pressure, such as environmental factors, physical activity, psychological stress, diet, and behaviour. The management of risk and protective factors (including the aetiology, symptoms, and signs of hypertension) should be prioritised in order to decrease the risk of hypertension.

Normally, hypertension can be managed in primary care clinics. During a telemedicine appointment, the physicians review blood pressure and the risk of cardiovascular diseases and may commence antihypertensive treatment by prescription; the patients may submit home readings. Physicians need to prescribe hypertensive drugs based on factors such as the side effects of the medication, the blood pressure control status of patients, comorbidities, and the risk of cardiovascular diseases such as diabetes or renal disease. Management also involves screening renal function, retinal function, and cardiovascular function for signs of target organ damage. In the case of complications, it is necessary to travel to the hospital. Clinic appointments are conducted through online interaction with physicians. The physicians have online interaction with patients, discussing the amount of salt in the patient's diet and the knowledge, attitudes, and behavioural changes that can aid in managing hypertension.

The third step for the supporting teams should be to help doctors maintain accurate and private medical records, provide IT support for both doctors and patients, and make the next appointment at virtual clinics. In addition, clinical support teams can assist patients in self-monitoring and tele-monitoring their blood pressure if they face problems during treatment using digital health platforms. Moreover, information about patients' knowledge and behaviour change programmes should be encouraged online. Normally, virtual clinics provide online interaction between patients and healthcare professionals in a private atmosphere. The families of patients are an important part of patient support for both psychotherapy and compliance with hypertension management. However, patients with uncontrolled hypertension needed home visits by healthcare teams as an optional recommendation. Patient home visits and digital platforms can help prevent serious complications.

However, in Thailand, there are some limitations to this approach. First, some elderly patients with a low education level find it difficult to understand the digital health approach. Second, smartphones or smartwatches are expensive and cannot be afforded by patients with low incomes. Finally, nowadays, although digital technology has improved considerably, it is mainly used in private hospitals and medical school hospitals. Moreover, further research in Thailand is needed to improve technologies and standardize digital health intervention.

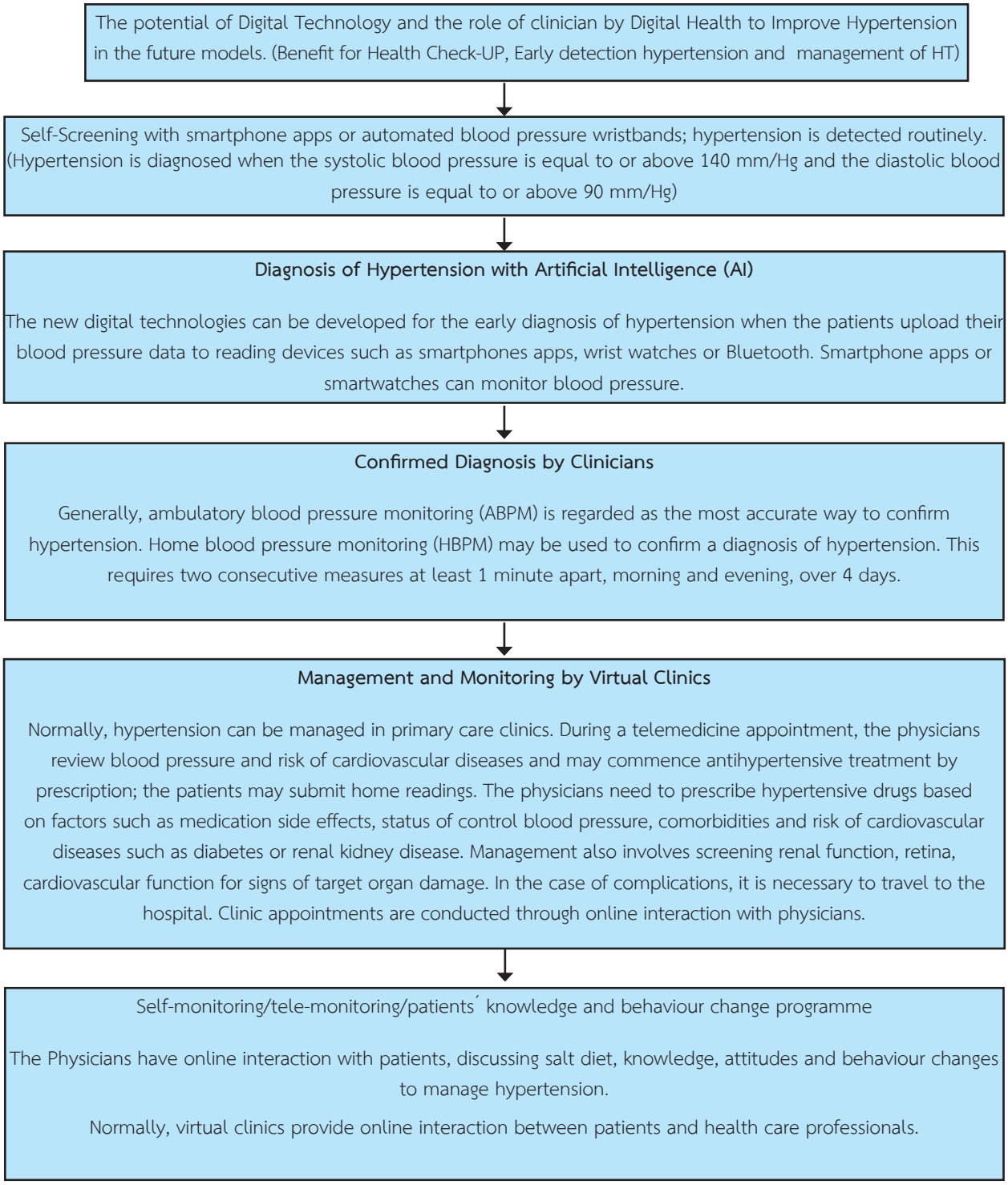

Figure 4. The effective digital platforms for screening, detection, and improving the management of hypertension in Thailand. The guideline on the use of digital health for self-monitoring and tele-monitoring of blood pressure for the future model of detection and the benefits of behaviour change conversations and behavioural modification to control hypertension via telemedicine (Kitt et al., 2020).

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Conclusion

In conclusion, the currently available digital health technologies are the way of the future in the management of hypertension. Further research, wearable devices and smartphone apps for blood pressure measurement are required for accurate blood pressure monitoring. Privacy is needed on digital health platforms. The benefits of behaviour modification and behaviour change conversation can reduce the occurrence of cardiovascular events and the serious complications in patients with hypertension.

Digital health has various beneficial aspects, particularly in health promotion and the management of non-communicable diseases during a pandemic. Additionally, this approach can considerably reduce hypertension and co-morbidities with accurate and effective verbal techniques.

Digital health platforms can effectively manage hypertension, including self-monitoring and telemonitoring patients in Thailand. However, new technologies or AI need to be developed, and health professionals need to understand the use of telehealth and digital health.

Importantly, a functional doctor-patient relationship and medical ethics are needed during consultation. Moreover, knowledge and decision making in the field of hypertension management need to be combined with psychotherapy, home visits and cooperation with the patients' families.

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