



# The effects of smartphone apps expected in self-management for hypertension management

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In the realm of healthcare, particularly in the treatment of hypertension, outpatient pharmacotherapy has traditionally held a dominant position. Patients typically engage in a system where they receive limited consultation time, undergo examinations, and are prescribed medication during outpatient visits, only to return for follow-up appointments several months later. This system presents challenges for busy physicians, who may find it difficult to gain a comprehensive understanding of the patient's medical condition and provide adequate patient guidance. On the other hand, patients may often find themselves taking medication without a full comprehension of the necessity and treatment goals. They may struggle to maintain treatment motivation, make behavioral modifications, and particularly in Japan, hypertension control rates have been notably suboptimal [1]. The state where healthcare providers fail to achieve treatment goals and do not investigate the underlying causes, or do not intensify treatment and instead adopt a watchful waiting approach, is referred to as clinical inertia. Clinical inertia represents a problematic scenario involving both healthcare providers and patients [2].

According to the Information and Communications White Paper published by Japan's Ministry of Internal Affairs and Communications, the ownership rate of mobile devices such as smartphones has exceeded 90% in recent years. Furthermore, during the COVID-19 pandemic, the significance and potential of non-face-to-face medical care have been explored, leading to significant changes in the landscape of hypertension treatment. In fact, the number

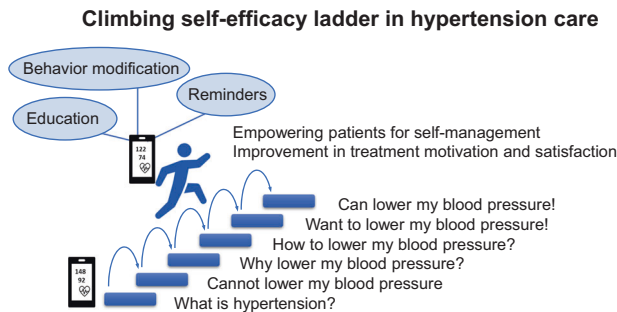
and utilization of healthcare apps have been increasing year by year. Smartphones have become indispensable in our daily lives, and health management using healthcare apps has become commonplace.

Various hypertension guidelines provide highly detailed recommendations based on a high level of evidence, including stratification of cardiovascular disease (CVD) risk, specific blood pressure (BP) targets based on comorbidities, and modifications to lifestyle habits. Interestingly, there is a high compatibility between guideline-based hypertension treatment and digital healthcare. Healthcare apps aim to bridge the gap between traditional point-to-point healthcare, not only assisting in hypertension treatment but also addressing clinical inertia. However, the establishment of evidence for these apps remains a challenge for the future.

The functionalities of apps for lifestyle-related diseases like hypertension encompass the management of parameters such as BP, body weight, physical activity, and various examination results. Additionally, these apps provide education on the necessary knowledge for treatment, counseling for lifestyle modification, bidirectional communication between patients and healthcare providers via the app, medication reminders, and alerts for abnormal values [3]. Apps equipped with these features hold strong potential for enhancing the quality of hypertension management and are highly expected to have a significant impact on BP reduction and overall prognosis improvement. Some systematic reviews have reported improvements in blood pressure control and medication adherence when using such apps [4–6]. However, it's important to exercise caution regarding the quality of research and potential biases. In fact, many healthcare apps may not have undergone oversight or accreditation by professional organizations or academic institutions [7]. Among these, there is significant attention being paid to groundbreaking hypertension treatment apps developed in recent years. In the HERB-Digital Hypertension 1 (HERB-DH1) trial, the use of an app-based

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**Fig. 1** Mobile apps have the potential to enhance patients' self-management abilities. Apps improve the quality of hypertension management through education, achieving behavior modification, and daily medication reminders. Furthermore, apps can improve self-efficacy, increase treatment motivation, and enhance treatment effectiveness

non-pharmacological intervention for hypertension treatment resulted in a statistically significant reduction in home blood pressure (24 h systolic BP measured by ABPM) after 12 weeks compared to the control group receiving standard non-pharmacological therapy alone ( $-4.9$  vs  $-2.5$  mmHg) [8]. The intervention using this app showed a significant effect in reducing body weight and salt intake, as observed by a significant decrease in both parameters [9]. Furthermore, what's particularly intriguing is that in a recent report, a post-hoc analysis of HERB-DH1 defined the number of patient activity reflections recorded per day as "self-reported behavioral efficacy (SER)." The analysis revealed a significant association between SER related to salt reduction and weight loss and improvements in early morning blood pressure. The authors suggest the possibility that patients actively utilizing the app to reflect on their lifestyle choices may lead to an improvement in self-efficacy, increased treatment motivation, and potentially contribute to blood pressure reduction effects [10]. However, caution is warranted in interpreting the usefulness of this indicator, given the lack of associations observed with SER related to exercise and the absence of correlations between each SER and evening BP. Nevertheless, as previous meta-analyses [11] have indicated the potential impact of external interventions through apps in hypertension treatment, highlighting not only improvements in behavioral patterns but also increased patient satisfaction through internal interventions, such as education and counseling, is significant.

In the context of hypertension management, apps have the potential to enhance patients' self-management abilities, which may not be adequately addressed through standard outpatient care. Simultaneously, they have the potential to boost treatment motivation and self-esteem, as patients gain a

better understanding of their desire to effectively manage hypertension and realize that lifestyle modifications can lower their BP. This bodes well for the continued improvement in the quality of hypertension management (Fig. 1).

## Compliance with ethical standards

**Conflict of interest** The authors declare no competing interests.

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