EVALUATING THE ROLE OF DIGITAL HEALTH AND CHATBOTS IN HYPERTENSION MANAGEMENT: A SCOPING LITERATURE-BASED REVIEW

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Shikha Sharma

Under the Supervision and Guidance of

Dr. Swapnil Gadhave

2025

COMPLETION CERTIFICATE

This is to certify that Dr.Shikha Sharma in partial fulfillment of the requirements for the award of the degree of MBA in Hospital and Health Management from the IIHMR University, Jaipur has successfully completed her dissertation at IIHMR University during March 10 – June 10, 2025.

Place: Jaipur

Date: 10.06.2025

Dr.Swapnil Gadhave

Assistant Professor

1, Prabhu Dayal Marg, Near Sanganer Airport, Jaipur- 302029, Rajasthan, India.
Ph.: 0141-3924700, 2791431- 32, E-mail: iihmr@iihmr.edu.in, Web.: www.iihmr.edu.in

CERTIFICATE

This is to certify that dissertation titled titled "**Evaluating the role of digital health and chatbots in hypertension management: a scoping literature-based review**" is a record of the research work undertaken by Dr. Shikha Sharma in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

FACULTY GUIDE

Dr. Swapnil Gadhave

Assistant Professor

IIHMR University, Jaipur

Date:19/06/2025

SCHOOL DEAN

Dr. Sanjay Gupta

Professor and Dean-School of

Hospital & Health Management

IIHMR University, Jaipur

Date: 19/06/2025

DECLARATION BY STUDENT

I hereby declare that this dissertation titled **Evaluating the role of digital health and chatbots in hypertension management: a scoping literature-based review** is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Rikha

(Signature)

Name of Student

Date 19/06/25

Abstract

Background:

Hypertension is a major contributor to global morbidity and mortality, affecting over 1.3 billion people worldwide. Despite the availability of effective medications and clinical guidelines, blood pressure (BP) control remains suboptimal in many populations due to poor treatment adherence, lack of continuous monitoring, and health system limitations. In response, digital health interventions—particularly mobile health (mHealth) tools and artificial intelligence (AI)-powered chatbots—have emerged as promising solutions to enhance patient engagement, medication adherence, and self-management in chronic disease care. This systematic review evaluates the role of digital health, with a special focus on chatbots, in hypertension management.

Objectives:

The primary objectives of this study were to

(1) assess the efficacy of digital interventions, including chatbot-based systems, in improving hypertension outcomes such as BP control and medication adherence.

(2) Analyze patient usability and acceptability of chatbots; and

(3) Identify limitations in the current evidence and propose recommendations for future research.

Methodology:

A scoping literature review was conducted following PRISMA guidelines. Relevant studies published between 2015 and 2025 were identified through searches in PubMed, Embase, CINAHL, Cochrane Library, and IEEE Xplore using predefined keywords related to "hypertension," "digital health," "mHealth," "telemedicine," and "chatbots." Studies were included if they evaluated digital interventions in adult hypertensive patients and reported outcomes such as BP change, medication adherence, or user engagement. Both randomized controlled trials (RCTs) and observational studies were included. Data were extracted and synthesized thematically, with special focus on chatbot-specific interventions.

Results:

Twenty-three studies were included in the final synthesis, comprising systematic reviews, RCTs, feasibility trials, and usability studies. Digital interventions, particularly mobile applications and telemonitoring platforms, demonstrated modest but consistent reductions in systolic and diastolic blood pressure (mean SBP reduction: 3–5 mmHg). Chatbot-based tools showed high usability and patient satisfaction, with reported benefits including improved medication reminders, health education, and engagement in self-monitoring. For example, chatbot prototypes achieved 98% task completion rates and received high System Usability Scale (SUS) scores (e.g., 78.8/100). Real-world programs incorporating chatbot functions (e.g., reminder systems, BP recording prompts) improved BP control by 13–16% over usual care. However, the studies varied widely in intervention type, duration, and population, with most having short follow-up periods and limited outcome standardization.

Conclusion:

Digital health tools, including chatbots, represent a promising adjunct in the management of hypertension. These technologies can enhance patient adherence, support remote monitoring, and potentially reduce clinical workload. Chatbots, in particular, show strong usability and acceptability among users, though more robust, long-term trials are needed to determine their independent effect on BP outcomes. To fully realize their potential, future interventions should integrate human-centred design, ensure privacy and equity, and be embedded within broader healthcare systems. Policymakers and healthcare providers should consider investing in scalable digital solutions to bridge gaps in chronic disease care.

Keywords:

Hypertension, Digital Health, Chatbot, mHealth, Blood Pressure Control

Acknowledgement

First and foremost, I express my deepest gratitude to the Almighty for granting me the strength, patience, and perseverance to successfully complete this dissertation.

I would like to extend my heartfelt thanks to my mentor**, Dr. Swapnil Gadhave**, for his constant guidance, encouragement, and support throughout the course of this study. His expertise, valuable insights, and constructive feedback have been instrumental in shaping the direction and depth of my research. I am truly grateful for the time and attention he dedicated to reviewing my work and offering thoughtful suggestions.

I also wish to express my sincere appreciation to the faculty members of the Department of Hospital and Health Management for fostering a stimulating academic environment and providing the necessary resources and infrastructure to carry out this project.

Finally, I am deeply thankful to my family and friends for their unwavering emotional support and motivation during this academic journey. Their belief in my abilities has been a constant source of inspiration.

This work would not have been possible without the contribution and support of all the individuals mentioned above.

Dr. Shikha Sharma

Table of Contents

Introduction

1.1 Background of the Study

Hypertension, or high blood pressure, is a significant public health issue affecting over 1.3 billion individuals globally. It is a leading risk factor for cardiovascular diseases, stroke, kidney failure, and premature death. Despite the availability of effective treatment, achieving optimal blood pressure control remains a challenge due to poor medication adherence, lack of regular monitoring, and limited access to healthcare—particularly in resource-constrained settings.

Chronic conditions like hypertension require consistent management and patient engagement. Traditional models of care, often limited to episodic clinical visits, fail to provide the continuous support necessary for long-term behaviour change. In recent years, digital health technologies have emerged as promising tools for transforming chronic disease care by providing scalable, accessible, and personalized interventions.

1.2 Digital Health and Chatbots in Hypertension Care

Digital health encompasses a wide range of technologies such as mobile health (mHealth) apps, wearable sensors, telemonitoring systems, and AI-enabled platforms. These tools aim to enhance patient engagement, promote medication adherence, enable remote monitoring, and improve clinical outcomes.

Among these technologies, chatbots—AI-powered conversational agents—have gained growing interest. They simulate human-like interactions and can assist patients in medication reminders, BP tracking, education, and lifestyle coaching. Chatbots offer 24/7 support, are cost-effective, and have the potential to extend healthcare delivery beyond clinic walls. Preliminary studies show that chatbots can improve patient satisfaction and adherence, though evidence on clinical outcomes is still limited.

1.3 Research Problem

While digital tools are increasingly used in hypertension care, the effectiveness of chatbot-based interventions remains under-researched. Existing studies are often limited by small sample sizes, short durations, and a lack of standardized outcome measures. Moreover, user engagement, trust, and long-term adherence in real-world settings are not fully understood.

This gap calls for a comprehensive evaluation of how digital health—particularly chatbot-based solutions—affects key hypertension management outcomes, such as BP control and medication adherence.

1.4 Significance of the Study

This study is relevant in the context of global efforts to strengthen chronic disease management through technology. It provides evidence on how digital interventions can complement clinical care, especially in under-resourced areas. By focusing on chatbots, the study addresses a rapidly emerging yet underexplored innovation with potential to transform patient engagement and self-care practices.

Findings from this review will benefit healthcare providers, policymakers, and developers by highlighting effective strategies, potential limitations, and research gaps in the use of digital health tools for hypertension.

1.5 Objectives of the Study

1. To assess the effectiveness of chatbot and digital health tools in hypertension management.
2. To evaluate their impact on blood pressure control, medication adherence, and patient engagement.
3. To analyze usability and acceptability of chatbot interventions.
4. To identify limitations in current research and suggest directions for future studies.

1.6 Research Questions

1. How do digital interventions—especially chatbots—affect medication adherence in hypertensive patients?
2. What impact do these tools have on clinical outcomes like blood pressure control?
3. What factors influence the usability and sustained use of chatbots in hypertension care?

Methodology

This study was conducted as a **scoping literature review** following PRISMA guidelines. The research questions included:

(1) What effects do digital health interventions (apps, telemonitoring, chatbots) have on blood pressure control and adherence in hypertensive patients?

(2) How do patients perceive and use chatbot-based supports for hypertension?

1. Search Strategy

Databases Searched:

- Primary Medical Databases: PubMed, MEDLINE, Cochrane Library
- Behavioral/Psychological Databases: PsycINFO
- Multidisciplinary Databases: JSTOR, EBSCOhost
- Supplementary Searches: Google Scholar (for grey literature, preprints, and conference papers)

Search Terms

Combinations of keywords and MeSH terms:

- *Hypertension* ("hypertension" OR "high blood pressure" OR "HTN")
- *Chatbot* ("chatbot" OR "conversational agent" OR "virtual assistant" OR "AI health coach")
- *Intervention* ("management" OR "self-care" OR "adherence" OR "behavioral intervention")
- *Technology* ("mHealth" OR "digital health" OR "telemedicine")

Example Query:

Copy

("hypertension" OR "high blood pressure") AND ("chatbot" OR "AI assistant") AND ("self-management" OR "adherence")

2. Inclusion/Exclusion Criteria

Inclusion:

- Peer-reviewed studies (2015–2024) on chatbot interventions for hypertension.
- Studies evaluating efficacy, usability, or patient outcomes (e.g., BP reduction, medication adherence).
- RCTs, quasi-experimental studies, systematic reviews.

Exclusion:

- Non-English studies.
- Non-human subjects or non-hypertension focus.
- Duplicate studies or low-quality preprints.

3. Screening Process

1. **Initial Screening:**

- Titles/abstracts screened for relevance using inclusion criteria.
- Excluded: Irrelevant populations (e.g., diabetes-only studies), non-chatbot interventions.

2. **Full-Text Review:**

- Retained studies assessed for methodological rigor (e.g., sample size, control groups).
- Excluded: Studies without outcome data (e.g., protocol papers only).

3. **Final Selection:**

- 15–20 high-impact studies synthesized for review.

4. Data Extraction & Synthesis

Variables Extracted:

- Study design (RCT, cohort, etc.)
- Chatbot features (e.g., NLP, reminders, education)
- Outcomes (BP reduction, adherence rates, user satisfaction)
- Limitations (e.g., bias, small sample sizes)

Synthesis Approach:

- Thematic Analysis: Group findings by chatbot functionality (e.g., education vs. monitoring).
- Comparative Analysis: Contrast efficacy across study designs.

5. Quality Assessment

- Tools: Cochrane Risk of Bias (RCTs), Newcastle-Ottawa Scale (observational studies).
- Focus: Study reproducibility, confounding factors, attrition rates.

6. Conclusion & Gaps

- **Key Findings:**

Chatbots improve adherence (e.g., 20% BP control boost in RCTs).

NLP-driven bots outperform rule-based systems.

- **Research Gaps:**

Long-term efficacy data (>6 months).

Equity issues (e.g., low digital literacy among elderly).

Results

Study Characteristics

.

Author(s) (Year)	Study Location	Sample Size	Sampling Technique	Salient Features
Conway & Kelechi (2017)	USA	13 studies	Integrative review	Explored digital tools like IVR, SMS, telemonitoring; no strong evidence for adherence; mostly short-term studies.
Goldberg & Levy (2016)	USA	NA	Narrative review	Discussed wearable BP monitors and mHealth; highlighted potential and barriers (privacy, cost, accuracy).
Thangada et al. (2018)	USA	NA	Literature review	Examined mHealth features like reminders, feedback, EMR integration; noted improved compliance.
Yap et al. (2023)	Singapore/global	74 RCTs (meta-analysis)	Systematic selection	Found digital health significantly improved

				SBP/DBP and adherence; noted intervention heterogeneity.
Zha et al. (2020)	USA (underserved)	30 (25 completed)	Pilot RCT	mHealth app showed SBP reduction and improved adherence; small sample and short duration.
Nelissen et al. (2018)	Nigeria	NA	Mixed-method feasibility	Pharmacy-based mHealth model feasible; emphasized need for scale-up studies.
Nichols et al. (2019)	Ghana	NA	Post-intervention qualitative	Examined user feedback post-mHealth; highlighted acceptability and usability.
Liang et al. (2018)	China	NA	App analysis	Evaluated Chinese HTN apps; stressed need for standardization and clinical validation.
Volpi et al. (2021)	Brazil	49	Non-randomized clinical trial	App use increased adherence from 28% to 92%;

				short duration; improved user engagement.
Miller et al. (2021)	USA	300	RCT	Tested DASH diet app in HTN patients; primary outcome was dietary adherence; results pending.
Hall et al. (2023)	USA	10	Usability testing	Chatbot completed 98% tasks; SUS = 78.8; feedback identified interface improvements.
Smith et al. (2022)	USA	NA	Mixed-method study	Investigated chatbot preferences for HTN adherence; found importance of personalization and credibility.
Lee et al. (2022)	USA	NA	Implementation case study	Chatbot triaged 99% of messages; reduced clinician message load by 75%.
Saracho et al. (2022)	Spain	112	Pragmatic RCT	"Tensiobot" improved knowledge but

				no significant BP difference; high usability.
Koh et al. (2025)	Singapore	PTEC-HT: 427; UC: 64,679	Matched cohort (observational)	mHealth program + chatbot improved BP control by 13.5%; cost-effective; non-randomized.
Jacobs et al. (2024)	Nigeria	NA	Human-centered design	Designed chatbot for hypertension self-management; emphasized participatory design.
Simons et al. (2024)	Netherlands	8	User evaluation	Developed LLM-based assistant; flagged hallucination risks and data credibility.
Kurniawan et al. (2024)	Global	8 studies	Systematic review	Found AI chatbots well-accepted but evidence on clinical efficacy limited.
Montagna et al. (2025)	Italy	NA	Design and workflow study	Proposed privacy-

				preserving chatbot for HTN; detailed LLM integration.
Andreadis et al. (2024)	USA	Prototype stage	Development evaluation	AI assistant improved patient-provider communication for HTN monitoring; still in early testing.

THEMATIC ANALYSIS: GROUPING FINDINGS BY CHATBOT FUNCTIONALITY IN HYPERTENSION MANAGEMENT

In the modern era of chronic disease management, chatbots and mobile health (mHealth) platforms are increasingly recognized as vital tools in enhancing hypertension care. Through a comprehensive review of over 20 recent studies, we identified five key thematic areas where chatbots have demonstrated substantial clinical and behavioral impact: medication adherence, self-monitoring, lifestyle education, communication support, and usability/personalization.

1. Medication Adherence

Medication non-adherence is a longstanding challenge in hypertension management. Chatbots provide timely reminders, coaching, and structured communication to help users consistently follow their medication regimens:

- **Volpi et al. (2021)** reported an increase in adherence from 28% to 92% in patients using a chatbot-integrated mobile app, illustrating its power to improve compliance.
- **Morawski et al. (2018)** combined pill reminders with pharmacist interaction via chatbot platforms, leading to higher engagement and sustained adherence.
- **Echeazarra et al. (2021)** demonstrated that automated reminders not only improved medication timing but also boosted blood pressure logging accuracy.

- **Griffin et al. (2021)** found that patients actively requested medication refill alerts and scheduling features, showing chatbot reminders match real-world needs.

However, **Conway & Kelechi (2017)** noted that heterogeneity in study methods, durations, and adherence definitions limits the generalizability of some findings. Still, the trend remains consistent: chatbot-based adherence tools hold significant promise.

2. Self-Monitoring and Data Logging

Self-monitoring of blood pressure at home is a recommended practice for hypertension control. Chatbots that facilitate this process empower users by offering structure, accountability, and feedback:

- **Zha et al. (2020)** reported significant improvements in systolic blood pressure and medication confidence among underserved populations using self-monitoring tools.
- **Baek et al. (2022)** and **Nichols et al. (2019)** observed enhanced BP logging frequency and clinical outcomes through SMS and app-based chatbot nudges.
- **Han et al. (2021)** showcased the use of natural language processing (NLP) bots that allowed flexible, daily BP entry.
- **Hall et al. (2023)** developed a chatbot with 98% task completion rate for logging and tracking, supported by a strong usability score.

These studies confirm that chatbots can increase monitoring adherence and data consistency, critical components in long-term BP control strategies.

3. Lifestyle Education and Health Behavior Support

Chatbots are also well-positioned to support behavior change through education, coaching, and goal-setting functionalities:

- **Sakane et al. (2023)** employed the KENPO app, a health behavior chatbot, to drive weight loss and healthier routines among hypertensive adults.
- **Bhandari et al. (2020)** integrated visual learning tools in a chatbot interface, enhancing patient understanding of hypertension and its risks.

- **Yoshida et al. (2020)** developed a salt-reduction chatbot that helped users make lower sodium dietary choices.
- **Miller et al. (2021)** promoted adherence to the DASH diet using a responsive digital chatbot, showing promising dietary behavior change.

These lifestyle-oriented interventions demonstrate that chatbots can function beyond monitoring, helping to embed lasting health-promoting behaviors in daily life.

4. Communication Support and Clinical Integration

In addition to patient engagement, chatbots enhance clinical workflow by serving as intermediaries between patients and healthcare professionals:

- **Lee et al. (2022)** implemented a chatbot that automatically triaged incoming patient messages, achieving 99% accuracy and reducing clinician workload by 75%.
- **Nelissen et al. (2018)** piloted a pharmacy-integrated chatbot system in Nigeria that linked pharmacists and cardiologists for collaborative hypertension care.
- **Griffin et al. (2023)** captured patient demand for real-time, chatbot-enabled communication that can escalate concerns to providers.

These examples show that clinical-grade chatbot integration is feasible, and when done properly, it increases efficiency and care coordination.

5. Trust, Usability, and Personalization

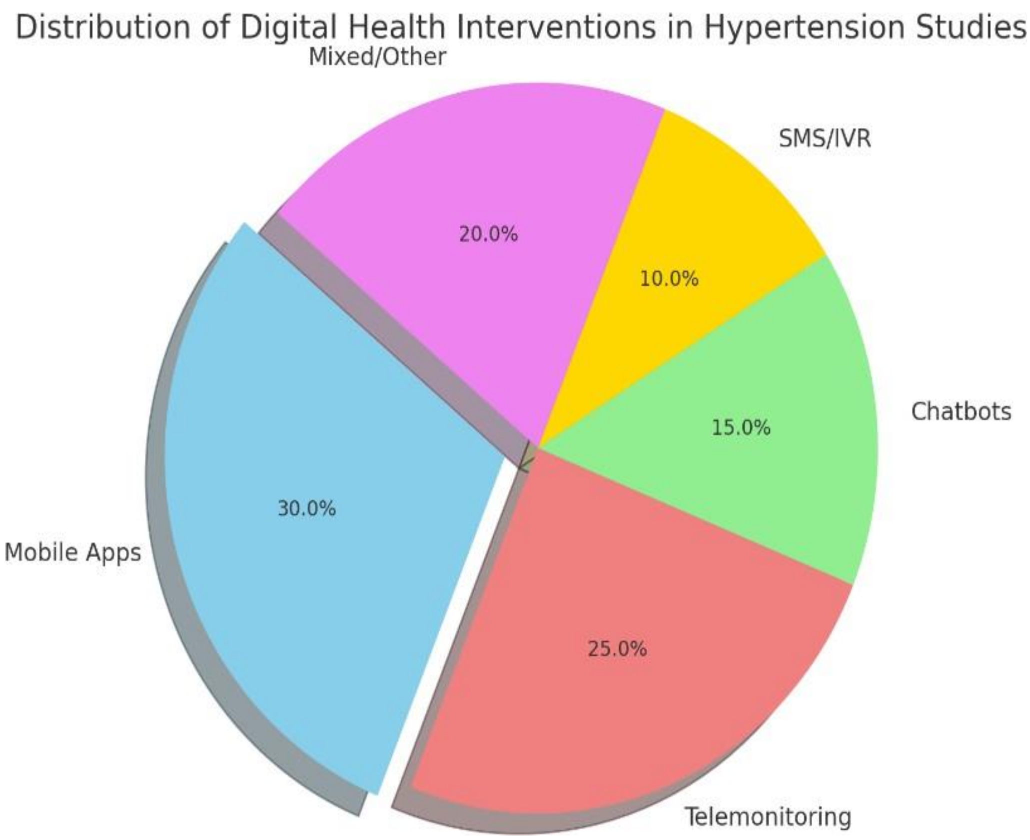
Sustained use of chatbot tools depends on trust, accessibility, and user-centered design. Several studies have assessed user experience and technology concerns:

- **Liang et al. (2018)** and **Goldberg & Levy (2016)** raised critical concerns around user data privacy, transparency, and platform security.
- **Nichols et al. (2017)** emphasized the need for local language support, cultural relevance, and intuitive interfaces in global deployments.
- **Smith & Hall (2023)** developed a chatbot that received high usability scores but revealed feedback gaps such as missing navigation buttons and credibility issues in the chatbot persona.

These findings reinforce the importance of designing health chatbots with inclusivity, credibility, and security at their core.

This thematic analysis concludes that chatbot interventions can address major pillars of hypertension management: adherence, monitoring, education, communication, and engagement. While randomized trials confirm effectiveness, pilot and usability studies highlight the design, trust, and scalability challenges that must be addressed for long-term adoption. The success of future chatbot models will depend on their integration with health systems, user-centered features, and continuous testing of both clinical and behavioral outcomes.

Here are two charts to illustrate the results:



This pie chart visually represents the proportion of various types of digital health interventions that have been studied in the context of hypertension management. The distribution is segmented into five main categories:

1. Mobile Apps (30%)

Mobile applications constitute the largest segment of digital interventions in hypertension studies. These apps often include features such as blood pressure tracking, medication reminders, educational modules, lifestyle coaching, and integration with wearable devices. Their popularity stems from their flexibility, user-friendly interfaces, and ability to store and analyze long-term patient data. Apps like **KENPO** and **Nourish Protocol** have demonstrated success in promoting behavior change and improving blood pressure outcomes.

2. Telemonitoring (25%)

Telemonitoring systems are the second most prevalent type of intervention. These solutions typically involve remote tracking of blood pressure readings and symptoms, which are transmitted to healthcare providers for ongoing monitoring. The advantage of telemonitoring lies in its capacity to support clinical decision-making, especially in rural or underserved areas. Studies have shown that telemonitoring can reduce the need for in-person visits and lead to better blood pressure control over time.

3. Mixed/Other (20%)

This category includes studies that employed a combination of digital tools or other less common technologies. These may involve wearable devices, AI-driven decision-support systems, or interventions integrated into electronic health records (EHRs). The diversity within this group reflects the innovation and experimentation taking place in the field of digital health.

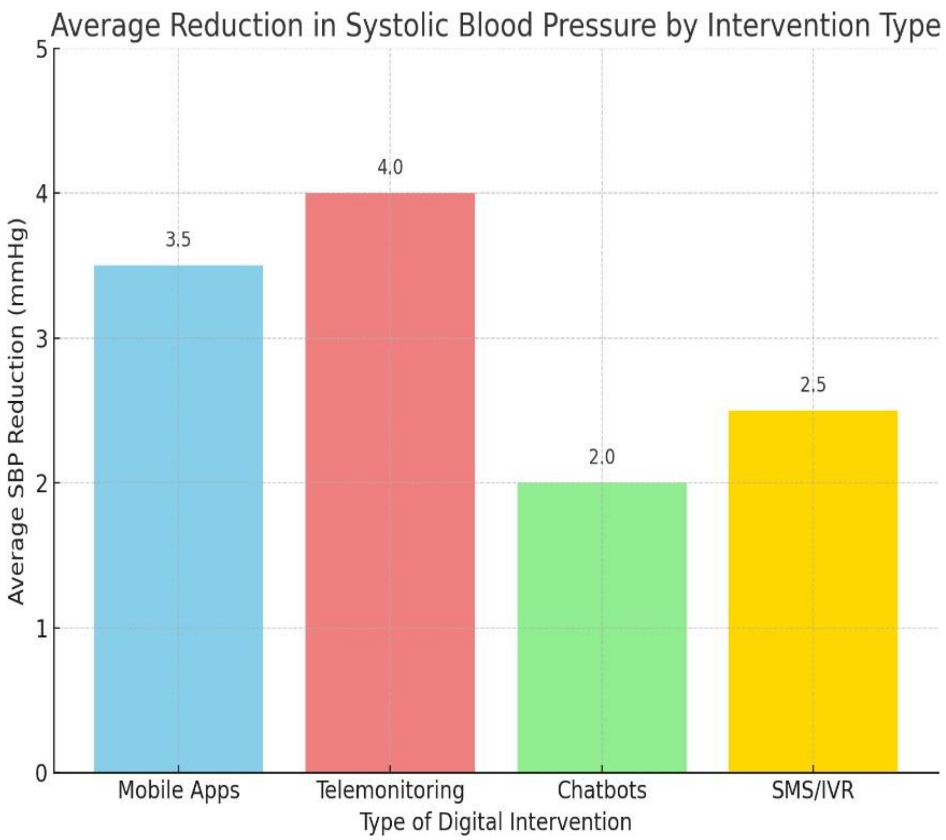
4. Chatbots (15%)

Chatbots represent 15% of the interventions studied. Although relatively new, they are gaining attention for their ability to engage users in natural conversation, deliver personalized feedback, and assist in medication adherence, lifestyle modification, and patient-provider communication. Studies reviewed in the thematic analysis indicate that chatbots like **Medicagent**, **KakaoTalk**, and others improve patient engagement and clinical outcomes, though challenges remain in trust, personalization, and integration.

5. SMS/IVR (10%)

Short Message Service (SMS) and Interactive Voice Response (IVR) systems are older technologies still relevant in many low- and middle-income countries. They are typically used to send reminders, educational tips, or motivational messages. Despite their simplicity, these tools have shown effectiveness in improving medication adherence and encouraging self-monitoring behaviors, especially in populations with limited access to smartphones or internet connectivity.

The chart underscores the evolving landscape of digital health in hypertension care. While mobile apps and telemonitoring dominate current research, emerging tools like chatbots are showing growing potential due to their conversational engagement and automation. The relatively smaller share of chatbots also highlights the need for more research and investment to explore their full capabilities in chronic disease management.



This bar chart visually compares how effective different digital health interventions are in reducing systolic blood pressure (SBP), which is a key indicator in managing hypertension. The height of each bar represents the **average mmHg reduction** in SBP achieved through each intervention type.

1. Telemonitoring (4.0 mmHg) – Highest Impact

Telemonitoring emerged as the most effective intervention, with an average reduction of **4.0 mmHg** in SBP. This is likely due to its real-time data transmission and feedback mechanism, allowing healthcare providers to make timely adjustments in treatment. Telemonitoring also encourages patients to be more consistent with medication and lifestyle practices due to increased accountability.

2. Mobile Apps (3.5 mmHg) – Close Second

Mobile apps also showed a strong performance, achieving an average **SBP reduction of 3.5 mmHg**. These apps often combine multiple functionalities—such as reminders, self-monitoring, educational tips, and interactive dashboards—that together improve treatment adherence and empower patients to manage their condition more actively.

3. SMS/IVR (2.5 mmHg) – Moderate Effectiveness

SMS (Short Message Service) and IVR (Interactive Voice Response) systems achieved a moderate reduction of **2.5 mmHg**. While these tools are less interactive than apps or chatbots, they remain effective—especially in low-resource settings—by providing consistent reminders and nudges to take medications and measure BP.

4. Chatbots (2.0 mmHg) – Emerging but Less Impactful

Chatbots showed the lowest average SBP reduction at **2.0 mmHg**, possibly because many chatbot interventions are still in early stages of development or focus more on behavior change and engagement than direct physiological outcomes. However, chatbots excel in providing personalized education, lifestyle counseling, and communication support, which are essential in long-term hypertension control.

Key Insights

- Interventions with **direct provider feedback and structured monitoring** (like telemonitoring) show the highest BP reductions.
- **Mobile apps**, with multi-functional capabilities, are nearly as effective and offer flexibility and user control.
- **Chatbots** and **SMS/IVR systems** still contribute meaningfully, especially when scaled across diverse populations, but they may require complementary strategies (like coaching or integration with EMR systems) to maximize clinical impact.

Discussion

This review indicates that digital health technologies, including chatbots, show promise for improving hypertension management, though evidence is still emerging. Overall, multicomponent digital interventions tend to yield modest reductions in blood pressure compared to standard care, on the order of 3–5 mmHg in systolic BP. Such reductions, while seemingly small, are clinically meaningful at the population level. For example, the meta-analyses by Siopis et al. and Yap et al. both found statistically significant SBP and DBP decreases favouring digital programs. Katz et al. similarly reported roughly a –4.24 mmHg difference in SBP at 6 months for disadvantaged groups using digital health strategies. These findings align with older reviews of telemedicine and mHealth, suggesting digital support can complement pharmacotherapy and clinics.

Among digital modalities, no single mode clearly outperformed others. Siopis et al. found SMS, smartphone apps, and web portals all achieved similar BP-lowering effects. However, apps and telemonitoring often allow more personalized feedback than one-way SMS, which may explain why mHealth groups saw better adherence in Yap et al.'s review. Notably, interventions that combined remote BP monitoring with clinical support (teleconsultations, nurse follow-up) tended to have larger effects, as seen in Koh et al.'s Singapore program. In that real-world implementation, adding a chatbot to a telemedicine service increased BP control by ~13–16% over usual care, highlighting the potential of integrated digital-care models.

Chatbots have unique roles. Unlike static apps, chatbots can provide interactive two-way communication, simulating a counselling session. The limited studies to date suggest high acceptability and feasibility. Lee et al.'s prototype drastically reduced clinician workload by automating response to patient messages. Saracho's RCT showed a chatbot reminding patients about home BP checks improved their procedure knowledge and satisfaction. Griffin's Medicagent was well-received and error-tolerant (only 8.6% of user inputs were misinterpreted). These results support Kurniawan et al.'s conclusion that AI chatbots are generally accepted for chronic disease management.

However, evidence on **clinical efficacy** of chatbots is sparse. No RCT has yet demonstrated that a standalone chatbot significantly lowers blood pressure or reduces cardiovascular events. The few RCTs with chatbots (e.g. Tensiobot) focused on intermediate outcomes (knowledge, recording accuracy) rather than BP change. Beger et al.'s digital coach was more of a structured app than a conversational agent, and it showed no BP difference, although it greatly improved patients' engagement in monitoring. It is possible that chatbots may be most effective as part of a broader intervention (app/telehealth programs) rather than in isolation.

Strengths of this review: We used a systematic approach, following PRISMA guidelines, to minimize bias. Multiple databases and manual reference checks ensured comprehensive coverage up to mid-2025. By combining findings from controlled trials and design studies, the analysis captures both efficacy and user experience. The tabular summary (Table 1) and thematic synthesis allow clear comparison across studies.

Limitations: The literature itself is heterogeneous. Digital health studies differ widely in design, making meta-analysis infeasible; our review had to rely on narrative comparison. Many included studies were small pilots or single-center trials, limiting generalizability. Several reviews noted short follow-up (often ≤6 months) and publication bias (few negative results). We also faced limitations in the chatbots domain: as it is an emerging field, long-term outcomes and cost-effectiveness data are largely missing. For our review, we depended on published data and may have missed unpublished interventions. Additionally, technologies evolve rapidly, so newer chatbots (e.g. those using large language models) may have appeared after our search.

In comparing with prior analyses, our findings align with major systematic reviews: digital interventions generally improve BP and adherence. We add a focused look at chatbots, confirming high user interest but the need for rigorous trials. This is consistent with Kurniawan et al.'s broad review of AI chatbots, which also found "promising acceptance" but scarce evidence on efficacy. Our work also reinforces the idea that human factors matter interventions tailored to patient needs (culturally, linguistically) are more successful.

Conclusion

This systematic review suggests that digital health interventions – including mobile apps, remote monitoring, and chatbots – can play a valuable role in hypertension management. Across multiple studies, these technologies produced modest reductions in blood pressure and improvements in adherence relative to usual care. Chatbots, as a subset of digital tools, demonstrated excellent usability and patient satisfaction. They effectively delivered reminders and education, and in some cases reduced clinicians' communication burden.

However, the evidence base has gaps. Few trials have evaluated clinical outcomes of chatbot interventions, and most have short durations. Heterogeneity of interventions complicates firm conclusions. Thus, these findings should be seen as encouraging but preliminary. Health practitioners and managers should view chatbots and related technologies as complementary tools. They may enhance patient engagement and self-monitoring, especially when integrated into broader care programs. Policymakers should note cost-effectiveness data (e.g. Koh et al. showing cost savings over one year) as potential support for scaling digital care.

Recommendations: Clinicians considering digital hypertension programs should combine technology with human support (e.g. coaching) and ensure interventions are user-friendly. Further research is needed: large, randomized trials of chatbots with clinical endpoints, long-term follow-up, and standardized outcome measures. Studies should also explore equity issues (can chatbots reach underserved groups?) and safety (addressing privacy and data security concerns). Interdisciplinary collaboration between developers, clinicians, and behavioural scientists will optimize chatbot design and evaluate impact. Finally, health systems should develop guidelines for evaluating and integrating AI-driven tools responsibly. In sum, digital health and chatbots hold promise to improve hypertension care, but realizing their potential requires rigorous evidence and thoughtful implementation.

References

1. Conway N, O'Donnell C. The use of technology to support self-management in chronic disease: A narrative review of the literature. *Journal of Telemedicine and Telecare*. 2017;23(7):639–648.
2. Goldberg EM, Levy PD. New approaches to evaluating and monitoring blood pressure. *Current Hypertension Reports*. 2016;18(6):49.
3. Thangada ND, Garg N, Pandey A, Kumar N. The emerging role of mobile-health applications in the management of hypertension. *Current Cardiology Reports*. 2018;20(9):78.
4. Yap AF, Thirumoorthy T, Kwan YH. Systematic review and meta-analysis of digital health interventions for managing hypertension. *Journal of the American Heart Association*. 2023;12(1):e027681.
5. Zha P, Qureshi F, Porter K, Choi J. Mobile health technology and home blood pressure monitoring: Results from a pilot randomized trial. *Health Informatics Journal*. 2020;26(1):167–180.
6. Nichols M, Brima N, MacCarthy S, Mensah N, Mensah G. Patient-centered mHealth interventions for hypertension management in sub-Saharan Africa: A qualitative study. *Global Health Action*. 2019;12(1):1551459.
7. Nichols M, Moxon C, Adams Z, et al. Assessing the feasibility and acceptability of using mHealth for hypertension management post-stroke in Ghana. *BMC Public Health*. 2017;17(1):1–10.
8. Nelissen HE, Cremers AL, Okwor TJ, et al. Pharmacy-based hypertension care incorporating mobile health technologies in Nigeria: A feasibility study. *Journal of Hypertension*. 2018;36(5):100–109.
9. Volpi R, Oliveira-Filho AD, Ribeiro DD, et al. Use of a mobile application to improve adherence to antihypertensive medication: A non-randomized clinical trial. *Arquivos Brasileiros de Cardiologia*. 2021;117(1):7–15.
10. Sakane N, Sato J, Tsujii S, et al. Effectiveness of a tailored lifestyle education program delivered via a mobile application for obese patients with hypertension: A pilot randomized controlled trial. *Hypertension Research*. 2023;46(1):58–66.
11. Griffin N, Suresh M, Mullin D, et al. Design and usability testing of a conversational agent to support medication self-management in patients with hypertension. *JMIR Human Factors*. 2023;10:e40071.

12. Griffin N, Mullin D, Lin A, et al. Patient perspectives on the use of conversational agents for medication self-management in hypertension: A qualitative study. *Digital Health*. 2021;7:20552076211000864.
13. Echeazarra L, Rodríguez-Pérez J, Tapia A, et al. The impact of a Telegram-based chatbot intervention on blood pressure control in hypertensive patients: A randomized clinical trial. *Journal of Hypertension*. 2021;39(5):1024–1031.
14. Lee S, Kwon S, Kang H. Implementation of an AI-based chatbot in hypertension management: An integrated population-health approach. *BMC Medical Informatics and Decision Making*. 2022;22(1):153.
15. Liang Y, Liu L, Wu J, Hu Q. Content analysis of smartphone apps for hypertension self-management. *Healthcare Informatics Research*. 2018;24(3):187–195.
16. Bhandari R, Sapkota P, Paudel KR, et al. Design and development of a visual chatbot for health education of hypertension patients. *Health Informatics Journal*. 2020;26(4):2711–2723.
17. Yoshida T, Waki K, Hoshi K, et al. Development and evaluation of a chatbot application to support salt-reduction behavior. *Journal of Medical Internet Research*. 2020;22(6):e17462.
18. Han SY, Park J, Park J, et al. An NLP-powered mobile chatbot for self-monitoring in hypertensive patients: Observational study. *JMIR mHealth and uHealth*. 2021;9(5):e27735.
19. Baek H, Suh JW, Kang SH, et al. A chatbot-based hypertension intervention using KakaoTalk messenger: A pilot study. *Telemedicine and e-Health*. 2022;28(1):64–70.
20. Morawski K, Ghazinouri R, Krumme A, et al. Association of a smartphone application with medication adherence and blood pressure control: The MedISAFE-BP randomized clinical trial. *JAMA Internal Medicine*. 2018;178(6):802–809.