Article

A Case Study on App Interface Design for Hypertension Management

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Abstract: ***Background:*** Despite the consistent improvements in awareness, treatment, and control rates of hypertension, the global prevalence continues to increase. The proportion of patients achieving adequate blood pressure control remains alarmingly low. Additionally, while pharmacological adherence among individuals with hypertension is generally high, compliance to non-pharmacological lifestyle modifications—including dietary regulation, weight management, and other behavioral interventions—remains persistently insufficient. Current hypertension management frameworks often lack the capacity to be effectively tailored to patients' individual lifestyles, thereby reducing the efficacy of comprehensive blood pressure control strategies. ***Purpose:*** This study aims to provide scientific and practical design guidance for the development of blood pressure management products tailored to local patients, thereby supporting long-term and effective hypertension self-management. ***Methods:*** Three hypertension management apps were selected from the Apple App Store based on screening criteria including download volume, user ratings, and functional completeness. A comparative analysis was conducted focusing on their information architecture at the functional level and five key elements of the graphical user interface—layout, color scheme, icons, typography, and data visualization—to identify characteristic design patterns and common usability issues. ***Results:*** The study found that the interface design of Smart Blood Pressure demonstrates high reference value, exhibiting strong usability and a positive user experience. ***Conclusion:*** Compared to the apps commonly bundled with commercially available smart blood pressure monitors, the three standalone apps analyzed in this study are better designed for adolescent and middle-aged hypertensive patients, but exhibit insufficient adaptability for older adults. It is recommended that future hypertension management applications incorporate differentiated and personalized user experience designs—tailored to the characteristics and real-world needs of diverse patient groups, such as age, digital literacy, and health status—to improve both usability and clinical effectiveness.

Keywords: Hypertensive patients; Blood pressure management app; Graphical user interface (GUI) design; Five-element GUI design analysis; Information architecture

1. Introduction

1.1 Research Background

According to the World Health Organization (WHO), approximately 1.13 billion people worldwide suffer from hypertension, affecting roughly 1 in every 4 men and 1 in every 5 women (WHO, 2025). Since age is a significant contributing factor to hypertension, the number of patients is growing rapidly as the global population ages. At the global level, it is estimated that of the people with hypertension, only 57% know their condition, 40.6% receive antihypertensive drug treatment, but only 13.2% achieve controlled blood pressure levels (WHO, 2017). The "China Cardiovascular Disease and its Risk Factors Surveillance" project, conducted from 2020 to 2022, covered 262

monitoring sites across 31 provinces, autonomous regions, and municipalities in China, surveying a total of 298,438 individuals. The results showed that the prevalence of hypertension among Chinese residents aged 18 and above was 31.6%, higher in men (36.8%) than in women (26.3%), and higher in rural areas (33.7%) than in urban areas (29.1%) (Liu & He, et al., 2025). The awareness, treatment, and control rates of hypertension among residents were 43.3%, 38.7%, and 12.9%, respectively (Liu & He et al., 2024). Although these figures remain relatively low overall, all three indicators have consistently shown an upward trend. Furthermore, data from six national surveys of the China Chronic Disease and Risk Factor Surveillance (CCDRFS) indicate (Zhang, Wu & Zhang, 2021) that from 2004 to 2018, the awareness, treatment, and control rates of hypertension among Chinese adults aged 18–69 steadily increased (Figure 1).

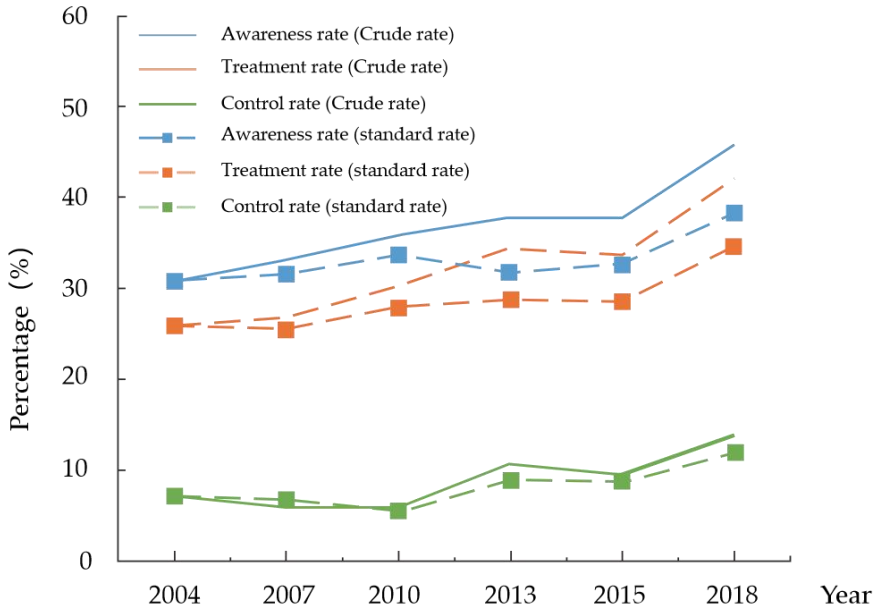


Figure 1. Trends in awareness, treatment, and control rates of hypertension among Chinese adults, 2004—2018 (Zhang, Wu & Zhang, 2021)

The above data indicate that hypertension has become a prevalent chronic disease worldwide (Li, Qu & Cang, 2012) and is a major contributor to cardiovascular and cerebrovascular diseases, potentially leading to physical disability, organ damage, and even death. The 2019 Global Burden of Disease (GBD) study found that elevated systolic blood pressure (SBP) was responsible for as many as 10.8 million deaths globally, ranking first among the 87 risk factors assessed (GBD 2019 Risk Factors Collaborators, 2020). To raise public awareness of hypertension prevention and control, the WHO and the International Society of Cardiology jointly established May 17 as "World Hypertension Day" on April 7, 1978 (Qian, 2017). Therefore, effective blood pressure management and achieving long-term stable control are crucial for improving the quality of life for hypertensive patients and reducing the risk of complications, representing a critical public health task that requires sustained attention and advancement.

1.2 Research Purpose

Long-term adherence to blood pressure management is a highly challenging task for patients. To help them overcome compliance difficulties, a variety of general-purpose blood pressure management apps, as well as dedicated software designed for specific brand blood pressure monitors, have emerged in the market. This study analyzes interface design cases from various hypertension management apps, systematically

summarizing their characteristics and the issues in information architecture and user interface design. The aim is to provide scientific and practical references for interface design in developing hypertension self-management apps that better meet user needs, thereby supporting patients in achieving long-term and effective blood pressure self-management.

1.3 Research Content

This study systematically reviews, from a theoretical perspective, the etiological factors, clinical characteristics, health risks, and current management status of hypertension to enhance overall understanding of the disease. At the application level, based on selection criteria such as download volume, user ratings, and functional comprehensiveness, three apps-Smart Blood Pressure, Songaree Blood Pressure, and Blood Pressure ++-were selected from the Apple App Store for analysis. Grounded in the practical usage needs of hypertensive patients, the study examines the functional architecture and graphical user interface (GUI) design of these three apps across dimensions, including readability, recognizability, guidance, reliability, visual fatigue, and operational intuitiveness. Focusing on information structure and five key GUI design elements-layout, color, icons, typography, and data visualization charts-the study conducts an in-depth investigation of their design features, evaluates the alignment between existing apps' user experience and patient needs, and further explores their effectiveness and potential for optimization in supporting patients' long-term self-management.

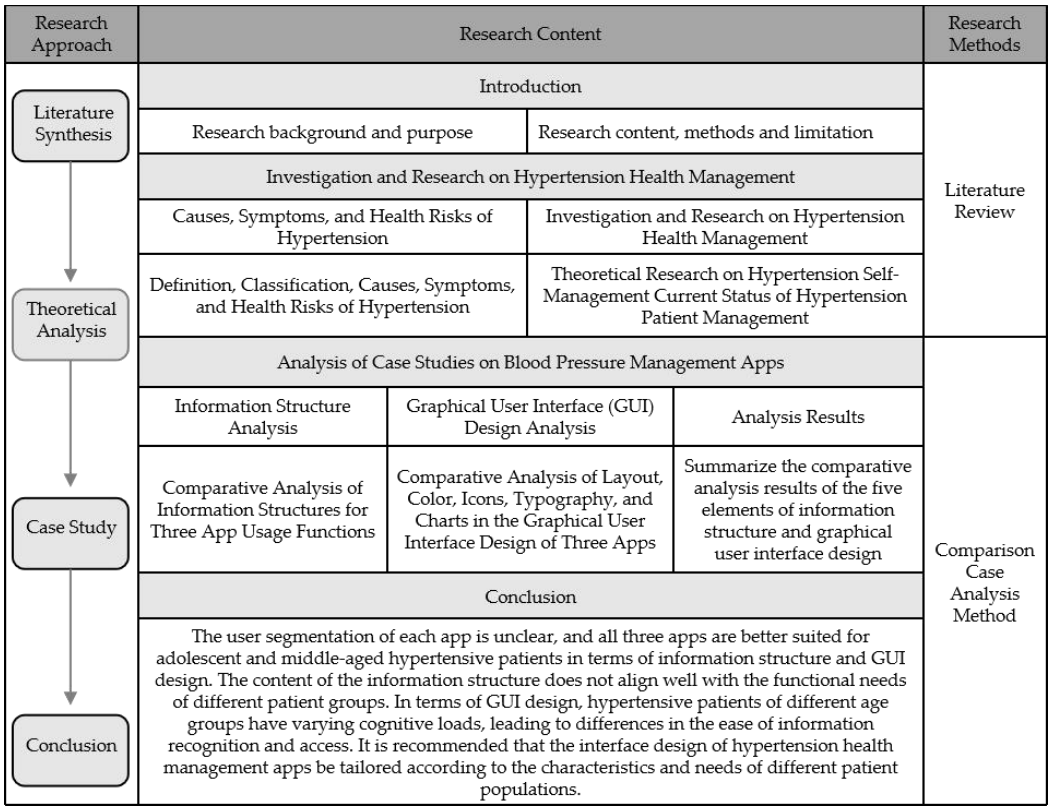


Figure 2. Research Process Flowchart

1.4 Research Methods

This study primarily employs the literature review method and case analysis method. The literature review method systematically examines the definition, classification standards, risk factors, clinical manifestations, and health risks of

hypertension, thereby providing a theoretical foundation for the research. Using the case analysis method, three representative blood pressure management apps are selected based on their download volumes and user reviews. A comparative analysis of their interface designs is conducted to summarize their design characteristics and identify issues in information architecture and user experience. The aim is to provide theoretical support and practical references for the interface optimization and functional design of companion applications for future smart blood pressure monitors.

1.5 Research Questions

Based on the aforementioned research background, objectives, content, and methodology, the research questions for this study are as follows:

Research Question 1: Given the low adherence to lifestyle management behaviors among hypertensive patients globally and the limited ability of existing blood pressure management tools to integrate with patients' individualized lifestyles, how can app interface design be used to enhance tool usability and user adherence?

Research Question 2: What common issues exist in the interface design — particularly in information architecture and the five key GUI elements — of leading hypertension management apps, and do these designs exhibit insufficient adaptability for diverse patient groups, such as older adults?

2. Investigation and Analysis of Hypertension Health Management

Understanding one's own blood pressure classification, recognizing risk factors, clinical symptoms, and potential health hazards of hypertension, helps improve disease awareness, strengthen self-management, and thereby more effectively control and manage blood pressure levels.

2.1 Definition and Classification of Hypertension

Hypertension is defined as a systolic blood pressure (SBP) of ≥140 mmHg and/or a diastolic blood pressure (DBP) of ≥90 mmHg, measured on three separate occasions in a clinical setting without the use of antihypertensive medications. When SBP is ≥140 mmHg, and DBP is <90 mmHg, it is classified as isolated systolic hypertension. Individuals with a history of hypertension who are currently taking antihypertensive medication should be diagnosed with hypertension even if their blood pressure falls below 140/90 mmHg (Revising Committee of Chinese Hypertension Prevention and Treatment Guidelines, 2019). Hypertension is classified into three grades based on blood pressure levels, as shown in Table 1.

Table 1. Blood Pressure Classification

Grading	SBP(mmHg)	DBP(mmHg)
Normal Blood Pressure	< 120 and	< 80
High Normal Blood Pressure	120 - 139 and(or)	80 - 89
Hypertension	≥140 and(or)	≥ 90
Grade 1 Hypertension (Mild)	140 - 159and(or)	90 - 99
Grade 2 Hypertension (Moderate)	160 - 179and(or)	100 - 109
Grade 3 Hypertension (Severe)	≥180 and(or)	≥110
Isolated Systolic Hypertension	≥140 and	< 90

Note: When SBP and DBP fall into different grades, the higher grade is used for classification.

The blood pressure classification criteria shown in Table 1 apply to general hypertensive patients. According to research by the Bureau of Disease Prevention and Control, National Health and Family Planning Commission (National Health and Family Planning Commission, Disease Prevention and Control Bureau, 2015), the blood pressure control target for most hypertensive patients should be below 140/90 mmHg. For patients with high-risk factors such as diabetes or proteinuria, it is recommended to lower blood pressure further to below 130/80 mmHg, provided that the treatment is well tolerated and sustainable. For elderly patients, the blood pressure reduction target is typically a systolic blood pressure below 150 mmHg (Du, 2017). Given the differences in blood pressure management goals across populations, these clinical guidelines can serve as important reference points in the design of hypertension management apps, supporting the development of personalized and precision-based blood pressure management features.

2.2 Causes, Symptoms, and Hazards of High Blood Pressure

A literature review of existing research on the causes of hypertension was compiled, with the results presented in Table 2, systematically summarizing the major factors that predispose individuals to hypertension. The pathogenesis of hypertension is complex, involving long-term interactions among multiple factors. Currently known contributing factors include individual characteristics such as genetics, age, body composition, smoking and alcohol consumption, chronic mental stress, and diabetes (Kuwabara, Hisatome & Niwa, et al, 2018; Gan, 2020), as well as physiological and external environmental factors such as levels of high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, total cholesterol, triglycerides, and occupational environment (Abudesimu, Liu & Siti, et al, 2018). Based on their modifiability, these risk factors can be categorized into two groups: non-modifiable factors, including age, sex, and genetics—biological baseline characteristics that individuals cannot change; and modifiable factors, encompassing long-term excessive alcohol consumption, smoking, persistent psychological stress, overweight and obesity, high-sodium diet, physical inactivity, and dyslipidemia, which can be regulated and controlled through lifestyle interventions. Among these, modifiable factors play a significant role in the prevention and management of hypertension. Scientific lifestyle adjustments can effectively control blood pressure and help patients achieve long-term self-management.

Table 2. Prior Research on Factors Causing Hypertension

Researcher(s)	Title	Causes of Hypertension	Remarks
Kim, Shin & Lee, (2020)	Comparison of nomograms designed to predict hypertension with a complex sample	Age, gender, obesity, overweight, family history (genetics), diabetes, drinking, stroke, dyslipidemia	Department of Statistics, Yeungnam University
Son, (2010)	Factors affecting the continuity of taking drugs and therapy for patients with hypertension in Korea	Genetic factors, smoking, alcohol, salt, weight, physical exercise, hyperlipidemia, and diabetes	Department of Health, Graduate School of Hanyang University
Kim & Son, (2012)	Prevalence and Risk Factors of Hypertension in the Elderly in Korea, Journal of Korean Biological Nursing Science	Gender, diabetes, overweight (obesity), age	a Ph.D. program in the Department of Nursing at Inje University
Liu, (2006)	Factors affecting hypertension	Age, smoking, socioeconomic factors, geographic environmental factors, and drugs.	Medicine (Professor of Cardiovascular Medicine)

Committee for the Revision of the Chinese Hypertension Prevention Guidelines, (2019)	Guidelines for the Prevention and Treatment of Hypertension in China (2018 Revision)	Eating habits (salt intake), weight (overweight, obese), alcohol (overdrinking), and long-term mental tension	Medicine (Medical organizations, such as the revision of guidelines for prevention of high blood pressure in China)
Hypertension Branch of Chinese Geriatrics Society, (2019)	Guidelines for the Management of Hypertension in Elderly Chinese Patients 2019	Smoking, blood lipid abnormalities, obesity, alcohol, eating habits (salt intake), and sleep quality	Medicine (Chinese Academy of Geriatrics)
Lin, Lu & Sun, (2014)	Retrospective analysis of risk factors and complications in 78 patients with essential hypertension	family history, overweight, food, obesity, drinking, mental strain	Medicine (International Medicine)

Clinical manifestations of hypertension vary among individuals. In the early stages, the condition is often asymptomatic or presents with subtle, non-specific symptoms. Some patients may experience only non-specific discomfort such as dizziness, headache, neck stiffness, fatigue, or palpitations. Blood pressure elevation frequently occurs after physical exertion, mental stress, or emotional fluctuations and may return to normal levels after rest. As the disease progresses, blood pressure gradually increases and remains persistently elevated, entering a chronic progressive phase known as "benign (or gradual-onset) hypertension." Common symptoms during this stage include headache, dizziness, decreased concentration, memory impairment, numbness in the limbs, increased nocturnal urination (nocturia), palpitations, chest tightness, and fatigue. Notably, many patients experience a rapid rise in blood pressure upon morning activity, a phenomenon known as "morning hypertension." This sharp morning surge significantly increases the risk of cardiovascular and cerebrovascular events (such as myocardial infarction and stroke), which often occur during the early morning hours.

When blood pressure rises sharply to a certain level, patients may experience clinical symptoms such as severe headache, vomiting, palpitations, and dizziness. In severe cases, symptoms such as impaired consciousness or seizures may occur—this condition is classified as accelerated hypertension or hypertensive crisis. At this stage, vital organs such as the heart, brain, and kidneys often suffer severe damage within a short period, including stroke, myocardial infarction, and acute renal failure (Zhao, 2020). Although these clinical symptoms are closely associated with a sudden increase in blood pressure, there is no clear linear correlation between symptom severity and the exact magnitude of blood pressure elevation. This suggests that disease progression is influenced not only by absolute blood pressure levels but also by multiple factors, including target organ tolerance and the patient's underlying health conditions.

2.3 Investigation and Analysis of Hypertension Health Management

The fundamental goal of hypertension management is to reduce the risk of complications and mortality in target organs such as the heart, brain, kidneys, and blood vessels, thereby effectively improving patients' quality of life and long-term health outcomes.

Hypertension management primarily relies on patient self-management. Self-management refers to an individual's active participation in the entire process of disease prevention, health maintenance and promotion, and early detection of health issues, starting with initial health management. Particularly, by receiving professional medical treatment, patients actively engage in thinking, making judgments, and responding to their own health conditions, thereby developing the positive daily

behavioral habits necessary for managing chronic diseases — this represents a key attitude in health management (Cao, 2023). Self-management for hypertensive patients typically includes taking medication regularly, monitoring blood pressure consistently, recording and evaluating blood pressure changes, as well as lifestyle modifications such as smoking cessation, weight control, limiting alcohol consumption, and maintaining a balanced diet. The goal is to achieve effective blood pressure control through long-term, sustained behavioral interventions (Xu, 2013).

Researchers Zhang et al. (2024), and colleagues explored the application of digital home blood pressure monitoring (HBPM) in hypertensive patients using a Bluetooth-enabled blood pressure monitor paired with a dedicated WeChat Mini Program, "FAIR Research Assistant." The Mini Program offers functionalities such as automatic HBPM data upload, historical blood pressure review, and personalized health management recommendations. To enhance adherence, the research team reinforced patient – clinician engagement through WeChat group interactions and telephone reminders. Statistical analysis from this clinical study demonstrated that a digital HBPM management model can effectively achieve high adherence to blood pressure measurement among participants.

In her study, Wang(2021) conducted on-site investigations of community healthcare institutions and carried out in-depth interviews with both patients and community physicians. By comprehensively analyzing resource allocation processes and operational models, she developed a new service blueprint and established a three-tier blood pressure management model–integrating "individual–community–hospital" levels–to realize an innovative design practice for community-based hypertension management and enhance user experience.

Currently, various hypertension self-management programs have been widely implemented in multiple countries, such as the United States, the United Kingdom, Canada, and Australia, and are gradually being integrated into routine community health services. However, overall, participation rates in these programs tend to be low, and they often struggle to integrate effectively into patients' daily lifestyles, facing numerous challenges during implementation. Warren-Findlow et al. (2018) and colleagues investigated the level of engagement in hypertension self-management behaviors, using the "H-Scale" as an assessment tool. This scale focuses on the prevention and management of chronic diseases and covers a series of key behaviors that help reduce the risk of hypertension-related complications. Using basic psychometric methods, the H-Scale can be used to evaluate patients' adherence to recommended hypertension self-management practices, thereby providing a scientific basis for developing intervention strategies.

Kushner and Sorensen (2013) noted that, as an emerging discipline, lifestyle medicine has gradually evolved in recent years into a systematic approach for managing chronic diseases. It focuses on intervening in multiple health-risk behaviors and enhancing individuals' self-efficacy in disease management. Unhealthy lifestyles are the primary root cause of chronic diseases worldwide; it is estimated that approximately 63% of deaths are closely associated with adverse lifestyle factors. Lifestyle medicine offers an innovative and challenging strategy for prevention and treatment, emphasizing the prevention, control, and even reversal of chronic diseases through evidence-based lifestyle interventions.

Improving hypertension management levels is an important research topic that urgently needs to be addressed.

From the above theoretical research, it can be seen that current hypertension management primarily relies on two models: self-management and lifestyle medicine. However, despite widespread promotion of these approaches, the incidence of hypertension and its related complications has not been effectively controlled. Most patients lack a systematic understanding of the pathological characteristics of hypertension at different stages and often remain at the level of "passive medication,"

blindly and mechanically taking prescribed drugs. This leads to suboptimal blood pressure control and may even result in paradoxical blood pressure elevation or worsening of target organ damage, causing a continuous deterioration in overall health. The main reasons for this situation include:

(1) Low adherence to management behaviors: Compared to pharmacological treatment, non-pharmacological interventions such as dietary regulation, weight management, and regular physical activity have significantly lower compliance rates.

(2) Lack of effective supportive management tools: Patients lack convenient and continuous support in daily management, making it difficult to establish stable behavioral habits.

(3) Poor adaptation of management models ("incompatibility with local conditions"): Existing self-management strategies are mostly adapted from experiences in developed countries and often fail to align with Chinese patients' living habits, cultural backgrounds, and practical circumstances, making implementation challenging.

(4) Insufficient disease knowledge and medication guidance: Patients have an unclear understanding of symptom presentation, disease progression, and types of medications for hypertension. Medication information is often vague, and patients lack dynamic guidance and personalized recommendations from healthcare providers during long-term treatment.

(5) Weak preventive awareness: Hypertension has complex causes, yet the general public commonly lacks systematic and proactive preventive measures in daily life.

Therefore, there is an urgent need to establish a collaborative management model that integrates self-management, healthy lifestyle interventions, and professional medical support. By integrating hospital resources, digital tools, and community services, this model aims to enhance patients ' comprehensive understanding of hypertension, strengthen their self-management capabilities, and facilitate a shift from "passive treatment" to "proactive prevention and control," thereby achieving long-term and effective management of hypertension.

3. Investigation and Analysis of Blood Pressure Management App Examples

The subject of this case study is mobile applications for hypertension management. Based on selection criteria such as download volume, user ratings, and functional comprehensiveness, three representative hypertension management apps were selected from the Apple App Store for analysis: Smart Blood Pressure (SmartBP), Blood Pressure ++ (Hypertension Tracker), and Songaree Blood Pressure. The Smart Blood Pressure (SmartBP) app has a rating of 4.3 and over 10,000 downloads. Its health-related features are limited to functions associated with hypertension etiology, making it more like a blood pressure diary. The Blood Pressure ++ app has a rating of 4.2 and has exceeded 10,000 downloads, but it offers limited health-related functionalities. The Songaree Blood Pressure app boasts a perfect 5.0 rating — indicating exceptionally high user satisfaction — and has been downloaded over 1,000 times, offering comprehensive health-related features. Notably, the first two apps support Apple Watch integration or automatic data synchronization via Apple Health, whereas Songaree Blood Pressure is a standalone blood pressure management app that does not support automatic synchronization. Detailed application information and selection criteria are provided in Table 3.

Table 3. App Survey Subjects

App Subject	Smart Blood Pressure（SmartBP）	Blood Pressure ++ (Hypertension Tracker)	Fongaree Blood Pressure

logo			
Evaluation	4.3 points	4.2 points	5 points
Download Volume	10000+	10000+	1000+
Usage Method	Can connect to Apple Watch	Can connect to Apple Watch	Standalone use
Features	Can connect to Apple Watch; supports manual blood pressure entry or automatic synchronization via Apple Health, includes blood pressure charts, data analysis, and features for sharing blood pressure information with doctors.	Can connect to Apple Watch; supports manual blood pressure entry or automatic synchronization via Apple Health, includes data analysis charts, analytics, and reminder functions.	Blood pressure management, medication management, diet management, weight management, blood pressure charts, reminder functions, and diagnosis management.
Characteristics	Well-organized layout, strong icon guidance, easy to use and understand, rich in features.	Simple layout, easy to use, limited features.	Well-organized layout, easy to use, comprehensive features.

This study systematically evaluates the strengths and weaknesses of the interface design of three hypertension management apps by analyzing their information architecture at the functional level and examining five key elements in GUI design—layout, color, icons, typography (Li, 2020), and data visualization—combined with user feedback from in-depth interviews. The aim is to provide a basis for optimizing the user experience of hypertension management apps.

3.1 Information Architecture Analysis

As shown in Figures 3, 4, and 5, the information structures of Smart Blood Pressure (Smart BP) and Songaree Blood Pressure are similar, both adopting a three-level information hierarchy. Users navigate from the main interface to secondary pages through functional icons such as "Blood Pressure," "Analysis," "Diet," "Medication," and "Sharing," enabling progressive access to information. This clear, consistent structure helps new users quickly understand the app's logic and easily locate desired functions, thereby enhancing usability and operational efficiency in blood pressure management. In contrast, although Blood Pressure++ (Hypertension Tracker) also employs a three-level information architecture, it features fewer functional modules on the main interface—limited primarily to core entries such as "Blood Pressure," "Analysis," and "Sharing." As a result, its overall information architecture and functional setup are more streamlined, with relatively limited depth of content and scope of management dimensions. Furthermore, in terms of device connectivity, both Smart Blood Pressure and Blood Pressure++ support integration with the Apple Watch, enabling automatic synchronization of blood pressure data, facilitating continuous monitoring, and improving the timeliness and completeness of data recording. In comparison, Songaree Blood Pressure currently supports only manual entry of blood pressure values, which is less convenient.

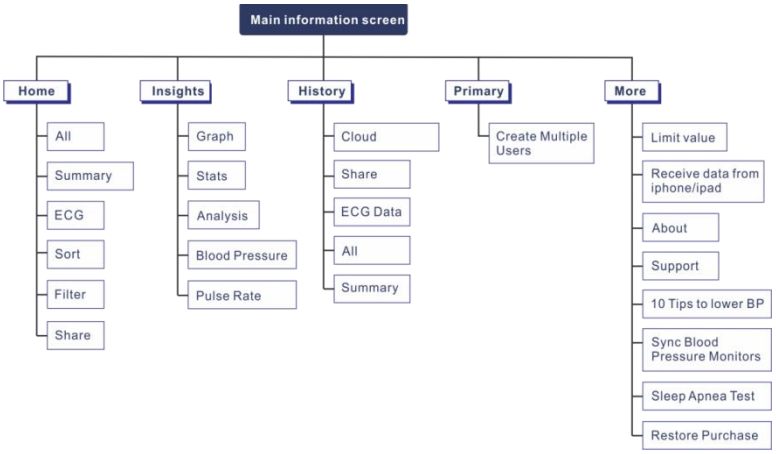


Figure 3: Main Information Structure of the Smart Blood Pressure App

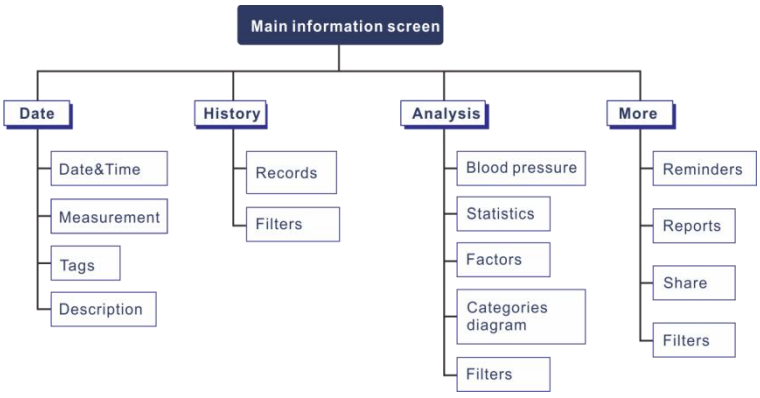


Figure 4: Main Information Structure of the Blood Pressure++ App

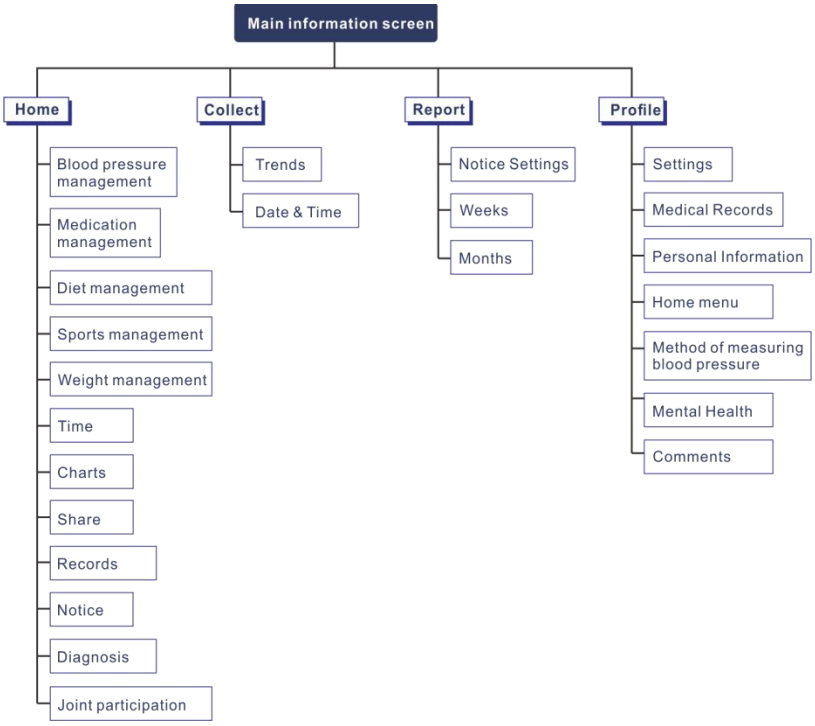
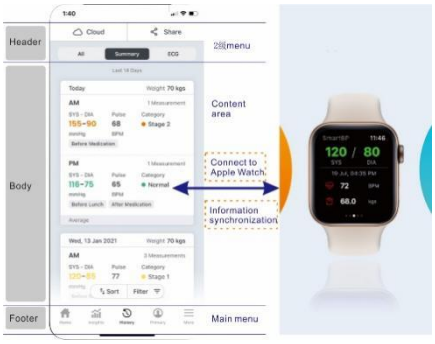
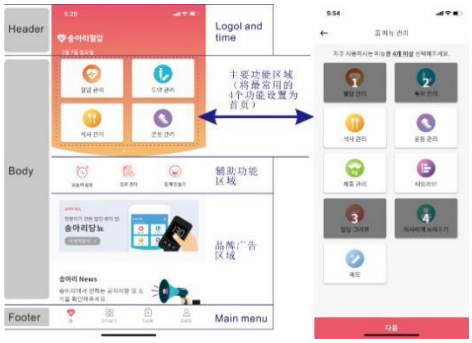


Figure 5: Main Information Structure of the Songaree Blood Pressure App

3.2 Graphical User Interface (GUI) Design Analysis

In terms of layout design (Table 4), the three apps exhibit notable differences. Both Smart Blood Pressure and Songaree Blood Pressure adopt a three-part structure on the home screen — Header, Body, and Footer — resulting in a similar overall framework. However, Smart Blood Pressure features a clearer information layout, well-defined logic, and strong interface guidance, enabling even first-time users to quickly understand and complete tasks. In contrast, Songaree Blood Pressure appears less clear in information categorization and organization, with functional entry points that are not sufficiently intuitive, potentially leading to user confusion. Although Blood Pressure++ employs a simpler two-part layout on the home screen — Body and Footer — without a dedicated Header section, its structure is clean and focused, with a logical visual flow. Users can quickly locate core functions, and operations are straightforward and convenient, demonstrating strong overall usability.

Table 4. App Layout Analysis

App	Smart Blood Pressure	Songaree Blood Pressure
Layout		
Characteristics	The homepage layout is divided into three sections—Header, Body, and Footer—making it very clear and well-organized. The content is easy to understand and allows for quick navigation and operation.	The homepage layout is divided into three sections—Header, Body, and Footer. However, the categorization and organization of information are somewhat unclear, which may lead to user confusion or misinterpretation.
APP	**Blood Pressure ++**	
Layout		
Characteristics	The homepage layout consists of two sections—Body and Footer—featuring a clear, well-defined structure that is easy to understand and enables quick and efficient operation.	

From a color design perspective, the three apps demonstrate harmonious, cohesive color schemes, each exhibiting a distinct visual style.

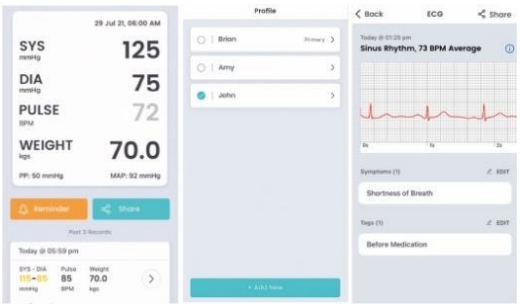
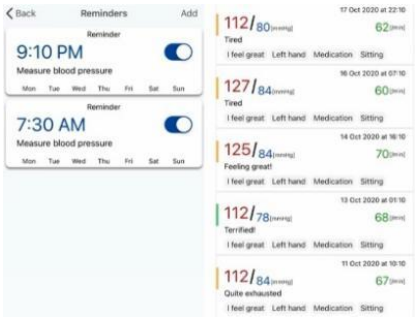
Smart Blood Pressure uses a comfortable shade of gray as the overall background color and skillfully incorporates subtle accent colors for highlights. This design not only makes the interface visually rich and non-monotonous but also creates a professional, calm visual impression, facilitating ease of use and comfortable prolonged interaction for users.

Blood Pressure++ boldly uses white as the primary background color, applying color only to highlight key information such as blood pressure readings, timestamps, and charts. This minimalist design approach results in a clean and clear interface, significantly enhancing information readability and helping users maintain focus.

Songaree Blood Pressure employs a color scheme that combines a gradient from red to orange-yellow with white, and most icons also use the same gradient color palette. The overall design features high color saturation, creating a vibrant, energetic impression. However, due to the extensive use of red and the gradient effects, it may amplify potential negative emotions such as irritability and anxiety in hypertensive patients, thereby impairing user experience and reducing users' affinity toward the app.

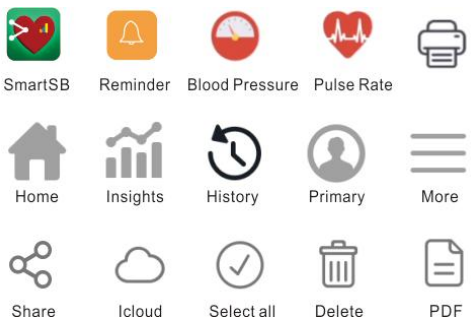
In summary, although the three apps each have distinct color design characteristics, given the special needs of hypertensive patients, color selection should not only be aesthetically pleasing but also consider their impact on users' emotional state. Soft, low-stimulation color schemes can enhance user comfort and encourage long-term use.

Table 5. App Color Analysis

App	**Smart Blood Pressure**	**Blood Pressure ++**
Color Scheme		
Characteristics	The background color is light blue-gray, with two symmetrical functional options on the homepage using complementary blue and orange. Most functional options throughout the app predominantly use shades of blue. The overall color scheme is very comfortable and harmonious.	The overall color scheme uses white as the primary background color, with only blood pressure values, timestamps, and charts displayed in color. This design is extremely minimalist and clean.
APP	**Songaree Blood Pressure**	
Color Scheme		
Characteristics	The overall color scheme employs a gradient from red to orange-yellow paired with white, and most icons use this palette. The high saturation of the colors creates an intense and vibrant impression.	

From the perspective of icon design (Table 6), although the three apps include icons representing the same functions, their visual expressions differ significantly, leading to noticeable differences in recognizability and user comprehension. For example, the "Home" icon in Smart Blood Pressure uses a universally recognized house symbol, which clearly relates to the "home page" function. The combination of image and text appears natural, allowing users to quicklyly understand its purpose. In contrast, Songaree Blood Pressure's "Home" icon is identical to its brand logo, lacking any visual association with the "home" function. Users cannot easily connect the graphic to its intended use, resulting in poor recognition and potential confusion. Regarding data analysis functionality, Smart Blood Pressure's "Insights" icon integrates visual elements such as bar charts and trend lines to clearly convey the concept of "blood pressure trend analysis." This design offers strong guidance and readability. In comparison, Blood Pressure++'s "Analytics" icon features an abstract, flower-like shape that, while artistic, lacks a direct connection to the concept of "analysis." Its ambiguous semantics increase cognitive load and make it harder for users to interpret. Most other icons across the apps are clear, with many adopting industry-standard symbols (such as hearts, gears, and calendars) or achieving good readability through close alignment of graphics and accompanying text, making them generally easy to recognize and use. In summary, icon design should prioritize functional clarity while balancing aesthetics and cognitive consistency. Smart Blood Pressure demonstrates superior performance in terms of icon semantic accuracy and user-friendliness, whereas the other two apps still have room for improvement in the practical design of certain icons.

Table 6. Comparative Analysis of App Icons

App	Smart Blood Pressure	Blood Pressure ++
Icon		
Characteristics	The overall icon design uses a combination of graphics and text labels to convey information to users, reinforcing memory and guiding user interaction. To emphasize key information, some icons employ bright colors to attract user attention.	Very few icons are used—apart from the logo, only the navigation icons at the bottom of the app's home screen are present, and colors are limited to gray and black.
APP	Songaree Blood Pressure	

Icon	
Characteristics	The app uses a large number of icons throughout, with strong visual guidance that clearly conveys the meaning of each icon. A variety of colors is used to differentiate the icons, while gradient coloring enhances their visibility and prevents the interface from appearing monotonous. For hypertensive patients, the use of multiple colors provides emotional comfort. However, some icons have weak associations with their accompanying text labels; without the text, they could easily lead to misoperation—for example, the "Home" icon.

From the perspective of chart design for data analysis (Table 7), the three apps employ different approaches to visualizing the blood pressure data, resulting in noticeable differences in clarity and user comprehension. Songaree Blood Pressure primarily uses line charts and pie charts for blood pressure analysis. The line chart displays trends in systolic pressure, diastolic pressure, and pulse rate over a one-week period using three distinct colors to clearly illustrate dynamic fluctuations. The pie chart shows the distribution of blood pressure readings over a given cycle, with differently colored segments representing various blood pressure levels — for example, red indicating the proportion of "dangerously high" readings. Both chart types are designed simply and clearly, enabling intuitive understanding and self-assessment by users. Blood Pressure++ mainly uses a connected scatter plot to display blood pressure data, with differently colored dots representing systolic pressure, diastolic pressure, and heart rate. However, due to the dense clustering of data points and connecting lines, combined with low color contrast, the overall visual appearance is cluttered. This increases cognitive load and makes information interpretation difficult for users. Additionally, its "FACTORS" chart lacks sufficient labels and explanatory notes, resulting in ambiguous functionality and further reducing its comprehensibility. Smart Blood Pressure employs three types of charts for multidimensional analysis. First, the main blood pressure chart uses dual-colored lines to represent systolic and diastolic pressure, respectively, providing a clean and immediately understandable visualization of trends. Second, to help users gain deeper insights into their blood pressure control, a separate bar chart for systolic pressure is provided, using colored bars to show the proportion of readings falling into different ranges (e.g., normal, elevated, dangerous), thereby offering a clear visual assessment of control effectiveness. Third, while the "Sinus Rhythm" analysis chart is not a common chart type and may be difficult for average users to interpret, the app allows users to share the chart and supplementary explanations directly with their doctor with one tap. This facilitates professional interpretation of complex data and enhances clinical communication efficiency. In summary, Songaree Blood Pressure and Smart Blood Pressure place greater emphasis on clear information delivery and user-friendliness in their chart design, whereas Blood Pressure++ has significant room for improvement in terms of data readability. Thoughtful selection of chart types and effective labeling are crucial for enhancing hypertensive patients' data literacy and self-management capabilities.

Table 7. Comparative Analysis of App Charts

App	Songaree Blood Pressure	Blood Pressure ++
Charts		
Characteristics	Primarily uses line charts and pie charts for hypertension analysis. In the line chart, three different colors represent the trends of systolic pressure, diastolic pressure, and pulse rate over a one-week period. The pie chart shows the analysis of blood pressure measurements taken over a cycle, with different colored segments representing the proportions of various hypertension levels.	Blood pressure analysis primarily adopts a scatter plot with connecting lines. Although colored dots represent systolic pressure, diastolic pressure, and heart rate, the chart contains both lines and densely packed points with similar colors, making it visually cluttered and difficult to interpret. Additionally, the FACTORS chart lacks annotations, making it harder for users to understand its meaning.
APP	**Smart Blood Pressure**	
Charts		
Characteristics	Among the three types of charts mentioned, the blood pressure analysis chart uses a line graph with two colors to represent systolic and diastolic pressure, making it simple and easy to understand. To better understand blood pressure conditions, a separate systolic pressure analysis is conducted, where differently colored bars represent the proportions of various blood pressure levels. However, the Sinus Rhythm analysis chart is not a commonly used type, which makes it difficult for users to understand.	

From the perspective of text design, an analysis of the text in the aforementioned charts reveals that all three apps use sans-serif, bold fonts in their menu interfaces, which provide a clean, clear visual appearance, facilitating quick recognition and readability for users. To reflect content hierarchy and maintain alignment with the overall layout, each app enhances emphasis and visual guidance by appropriately adjusting font size and weight. This approach not only improves interface readability but also strengthens the overall design's sense of hierarchy and aesthetic quality.

Using understandability, readability, visual fatigue, operational intuitiveness, and overall coherence as evaluation criteria for interface recognition difficulty, a comparative analysis was conducted on the interface designs of the three apps. The results show:

Smart Blood Pressure demonstrates the best overall performance in GUI design. Its layout is clear, color scheme harmonious, icon semantics explicit, charts intuitive and easy to understand, and typography appropriately applied. The five key design elements are highly integrated with a consistent style, resulting in a positive user experience.

Blood Pressure++ features a clean, clear color design; however, it performs relatively weakly in other aspects, such as layout, icons, charts, and text presentation. Information hierarchy is insufficiently emphasized, and certain design choices hinder comprehension efficiency, resulting in overall performance slightly inferior to that of the other two apps.

Songaree Blood Pressure excels in icon and chart design, with simple graphics and clear logic that facilitate user understanding and operation, outperforming the other two apps in these aspects. However, it falls short in terms of the psychological suitability of color, potentially causing discomfort for users.

In summary, each of the three apps has its own strengths. Among them, Smart Blood Pressure stands out as the most balanced and superior in terms of overall interface design coherence and usability.

3.3 Analysis Results

The three apps have their own strengths and weaknesses in information structure and GUI design. The comparative analysis reveals that Smart Blood Pressure's design is worthy of replication. Through optimized layout and icon guidance, effective use of color and font size for differentiation and emphasis, and integration of chart analysis with doctor interaction features, it helps users understand complex information. Even with a large amount of content, users can quickly locate the information they need. Songaree Blood Pressure shares a similar information structure with Smart Blood Pressure, but its layout is disorganized, with overlapping section titles. The app uses a wide range of colors, with red prominently featured with gradient effects, which could intensify feelings of irritation and anxiety in hypertensive users, thereby reducing user attraction and willingness to use the app. Although its icon and chart designs are simple and easy to understand, these strengths are insufficient to compensate for the drawbacks caused by poor layout and color design. Blood Pressure++ has a simpler information structure compared to the other two apps. However, it uses very few icons, lacking sufficient visual guidance. The interface is predominantly white, with minimal use of color, which weakens visual distinction and emphasis on key content. Long blocks of text can easily cause visual fatigue and reduce users' reading engagement. Furthermore, inconsistencies between labels and graphical information in the charts, combined with cluttered chart design, make them confusing and difficult to interpret.

The five elements of information structure and GUI design have a mutually reinforcing and optimizing relationship. Through thoughtful layout planning, effective icon guidance, improved chart readability, and the strategic use of color and typography for differentiation, emphasis, and explanatory purposes, these elements collectively enhance information delivery efficiency, improve user comprehension, and increase user satisfaction.

4. Conclusion

This study investigates and analyzes three apps—Smart Blood Pressure, Songaree Blood Pressure, and Blood Pressure++—from the patient's perspective. By comparing these apps as design case studies for companion applications of smart blood pressure monitors, and integrating the actual needs of hypertensive patients across three age groups — older adults, middle-aged adults, and adolescents — it identifies both commonalities and differences. A key commonality is that all three apps, in terms of information structure and GUI design, primarily cater to the needs of adolescent and middle-aged users. A notable difference is that all personal information must be entered manually in these apps, and only users with an Apple Watch can achieve automatic synchronization of measurement data. This results in a relatively complex and difficult operation process, imposing a significant usage burden on elderly users. Furthermore, older adults commonly experience vision deterioration and other age-related issues; prolonged app use can easily lead to visual fatigue, thereby reducing their willingness to

use the app and their overall product acceptance. Although Smart Blood Pressure offers certain management features that help adolescent and middle-aged patients reduce their reliance on frequent daily measurements, its design does not fully align with the practical needs of these user groups, and user satisfaction remains relatively low.

The research findings indicate that both standalone hypertension management apps and companion apps for smart blood pressure monitors lack clear user segmentation. There is a mismatch between the information structure and the functional needs of different patient groups. Hypertensive patients are predominantly elderly, followed by middle-aged and adolescent users. Each age group has distinct characteristics and varying functional requirements. In terms of GUI design, there are also differences among these groups in how easily they recognize and access information. Therefore, the interfaces of the hypertension health management app should be designed in a targeted manner, taking into account the specific characteristics and actual needs of different patient populations.

In summary, design recommendations should be tailored to user groups. For older adults with hypertension—who spend more time at home—interfaces should prioritize multimodal interaction, combining voice-based operation with enlarged text and charts to reduce cognitive load and learning barriers. An integrated smart blood pressure monitor that automatically saves readings (without requiring manual uploads) and provides real-time analysis of recent trends is recommended; it should offer actionable insights, including early warnings for severe fluctuations, to help prevent stroke or myocardial infarction. Additional features should include data-driven blood pressure analytics, medication logging with adherence reminders, symptom clarification, lifestyle guidance, and dietary management. In contrast, younger and middle-aged users — typically occupied with school or work during the day — require portable, real-time monitoring solutions, such as smartwatches or compact blood pressure devices paired with mobile apps. Their interface should build on the information architecture designed for older adults but incorporate AI-powered diagnostic capabilities. Furthermore, visual elements—including layout, color scheme, typography, icons, and data visualizations—should reflect a modern, tech-savvy aesthetic to align with their stylistic preferences and expectations.

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