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Elderly User Engagement with Mobile Health Applications: A Qualitative Analysis of User Interface and User Experience for Enhanced Technology Acceptance through a Scoping Review

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Abstract

Background: Mobile health applications (mHealth Apps) are designed to align with user preferences to enhance engagement and create valuable experiences. This study aimed to investigate user interface (UI) design patterns in mHealth applications and promote technology acceptance among elderly users.

Methods: The study employed a scoping review methodology. A comprehensive search was conducted across databases using the PRISMA framework, and the Rayyan application was utilized to further compile data from various sources regarding mHealth usage among individuals aged 60 years and older. The scoping review synthesized and summarized findings on how the elderly adopt mHealth applications for health benefits.

Results: The findings indicated that factors such as visual clarity, color scheme, layout, intuitive navigation, iconography, and accessibility had a significant relationship with users' behavioral intentions to engage with mHealth UIs. It is anticipated that designing interfaces based on the preferences of a certain group of users could enhance their acceptance of technology.

Conclusion: This study underscored the critical role of UI design in developing mobile applications for the elderly. It encouraged UI designers to incorporate relevant design elements while developing these applications. Recommendations for developers included ensuring easy navigation, using clear fonts and colors, minimizing content, and incorporating visually intuitive buttons. Moreover, the study highlighted the importance of including emergency contact numbers in m-health applications.

Keywords: Mobile health, User intention, User interface, User experience, Technology acceptance, Elderly

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Introduction

Elderly individuals represent one of society's most valuable resources. Aging is a natural phenomenon that brings both opportunities and challenges. Many countries are experiencing growth in the size and proportion of their elderly populations. It is projected that by 2030, the ratio of elderly individuals aged 60 years and older will be 1 in 6, with the global population of older adults expected to double to 2.1 billion by 2050 (1).

According to the 2011 census, India has approximately 104 million individuals aged 60 and older, constituting around 8.6% of the total population (1). The Indian government has established frameworks to address the needs of the elderly, including the National Policy on Older Persons (1999), the Maintenance and Welfare of Parents and Senior Citizens Act (2007), and the National Policy for Senior Citizens (2011). Moreover, Ayushman Bharat, the National Programme for Health Care of the Elderly, aims to enhance healthcare services through health and wellness centers in primary healthcare settings.

Despite advancements in healthcare delivery for the elderly, there has been a stable rise in the prevalence of moderate to severe diseases among the elderly in the past few decades (2), resulting in increased utilization of different health services (3-6). Many elderly individuals encounter difficulties accessing healthcare services due to challenges such as remoteness of hospitals and clinics, limited resources, and age-related degradation (7,8).

The rapid advancement of communication technology has made it easier for individuals to monitor and manage their health through various devices and applications (9-12). Such systems enable patients to record and access a wide array of health data, providing education about common conditions among the elderly, such as diabetes, hypertension, and myocardial infarction (13). These technologies can also facilitate communication with

healthcare practitioners and caregivers.

However, the limited experience of elderly individuals with technological tools, along with age-related cognitive and non-cognitive changes, may impede their ability to effectively use these technologies. For instance, vision impairment is a common consequence of aging that can hinder the use of mobile health applications. Besides, age-related declines in memory may complicate tasks such as logging in or registering for mobile health services. Addressing these barriers is crucial when developing health service applications for mobile devices.

Mobile health technology and electronic health technology: An overview

Since 1999, electronic health (e-health) has been recognized as a distinct category of electronic services, such as e-commerce and e-solutions. E-health encompasses any service that integrates computer technology with healthcare delivery (14). It combines elements of medical informatics and public health while utilizing internet-based services to enhance medical access and communication. E-health is beneficial not only to organizations but also to patients and caregivers, aiming to provide effective healthcare solutions. Research indicates a need for increased education and development to promote broader acceptance of e-health among users (15).

Mobile health applications (mHealth apps) utilize internet-enabled communication devices – specifically mobile devices - to deliver medical assistance and health-related information to patients (16). This technology empowers individuals to improve their health and facilitates access to medical care, particularly for the elderly, who may be motivated to enhance their health (17). These applications can help health-conscious individuals avoid unhealthy behaviors and maintain a healthy lifestyle (18). Furthermore, mHealth allows for remote consultations with healthcare providers (19). As mobile-based solutions, mHealth applications can be customized to meet user needs, thereby enhancing accessibility (20,21) and increasing user satisfaction. User perceptions and attitudes toward these applications form the initial contact point between the users and the application (22).

Elders' perceptions towards mHealth and technology acceptance

As people age, they often experience an increase in chronic diseases and cognitive decline (23), which can put a significant burden on the healthcare system (24). Mobile Health applications can alleviate some of this burden for elderly users (25) by providing timely medication reminders and health monitoring capabilities. These applications also serve to inform users about age-related problems, including causes, symptoms, and necessary precautions.

Technology acceptance among the elderly

Research on technology acceptance, including frameworks such as the Technology Acceptance Model (TAM) (26) and TAM-2 (27), has been instrumental in understanding how elderly individuals adopt and use technology. The Senior Technology Acceptance Model (STAM), an extension of TAM specifically tailored for senior citizens, identifies key elements such as user context, perceived usefulness, intention to use, experimentation and exploration, ease of learning and use, confirmed usefulness, actual use of technology, and acceptance and rejection of technology, as shown in Figure 1 (28).

Four principles have been recommended for the user interface (UI) and user experience (UX) design of mobile applications aimed at elderly users: perceivable, operational, understandable, and accessible (29). This study sought to identify the level of technology acceptance

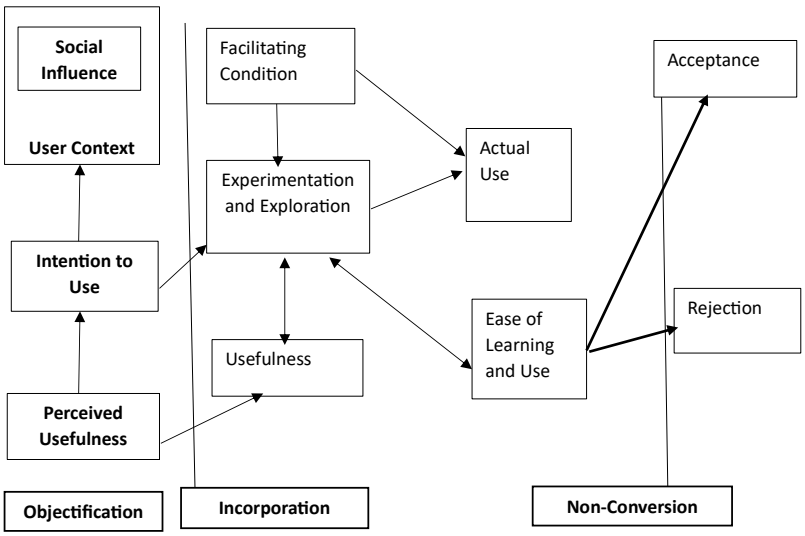

Figure 1. Proposed Senior Technology Acceptance Model (STAM) (28)

among the elderly and understand the UI/UX interfaces most suitable for the elderly's use of mHealth applications. The perspective of the elderly towards the use of mHealth and UI/UX interfaces has received little attention in research. Therefore, this scoping review aimed to examine the views of older adults on technology acceptance and the use of mHealth applications. Moreover, current research on mobile application design using appropriate UI/UX standards for the elderly lacks focused guidance for digital stakeholders, mHealth developers, and elderly users. Accordingly, this study aimed to:

1. Investigate the willingness of older adults to use m-Health applications to monitor and manage their health conditions
2. Identify the UI/UX indicators relevant to older adults using mHealth applications to monitor and manage their health conditions.
3. Define the features of mHealth applications that motivate older adults to monitor and manage their health conditions

Methods

This study employed a scoping review methodology, which involves a comprehensive examination of existing literature, to assess the conceptual exactitude of the use of mHealth applications among the elderly (30,31). The decision to use a scoping review rather than a systematic review (32) is based on the distinction that systematic reviews focus on synthesizing quantitative and qualitative data to evaluate the efficacy of treatments and interventions. On the contrary, scoping reviews are more appropriate for: a) exploring the available literature on mHealth applications and their use by the elderly; b) elucidating key concepts related to the subject of the study; and c) identifying gaps in the literature.

The analysis of the study articles involved several phases:

Phase 1: Identifying the existing literature for review: The articles were selected from different research databases such as Scopus, PubMed, ProQuest, and the Journal of Medical Internet Research (JMIR); Phase 2: Selecting and reviewing the studies; Phase 3: Charting the data; and Phase 4: Summarizing and analyzing the results. For the scoping review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-ScR) was utilized.

Phase 1: Eligibility criteria

The studies included in this review were selected based on the following criteria: (i) articles published in English; (ii) qualitative, quantitative, or mixed-methods studies contributing to empirical research; (iii) articles published in peer-reviewed journals or conferences; and (iv) study participants and respondents aged 60 years or older. Exclusion criteria were as follows: (i) articles not written in English; (ii) grey literature; and (iii) studies conducted on respondents or participants younger than 60 years. The age criterion of 60 years and older aligns with the United Nations' definition of an "older" person, applicable globally (33,34). Included studies explored factors such as social influence, intention to use, perceived usefulness of the application, conditions facilitating UI and UX interfaces, experimentation or exploration of mHealth applications, ease of use, and rejection or acceptance of mHealth applications by the elderly.

Phase 2: Screening

In the second phase, guided by Arksey and O'Malley's framework (31), relevant studies for the scoping review were identified. This phase included two stages of screening: (1) searching titles and abstracts using the keywords listed in Table 1; and (2) conducting a full-text screening. In the first stage, titles were examined to determine relevance to mHealth and elderly populations, followed by an analysis of abstracts based on inclusion or exclusion criteria. Articles meeting the inclusion criteria proceeded to the second stage, where full-text articles were reviewed. Any articles not fulfilling the required criteria were excluded from the study.

Phase 3: Charting the data

Data were charted utilizing a PRISMA flow chart (Figure 2). Initially, 100 papers were identified and uploaded to Rayyan (49) for data screening, applying the established exclusion and inclusion criteria. After screening titles against pre-defined eligibility criteria, 250 studies were excluded, leaving 100 papers for further consideration. Subsequently, 25 papers were excluded during abstract screening, resulting in 17 papers deemed suitable for data extraction. Throughout the preliminary data screening, it was emphasized that study participants should be aged 60 years or older (50,51).

Phase 4: Analysis

Data were extracted from the 17 included studies, noting the following information: author and year, use

Table 1. Search strings used as keywords

Mobile application	Elderly	Perspective	Facilitate
M-health	Elders	View	Motivation
e-Health	Older people	Perspectives	Perseverance
Telehealth	Ageing generation	Attitude	Promotion
Mobile health	Ageing population	Perception	Ease of Use
Mobile technology	Older population	Ease of use	Security
Telematic health apps	Elder generation	Mindset	Helpful
Mobile health application	Geriatric	Willingness	Aid
		Adaptability	
		Acceptability	
		Readiness	

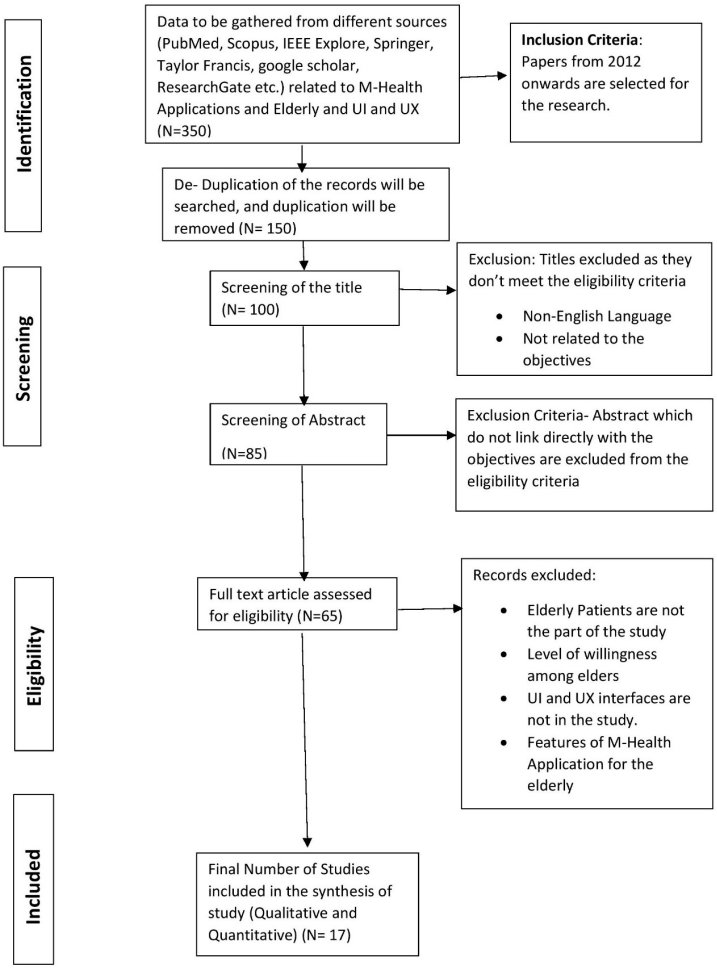

Figure 2. PRISMA flowchart of the study selection process

of mHealth among the elderly, study design, focus of the study (interventions promoting the use of mobile for health and well-being), population age, and application of technology for health interventions, as shown in Table 2. The results were analyzed using the STAM, with a focus on the use of UI/UX interfaces among older adults as a central theme of the study.

Results

The findings from the literature and scoping review highlighted the following:

Benefits of using mHealth applications among older adults

Assessing the use of mHealth applications and the willingness of older adults to adopt these tools is necessary for understanding how they meet health-related needs. With mHealth applications, elderly individuals can more easily monitor and track their health status. These applications facilitate telemedicine consultations through video calls, allowing users to consult healthcare professionals about their medications and health issues remotely. Other benefits include customized features that enable elderly users to receive consultations from healthcare providers in distant locations, thereby allowing nurses to monitor different patients simultaneously.

The reminder functions of mHealth applications greatly assist the elderly in managing their medication schedules, making appointments with doctors, and tracking health updates. The other advantage of mHealth apps is their cost-effectiveness, as the applications are often free to download, and the cost of virtual consultations is generally lower than in-person visits to hospitals.

Challenges faced by the elderly when using mHealth applications

The challenges elderly individuals encounter in using mHealth applications are closely linked to their willingness to adopt these technologies. The scoping review revealed that many of these challenges stem from technological bewilderment and difficulties in navigating mobile applications. Elderly users often require assistance to find the appropriate options within the application, contributing to issues with usability, viewability, and overall presentation.

UI/UX interface for users and challenges for developers

The interface of mHealth applications must prioritize

Table 2. Data extraction from the reviewed literature

Author(s) (year)	Study design	Focus	Population (mean age)	Technology	Findings
Kruse et al (2017) (33)	Qualitative	Medical literacy for the elderly	65 and older	Mobile phones	mHealth can provide the elderly with a sense of independence, according to the systematic narrative analysis of studies over the last year. Future research should focus on improving medical literacy and addressing the complexity of technology to facilitate further adoption.
Kim et al, 2014 (34)	Qualitative	mHealth informatics	50 and older	Mobile phones	With the increase in the use of mobile phones, it is expected that the elderly will be regularly checking their health status at any time and place.
Sama et al, 2014 (35)	Quantitative	Fitness and self-monitoring	60 and older	Mobile devices	mHealth applications are focused on witnessing and self-monitoring. These apps' involvement is restricted, but they provide a chance to increase the efficacy of technology.
Arnhold et al, 2014 (36)	Mixed-methods	Mobile application for patients with diabetes	50 and older	Mobile devices	Applications with limited functionality performed poorly. Furthermore, features like documentation or analysis capability were substantially reduced.
Laakko et al, 2008 (37)	Qualitative	mHealth and wellness	Not specified	Mobile devices	The novel application, UPHIAC, uses a database solution to retrieve and share health information via mobile terminals. It enhances data sharing and communication.
Zhou et al (2019) (38)	Quantitative	User-centric mHealth apps	Not specified	Mobile devices	The new IPHR application allows users to handle a wide range of personal health data in one location. The app bridges the knowledge gap between clinical appointments. According to the research findings, IPHR fits the needs of consumers and is well-received by them.
Paiva et al, 2020 (39)	Qualitative	Mobile applications for elderly healthcare	60 and older	Mobile devices	Most health applications are developed for high-income countries.
Alsswey et al, 2018 (40)	Quantitative	Culturally adapted UI for mHealth apps	60 and older	Mobile devices	Culturally tailored designs improve acceptance. Pharmaceutical companies should align mHealth apps with elderly users' needs.
Handayani et al, 2018 (41)	Mixed-methods	Critical success factors (CSFs) for mHealth	Not specified	Mobile devices	Android-based apps can support elderly self-management in routine health monitoring.
Othman et al, 2018 (42)	Qualitative	Android-based health monitoring for adults	60 and older	Mobile applications	The study focused on self-management via Android apps for elderly routine health management.
Fletcher & Jensen, 2015 (43)	Qualitative	Technology adoption for mHealth	65 and older	Mobile applications	The study identified barriers to mHealth use among the elderly aged 65 and older
Charness & Boot, 2009 (44)	Qualitative	Technology adoption across age groups	24 to 85 and older	Internet/desktop/ mobile devices	Normative age-appropriate design should be considered for elderly users.
Gjevjon et al, 2014 (45)	Qualitative	ICT use among the elderly	59-95	ICT devices	Concerning the use of technology, the elderly's willingness and ability to adopt technology varies from person to person.
Hurmuz et al, 2022 (46)	Mixed-methods	SAM application for health intervention	Not specified	SAM application	mHealth apps can reveal users' personality traits.
De Oliveira et al,2021 (47)	Qualitative	Fall detection via mHealth		iOS and Android Smartphones	The m-Health applications available on iOS and Android are helpful for the adults.
Isaković et al, 2016 (48)	Qualitative	Destress Assistant (DeSA), the diabetes monitoring application	60 and older	Smartphones	Elderly-specific requirements must guide diabetes app development.

clarity in UX and UI design tailored for the elderly. The findings from the scoping review indicated that functional elements should be clear, rudimentary, easy to navigate, and easy to use. In addition, applications should use bright colors and larger font sizes to enhance visibility. Developers should ensure that options for communication, such as booking an appointment or initiating a video call, are easily accessible and clearly presented, potentially through visual icons or pictograms. Furthermore, applications should be designed to meet the specific needs of elderly users, providing timely reminders for medications and appointments. It is crucial that the UI/UX interface avoids information overload and presents information concisely. Font sizes should be adjustable to accommodate varying visual capabilities among elderly users.

Discussion

The integration of mHealth utilization and receptiveness within older populations is a critical focus for research aimed at elucidating the prospective advantages of mHealth applications for enhancing the health and well-being of elderly individuals. Customizing applications to address personal health requirements enables elderly persons to avail themselves of medical consultations from remote locales, concurrently allowing for remote monitoring of numerous patients by healthcare professionals. The imperative necessity lies in ensuring that the UI of mHealth applications is intuitive and accommodating to older

users, thereby prompting developers to strive towards crafting applications that are universally accessible for this demographic cohort.

From the literature analyzed in this scoping review, it can be concluded that with the use of mHealth applications, elders can track their health, manage health records, and maintain online prescriptions (50-57). Remote healthcare access was also viewed as a significant benefit of mHealth applications, allowing for remote doctor consultation from the comfort of home at their convenience (52-63).

Regular healthcare and doctor consultations are vital for elderly individuals. Authors emphasized that remote consultations are particularly beneficial when access to nearby hospitals or doctors is limited. Thus, mHealth is positioned as a crucial resource for the elderly. The affordability of these applications has reportedly reduced medical expenses and hospital bills for elderly users (50-64).

Evidence from various studies indicates that mHealth applications promote greater self-reliance, self-regulation, and self-supervision among elderly users, while simultaneously alleviating pressure on healthcare providers. With the use of the application, there is an increase in communication between doctors, health professionals, and elderly patients. However, significant barriers persist, primarily due to the limited technological proficiency of many elderly individuals (61,63-65).

Based on the TAM for senior citizens, specific guidelines have been formulated to help developers in enhancing the adaptability and accessibility of mHealth applications. Table 3 outlines these constructs and recommendations for addressing the challenges faced by elderly users.

Table 3. Adaptability and accessibility of TAM constructs for mHealth applications

Construct	Recommendations	Constraints	References
Perceivability	Using simple and clear language	Excessive content within the application may hinder the elderly's ability to find their needs	(66)
	Maintaining a straightforward layout	Minimizing advertising to prevent distractions and help users focus on relevant tabs	(68)
	Using larger fonts	Ensuring that tab labels accurately reflect their content, avoiding similarity to reduce confusion	(68)
	Incorporating larger navigation buttons for ease of use		
	Utilizing alternative text for images and icons		
	Providing convenient navigation		
	Implementing color schemes		
	Presenting information concisely and succinctly, avoiding excessive verbosity		
	Including only basic functions needed by the elderly users to reduce complexity		
Coherence	Using clear, concise, and unambiguous language throughout the application	Hypertext navigation features can create complex, non-linear paths that may confuse elderly users	(66)
	Keeping content simple and easy to understand	Maintaining consistency in font styles, sizes, textures, and colors across pages	(67)
	Providing step-by-step instructions that are straightforward for elderly users	Frequent changes in layout and navigation can cause uncertainty about what actions to take	(67)
	Incorporating a recognizable and intuitive search toolbar for elders		(67)
	Including an SOS helpline number for emergency situations	Excessive content concentrated in one area can also lead to confusion	
Feasibility	Allowing elderly users to easily change font sizes	Avoiding overly technological features or complex elements that may overwhelm elderly users. Using color schemes that do not cause visual strain or impair eyesight	(66)
	Enabling switching between dark and light modes according to user preferences		(68)
	Designing the application so that font sizes and interface elements are customizable and adaptable as needed		(66)
Vigorousness	Developing a versatile and universal application compatible with various devices and operating systems globally. Ensuring the interface is adaptable for different visual abilities and usage contexts	Many mHealth applications are limited by incompatibility across different software platforms and technologies, restricting broad usability	

Key considerations include perceivability, feasibility, coherence, and viability.

The study results underscored the importance of developing mHealth applications that are accessible and user-friendly for the elderly, guided by the constructs and implications discussed. The literature further supports that mHealth application design should align with the TAM, where ease of use is a critical construct for the elderly. Promoting awareness among developers regarding these considerations is essential to improve the functionality and acceptance of mHealth applications for the elderly.

Conclusion

This scoping review highlighted insights regarding the accessibility and use of mHealth applications among the elderly, as well as their perceptions of technology acceptance through the lens of the TAM. The study explored the benefits of using mHealth applications for the elderly while addressing the challenges they encounter when utilizing technology for healthcare purposes.

The findings indicated that many elderly users struggle with adaptability to modern technology. Accordingly, several recommendations have been proposed for developers to enhance the usability of mHealth applications for the elderly. Key suggestions included ensuring easy navigation, utilizing visible fonts and colors, minimizing content complexity, and incorporating pictorial buttons to facilitate understanding. Moreover, the study emphasized the importance of including emergency contact features in mHealth applications.

Throughout the scoping review, the study examined whether e-health and mHealth applications can be beneficial not only for elderly users but also for developers. Insights gained from this study underscored the necessity of addressing the unique needs of older adults in m-health application design. By leveraging the benefits of mHealth, elderly individuals can improve their health outcomes by effectively monitoring their health status, tracking appointments, and accessing remote healthcare services.

In conclusion, aligning the design of mHealth applications with the needs and technological acceptance of elderly users is essential for promoting their adoption and facilitating improved health management.

Authors' Contribution

Conceptualization: Upasana Saxena.
Data curation: Upasana Saxena, Nikhilesh Sharma.
Formal analysis: Upasana Saxena.
Investigation: Nikhilesh Sharma.
Methodology: Upasana Saxena.
Project administration: Upasana Saxena, Nikhilesh Sharma.
Resources: Upasana Saxena.
Software: Nikhilesh Sharma.
Supervision: Nikhilesh Sharma.
Validation: Nikhilesh Sharma.
Visualization: Upasana Saxena.
Writing–original draft: Upasana Saxena.
Writing–review & editing: Upasana Saxena, Nikhilesh Sharma.

Competing Interests

The authors declared no conflict of interest in this study.

Ethical Approval

As this study involved a scoping review of existing literature, ethical approval was not required.

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