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Inclusive Design in Digital Medical Interface Adaptation for the Elderly

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Abstract

Addressing challenges posed by an aging society, this study explores inclusive design orientations for digital medical interfaces catering to the elderly. The aim is to enhance inclusiveness and optimize interactive experiences within the medical system for senior users. Employing inclusive design concepts, the study analyzes characteristics through literature, focusing on functional purpose, interactive behavior, and emotional expression in digital medical interface design for the elderly. User research methods, including in-depth interviews and field research, generate user personas and behavioral analysis diagrams, organizing and categorizing pain points for elderly patients with chronic diseases. The study proposes principles for improving service touchpoints based on inclusiveness, optimizing pain point types and design processes in age-friendly services. These enhancements aim to help the elderly adapt to and integrate into a digital lifestyle.Incorporating inclusive design principles enhances the inclusiveness of service design, improving the service experience for the elderly. Age-friendly service design with inclusiveness serves as a valuable entry point for research targeting elderly populations and provides practical strategies for age-friendly medical service process design.

Keywords: *Inclusive Design, Age-friendly, Interface Design, Senior Citizens, Digital Medical*

1. INTRODUCTION

As advancements in information technology continuously propel us forward, we are witnessing an accelerated pace of digitization and intelligence in our daily lives, primarily through smart devices. This progress, however, has also given rise to the digital divide. Aging population has emerged as a significant societal issue worldwide, and the current rate of growth for China's elderly population leads the global trend. Faced with an expanding elderly demographic, an increasing number of scholars are delving deeper into the issues brought about by aging, progressively forming systemic design theories such as inclusive design, barrier-free design, and universal design. Service design, a domain dedicated to enhancing user experience, must evolve with the times. The aging trend in the user demographic necessitates an urgent exploration into how to make this field more age-friendly, especially within medical services. For the silver generation (used in this paper to refer to those aged 50 and above - the primary users of age-friendly designs both now and in the future), the decline in physical function and resistance can lead to problems in product usage and health

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management. Current medical service processes often struggle to simultaneously meet the rigid medical demands and unique physiological and psychological needs of the silver generation, thus making the transition towards age-friendly thinking in service design of critical research value.

2. Age-friendly Challenges in Inclusive Design

(1) Challenges of Aging

Entering the 21st century, influenced by factors such as decreasing birth rates, the elderly population in most developed countries and some developing countries has seen considerable growth, transitioning into an aging society. The United Nations predicts a monthly net increase of two million people aged over 65 in the next 20 years [1].China has already entered the phase of population aging; by 2040, the elderly population is expected to reach 374 million, accounting for 24.48% of the total population. By 2050, this ratio will hit 30.7% - the peak period of aging. China will be among the countries with the highest absolute number of elderly and the fastest pace of population aging worldwide.

From a design perspective, research and practice in age-friendly design often fall within the purview of governmental and public welfare sectors. With social benefits surpassing economic gains in the short term, few companies are willing to invest in this field. Consequently, compared to the international academic and industrial community, China's research and development and applications in age-friendly design are insufficient.

(2) Diversity of Elderly Users

Sociological research suggests that the needs of elderly users mainly span three levels: physiological, social, and cultural [2]. Traditional age-friendly design often perceives the silver generation as a homogeneous group in a biological sense, focusing on solving the common issues caused by physiological changes and the decline in bodily functions. These studies indicate that the aging process involves the physiological decline across three levels: sensory, cognitive, and active. The behavior speed of the silver generation slows with age; the correlation between their sensation and cognition strengthens with age; and their operational skills require perceptual information assistance in specific contexts. The decline in these functions is likely to continue and become severe with age and changes in lifestyle, leading to partial or total disability in the late stages of life. Although these shared physiological characteristics are common in the aging process, Fozard (2000) pointed [3] out that the aging process exhibits variation with different environments. Aging is both a biological process and a transition in which the individual participates in social behavior and fulfills societal obligations. As people enter their twilight years, social roles change dramatically, activity scope shrinks, and life shifts from a social-focused existence to a family-centered one, leading to loneliness, suppressed life states, and unhealthy lifestyles, all of which can impact the rate of their physiological decline and the probability of geriatric diseases. Thus, evaluating the quality of life variables for the silver generation is complex, with their action abilities encompassing not only spatial but also social and economic significance. The needs of the silver generation are closely related to the cultural context they inhabit, pointing to the varied behavioral goals, patterns, values, and social subordination within different lifestyle groups. Research on elderly users should return to its social and cultural attributes and make contextual comparisons. In this sense, the focus of design research should be further refined into subcultures within the elderly population, such as elderly women, the oldest-old, those with diseases or disabilities, those residing in nursing homes, ethnic minority elders, the impoverished elderly, and those nearing the end of life, who constitute the more vulnerable groups among the elderly population. Currently, international research is particularly concerned with the quality of life issues of these vulnerable groups. Therefore, related studies have proven that traditional cultural values play a vital role in propelling the

demand system of elderly users, providing theoretical basis for traditional human-centered design. Under a multicultural background, the Maslow's hierarchy of needs model can no longer explain the genuine needs of the silver generation living in different social contexts.

(3) Age-friendly Design Theory Under the Humanistic Philosophy Paradigm

Population aging is an irreversible global trend, and how to shape an age-friendly society through design has become a focal point in the design realm. The humanistic philosophy paradigm and the user-centered design methodology provide effective theoretical and practical foundations for studying diverse aging populations and initiating social innovation designs. Inclusive Design, originating from the UK, and Universal Design from the USA [4], are the mainstream theories for tackling issues related to aging. Inclusive Design refers to a framework that eliminates the need for specific adaptations, and instead enables mainstream products and services to be used by as many users as possible. Its goal is to allow diverse groups to participate equitably. The opposite of inclusion is rejection, hence promoting inclusivity is also a process of countering rejection. Building on many years of Inclusive Design research, the Engineering Design Center at Cambridge University proposed the theory of Countering Design Exclusion (see Figure 1)[5]. This theory attributes design exclusion to the mismatch between user capabilities and the ability requirements of the product, positing that exclusion is caused by the external environment. Therefore, promoting inclusive design is often achieved by reducing the ability requirements of products and the external environment on users.

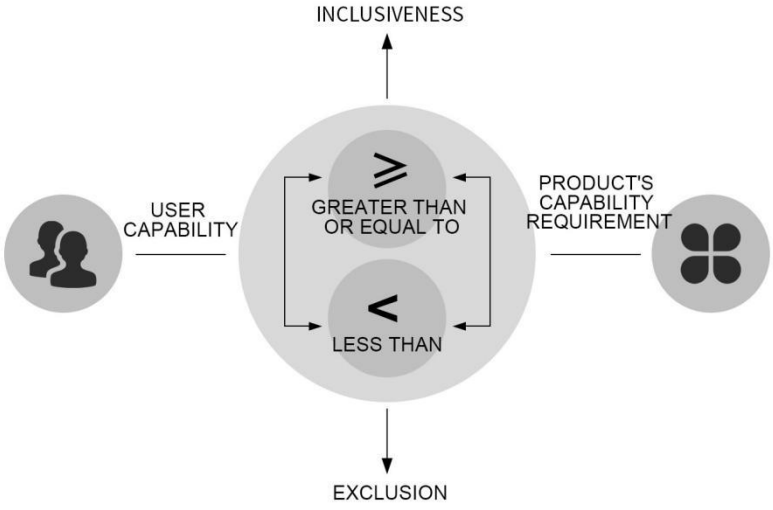

Figure 1. Model of Countering Design Exclusion

3. Key Issues in the Inclusive Design of Digital Medical Aging

(1) For Whom is Digital Medical Aging Designed

The concept of aging-friendliness is often paired with the notion of information accessibility. Information accessibility implies that anyone—able-bodied or disabled, young or elderly—can equitably, conveniently, and barrier-free access and use information under any circumstances. However, when we talk about digital aging-friendliness, it differs somewhat from total information accessibility. To make "aging-friendly" more focused, we have separated the older adult population from users with visual, hearing, physical, and cognitive

impairments。 Differences exist among the older population in cognition, abilities, and willingness to engage with the digital world: Cognitively, most digital services are designed by people born in the 80s and 90s, which is different from the era where older adults come from. Memory and comprehension decline affect older adults, leading to a limited understanding of the younger generation's culture. In contrast, many people with impairments share similar cultural cognition with us because they live in the same period. From an ability perspective, older adults experience difficulties in accessing the internet due to declines in vision, hearing, and touch, which can be addressed by reducing operational thresholds. However, visually impaired and other impaired groups are unable to use certain functions due to physiological defects, requiring form substitution, such as auditory compensation for visual impairment. From a willingness perspective, older adults' psychological barrier to engaging with the digital world is significantly more noticeable because of their fear and aversion to new things. They fear mockery for not using digital devices and worry about being deceived. By contrast, these concerns are less pronounced among those with disabilities.

(2) User Persona for the Application of Digital Medical Aging

Taking the service process of elderly patients with chronic diseases as an example, using questionnaires, in-depth interviews, and field research, we have constructed the user persona of the older population. They are largely retired or semi-retired, with abundant discretionary time and relatively leisurely lives. Their social circles have passively narrowed, dominated by acquaintances, with a short radius of life. They resist aging, worry about being disconnected from society, strive to understand new things, and fear burdening their families. Their physical health declines with age, but they view minor ailments as a norm, with more emphasis on maintaining a positive spirit. In contrast analysis, we have categorized the needs for medical care discovered in the research, and summarized them in Figure 2.

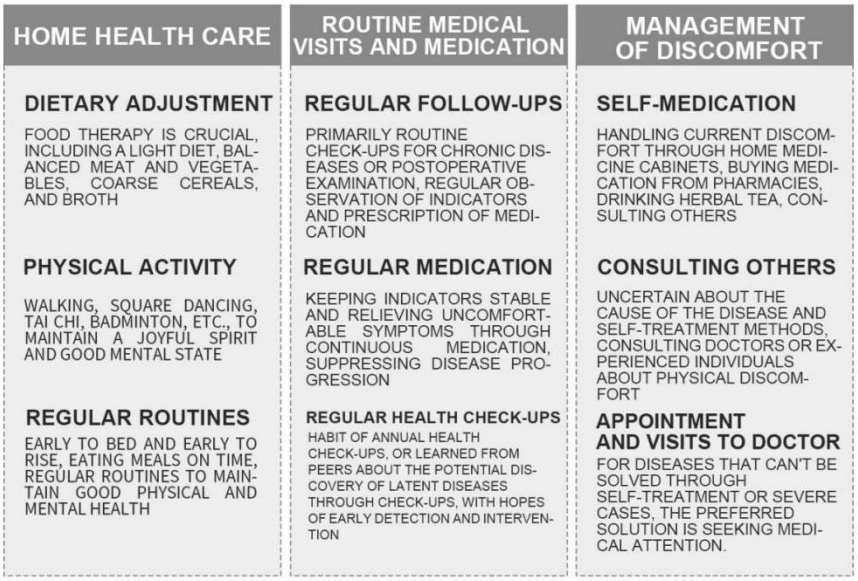

Figure 2. Categorization of New Healthcare Demands of the Older Population

(3) Pain Point Analysis for Aging-Friendly Digital Medical Services

To ascertain areas where inclusivity is insufficient in the service process, we classify service pain points based on their inclusive characteristics. The four categories of solution priority are: cannot and not satisfied > able but not satisfied = cannot but satisfied > able and satisfied. This paper randomly selects 30 elderly users in Changzhou, Nanjing, and Zhenjiang. Through non-participatory observation research, we find that the older

population primarily uses medical guidance systems to complete registration and consultation. Specific operations can be chronologically divided into four basic task links: entering the app for examination, diagnosis after examination, consultation with the doctor after diagnosis, and treatment after consultation with the doctor. Integrating and refining the behaviors exhibited by the older population in each task link, we find varying degrees of pain points. Parsing the aging-friendly design elements at each task link reveals that the functional purpose element is the goal set by the user on the basis of a progressive single-line consultation task, which also provides the prerequisite for the next step of work implementation. Interaction behavior elements are manifested in the user's cerebral analysis of behavior and physical interactive actions, which are decisive factors for interaction efficiency. The emotional expression element in the current interactive process of the older population using the medical guidance system is negative. Following the analysis path, we summarize the current service pain points of the older population on the user experience map (see Figure 3), including embodied cognition behaviors, pain point issues, and aging-friendly design elements at each task link, and categorize and classify the existing service pain points of elderly patients with chronic diseases.

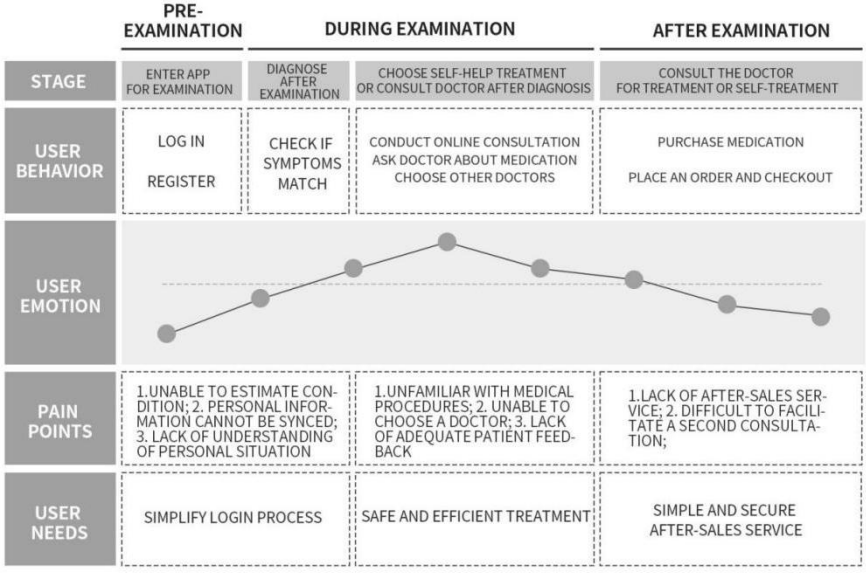

Figure 3. User Experience Map for Older Population

4. Strategies for Age-Friendly Digital Medical Interface Design

(1) Rooted in Medical Scenarios

The challenges faced by the older demographic in understanding and using digital medical technologies are evident. To address this, a strategic approach is essential, integrating digital age-friendliness with unique service features within medical scenarios. Healthcare services, being serious, offline, scarce, and sensitive, demand careful design considerations. Adherence to professional logic and industry standards is vital, involving collaboration with medical institutions, health commissions, and disease control bodies. Design services must follow established industry standards in color selection, copywriting style, format, and information collection methods. Logical rigor is imperative, aligning with medical logic to ensure complete, accurate, and timely information. Empathetic psychology should guide color and copywriting choices to address users' negative emotions. Ensuring quick access to resources, efficiency, and simplicity is crucial in urgent healthcare scenarios. Simple and straightforward interface designs are necessary due to the general lack

of medical knowledge in the population. Privacy protection for older users is paramount, emphasizing the careful handling of sensitive medical data to prevent privacy breaches.

(2) Complemented by Embodiment

Advancements in cognitive psychology reveal that cognition is influenced by bodily activities, emphasizing "body cognition" in understanding the world. The experience with online medical apps underscores active intervention in physical activities, showcasing embodied characteristics in older adults. Due to limited mobility and imperfect coordination, digital medical interfaces should stimulate reasonable bodily interactions based on user abilities. Embodied cognition in psychology focuses on body structure, behavioral mode, and perceptual experience, encompassing the positive impact of the brain on cognitive processes. Addressing embodied cognitive behavioral disorders is crucial to mitigate frustration and resistance in older users. Design should consider the transmissibility of visual information expression and use embodied interaction forms, creating a psychologically safe and comfortable information environment for older users.

(3) Aiming for Inclusivity

Research reveals that approximately 90% of the elderly population encounters difficulties while using smartphones, the most common of which are impediments related to trial-and-error processes and information acquisition. A survey indicated that 87.8% of users experienced difficulties with smartphones, with attempt-related obstacles being the most prevalent (66.5%), followed by information processing issues (63.4%)[6].

Constructing an egalitarian and psychologically supportive environment for the elderly is vital for fostering social interaction and pro-social behaviors, representing the ultimate goal in developing digital medical interfaces for aging populations. Inclusive design prioritizes individual welfare, recognizing diversity and differences while aiming for maximum product accessibility within resource constraints. The objective is to ensure well-being and social recognition for all users, contributing to a more inclusive value creation process. Design decisions for digital medical interfaces for the elderly should consider users' skills and needs, striving to minimize differences with the general population. The goal is to create a smooth and universally user-friendly product, addressing both physical and emotional considerations. Breaking down ideological barriers, viewing the elderly as integral to diversity, and understanding their characteristics facilitate interactive design possibilities. Classification methods, based on user pain points, guide design guidelines to enhance inclusivity, equality, convenience, and flexibility, ultimately providing a more user-friendly experience across various scenarios and for a broader user base.

5. Practical Implementation of Digital Medical Interface Design for the Elderly

(1) Building Information Hierarchy Framework

The design process, aligned with strategies for aging-appropriate applications, outlines features for a digital medical app catering to elderly outpatient services. Focusing on psychology, physiology, information, and environment, it proposes solutions for outpatient waiting services, constructing the "Always Smile Health" app's information hierarchy framework. Major function modules related to medical appointments are concentrated on the home page for improved patient efficiency, while auxiliary modules are distributed across three interfaces.

(2) Usability Testing of APP Interface Prototype

An interface prototype, based on the information framework, underwent usability testing, evaluating elements like "information recognition efficiency" and "ease of operation." Ten elderly participants experienced the prototype through three 30-minute rounds, providing feedback on functionality, customization, and module familiarity. Observational interviews and a Likert scale analysis yielded an average score of 4, indicating "excellent" usability. Post-interview data highlighted a preference for clean design, but users

expressed occasional hesitation with operating gestures. Recommendations included adding dynamic cues to alleviate uncertainties.

(3) APP Interface Design

The interface for older users integrates unique features into a cohesive experience, emphasizing visual balance. Blue, a common medical color, serves as the primary color, enhancing user trust. Orange and white as auxiliary colors improve visual recognition, creating a color hierarchy among interface function modules.

The page layout mainly adopts a list and card-style layout, allowing users to intuitively perceive the distribution of functions for optimal interface interaction and information transmission (see Figure 4).

two-dimensional space and emphasize spatial structure. The standout feature of the elderly outpatient waiting service app is its integration of unique smartphone capabilities, utilizing GPS positioning, voice guidance, vibration prompts, and animation demonstrations for precise services. The app caters to different age groups, setting varied waiting times and outpatient visit frequencies. However, despite professional design efforts, there's room for improvement in the overall interactive experience and emotional design. Subsequent design iterations will focus on areas with lower inclusiveness scores, enhancing visual design and interaction methods to elevate the user experience during the iterative refinement of the service system.

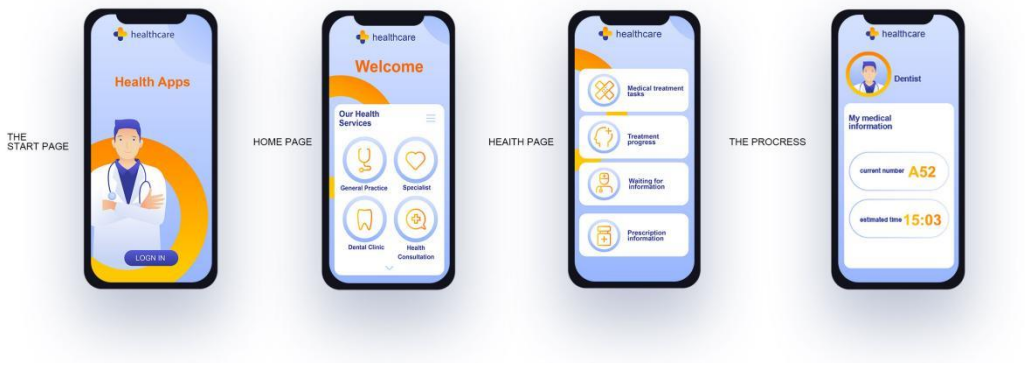

Figure 4. Main APP Interface Diagram

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6. Conclusions

In the face of the challenges posed by the "digital divide" and the consequent demand for age-friendly design, current design services lack consideration for inclusivity among user groups. However, the advent of an aging society signifies that the elderly population is an indispensable special consumer group. The inclusive digital medical age-friendly interface design process proposed in this study can offer theoretical and practical references for enhancing the inclusivity of service design. On the theoretical level, based on relevant theories and principles of inclusive design[ ], we propose principles of inclusive improvements, the types of pain points in age-friendly services, and inclusive evaluation methods based on functional and emotional dimensions, and

explore the design process of age-friendly services. On the practical level, we investigate the online medical service process for elderly patients with chronic diseases, identify service pain points and categorize them. Guided by the principles of service design inclusivity, we identify design opportunities in three directions for systematic design. It is hoped that this will provide a reference for subsequent research related to inclusive age-friendly service design.

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