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Investigation on the Factors Affecting Internet Medical Service Utilization among Elderly Patients with Chronic Diseases: Use of a Chain Mediation Model

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To investigate the current status of sensor- and IoT-enabled internet medical service utilization and its influencing factors among elderly patients with chronic diseases, in this study, we aim to provide evidence-based references for optimizing digital health service adoption, fostering an "active health" mindset, and promoting active aging. In particular, in this study, we emphasize how user-related cognitive and psychosocial factors shape the effective utilization of sensor-integrated and IoT-supported medical services, which is critical for the real-world performance of sensing-enabled healthcare systems. A convenient sampling method was employed to recruit elderly participants aged 60–70 years from cities with heterogeneous economic development levels in Guangdong Province for a cross-sectional survey. The investigated internet medical services primarily encompassed remote health monitoring, online registration, digital medical payment, and data-supported medical consultation, which are increasingly integrated with wearable sensors and connected health devices. These services rely on continuous data acquisition, transmission reliability, and user–sensor interaction as fundamental sensing components. IBM SPSS Statistics 25.0 and IBM SPSS Amos 28.0 software were used to conduct a serial mediation model analysis, with the active utilization of internet medical services as the core outcome variable, aiming to systematically identify the multifaceted factors affecting service adoption in this population. This analytical framework helps explain how sensing-enabled medical technologies are translated from technical availability into actual use. The results showed that the active utilization rate of internet medical services among elderly patients with chronic diseases was 35.7%, with online registration and medical payment being the most frequently used functions. Furthermore, self-efficacy and satisfaction with internet medical services exhibited a significant serial mediating effect in the relationship between social support and the willingness to adopt IoT-supported digital health services. These results provide user-oriented insights relevant to the design and deployment of sensor-based healthcare systems. These findings highlight the importance of enhancing user-centered sensor-integrated service

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design and digital health literacy to improve utilization among elderly individuals with chronic conditions. From a sensing perspective, our study contributes empirical evidence linking human factors with the effective deployment of IoT-based medical sensing systems.

1. Introduction

Against the backdrop of accelerating population aging, the demand for professional health management and targeted medical services among elderly patients with chronic diseases has been escalating substantially. Constrained by inherent temporal and spatial limitations, conventional healthcare delivery models are increasingly inadequate in addressing the long-term and multifaceted needs of this vulnerable population. As a technology-driven innovative service paradigm, the "Internet + Healthcare" model integrates advanced information and communication technologies (ICTs) with digital health platforms and sensor-supported data acquisition mechanisms to deliver more accessible, convenient, and cost-effective medical services tailored to individuals with chronic conditions. Centered on internet platforms as the core carrier, Internet-based healthcare leverages digital technologies to enhance the overall supply capacity of health services, facilitate the collection, transmission, and exchange of health-related information, and provide continuous and integrated health management services for elderly patients with chronic diseases, covering a full spectrum of interventions spanning disease prevention, clinical diagnosis, therapeutic treatment, post-treatment rehabilitation, and long-term nursing care.[1]

In this context, sensors and connected health devices constitute the fundamental interface between physical health states and digital medical services, directly shaping the effectiveness of data-driven healthcare delivery. Active aging has become an important national policy, and there is an urgent public demand for Internet healthcare services supported by connected devices and data-driven health management systems to overcome time-, space-, and content-related barriers in medical care for elderly patients with chronic diseases. Such services not only alleviate the pressure on physical medical institutions but also facilitate the balanced allocation of medical resources, mitigate the contradiction between uneven medical resource distribution and growing healthcare demand, and improve the healthcare experience of elderly patients who often encounter issues such as delayed treatment, cumbersome procedures, and difficulty in accessing medical services. Consequently, Internet healthcare provides a practical pathway for proactively addressing population aging at the national level.[2]

Traditional medical consultations primarily emphasize offline face-to-face interactions, whereas Internet healthcare enables more convenient consultations through the online transmission of photos, videos, and health data generated by wearable or home-based monitoring devices. The practical value of these sensing-enabled services depends not only on technological deployment, but also on whether users are willing and able to engage with sensor-integrated healthcare systems. This transformation reflects the deep integration of emerging digital technologies with conventional medical services and the interdisciplinary convergence of healthcare, information technology, and intelligent sensing. For elderly patients with chronic diseases, the advantages of Internet healthcare are mainly manifested in several aspects. First, it breaks temporal and spatial barriers to optimize the allocation of medical resources by facilitating hierarchical diagnosis and treatment and improving the efficiency of medical service delivery. Second, real-time health monitoring and early warning functions can be realized through intelligent wearable sensors and connected health devices, which continuously collect physiological data, enable platform-level data sharing, and assist clinicians in the timely adjustment of treatment strategies.

Third, patient-centered education and support functions are strengthened through Internet platforms that provide reliable chronic disease education resources, helping patients and their families to better understand disease-related information and acquire disease management skills. Finally, Internet healthcare promotes the integration of medical and elderly care services by providing continuous health management, advancing the development of integrated medical–nursing care models, thereby reducing the long-term economic burden on elderly patients with chronic diseases. These advantages highlight that sensing performance and system usability must be jointly considered to achieve effective healthcare outcomes. Despite these advantages, the willingness to use Internet healthcare services among elderly patients with chronic diseases remains relatively low. This phenomenon is closely related to factors such as age-related physiological and psychological characteristics, levels of social support, and the perceived complexity of digital and sensor-integrated healthcare technologies.

The results of previous studies have indicated that the ability of elderly individuals to accept and adapt to networked technologies constitutes a key bottleneck hindering the development and effective utilization of Internet healthcare services. From a sensing perspective, low utilization undermines the real-world effectiveness of sensor-based healthcare systems, regardless of their technical capabilities. Therefore, understanding usage willingness has become a critical concern for providers of Internet healthcare and digital health services. The factors affecting the willingness to use Internet healthcare platforms have been examined in recent domestic studies, but research focusing on the role of social support in promoting service utilization remains limited. On the basis of this gap, in the present study, we adopt social cognitive theory (SCT) as the theoretical framework to explore how social support, self-efficacy, and satisfaction with the digital service environment jointly affect the active use of sensor- and IoT-supported Internet healthcare services among elderly patients with chronic diseases. By introducing a chain mediation model, we provide a user-centered analytical perspective for evaluating how sensing-enabled healthcare services are translated from technological availability into sustained utilization. The findings aim to provide empirical references for fostering an “active health” attitude and advancing the realization of active aging.

2. Theoretical Foundations and Research Hypotheses

In SCT, originally formulated by the psychologist A. Bandura, it is postulated that human behavior is governed by a triadic reciprocal determinism involving three core factors: overt behavioral patterns, personal cognitive factors, and other individual attributes, as well as the external socio-environmental context in which an individual is embedded.[3] Among these components, the social environment plays a pivotal role in fostering the development of self-efficacy, which constitutes the cornerstone of human behavioral motivation and serves as a critical antecedent of an individual's intention to initiate and sustain target behaviors. In turn, diverse socio-environmental contexts exert a formative effect on individuals' behavioral tendencies and cognitive perceptions. As Bandura emphasized, self-efficacy exerts a pervasive and multifaceted impact on individuals' behavioral persistence and decision-making. Individuals with higher levels of self-efficacy are more likely to invest sustained effort in task engagement, concentrate on overcoming operational difficulties, and ultimately translate cognitive motivation into stable behavioral outcomes. As a widely adopted theoretical framework for examining patients' willingness to use Internet-based healthcare services, SCT has been empirically validated in numerous studies focusing on digital health adoption behaviors.

However, this framework does not explicitly articulate the interrelationships among social support, self-efficacy, satisfaction with sensor- and IoT-supported Internet healthcare services, and usage willingness, as shown in Fig. 1. Against this research backdrop, in the present study, we construct a serial mediation model grounded in SCT to elucidate the underlying mechanisms linking social support, service satisfaction, and utilization willingness among elderly patients with chronic diseases. Social support refers to the emotional, material, or informational assistance obtained through interpersonal interactions, which can enhance individuals' confidence and behavioral capabilities. Within the context of Internet healthcare services, social support may manifest through recommendations from family members, neighbors, or peers, as well as guidance from healthcare professionals regarding the use of digital platforms and sensor-enabled health monitoring services. Elderly individuals receiving such social stimuli are more likely to engage in observational learning, which helps reduce perceived technological barriers and enhances their willingness to use Internet healthcare services.[4] Social support may directly or indirectly promote adoption willingness by providing information, alleviating usage concerns (e.g., system operation, online payment, and data reliability), and strengthening trust in service quality. In particular, encouragement from family members can reduce elderly users' uncertainty toward digital and connected health technologies, while positive feedback from medical

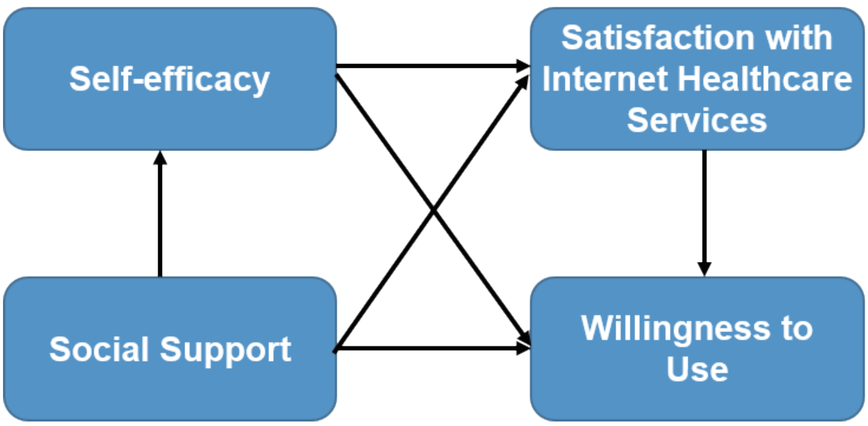

Fig. 1. (Color online) Research model.

professionals can increase expectations regarding service effectiveness and clinical reliability.(5) Accordingly, Hypothesis 1 is proposed as below.

H1: Social support has a direct positive impact on the willingness to use Internet healthcare services.

Social support also provides emotional, informational, and evaluative resources that enhance an individual's confidence in their own abilities, thereby strengthening self-efficacy. Prior research based on grounded theory has confirmed that self-efficacy significantly affect patients' willingness to use Internet healthcare services.(6) In the context of sensor-integrated Internet healthcare platforms, self-efficacy reflects elderly individuals' perceived ability to interact with digital interfaces, interpret basic health data, and engage with connected health services. Thus, social support may enhance self-efficacy, which in turn promotes willingness to use Internet healthcare services. On this reasoning, Hypothesis 2 is proposed as below.

H2: Self-efficacy plays a mediating role between social support and the willingness to use Internet healthcare services.

Social support further contributes to improving patients' satisfaction with Internet healthcare services. Support from family members and friends can enhance trust in digital medical platforms, while professional endorsement can increase confidence in service reliability and outcomes. Satisfaction with Internet healthcare services encompasses multiple dimensions, including medical consultation, nursing support, medication purchasing, and platform-level system support. From a user-experience perspective, satisfaction is also closely related to the usability and accessibility of sensor- and data-driven healthcare systems, especially for elderly patients with chronic diseases, who may face visual decline, memory impairment, or slower response. Design considerations such as simplified interfaces, enlarged icons and fonts, streamlined operational procedures, and elderly friendly functional modules can effectively reduce usage barriers and enhance satisfaction.(7) Consequently, social support may positively affect satisfaction with Internet healthcare services, which will subsequently affect usage willingness. Therefore, Hypothesis 3 is proposed as below.

H3: Satisfaction with Internet healthcare services plays a mediating role between social support and usage willingness.

Establishing a multidimensional social support system through family, community, and healthcare providers can reduce operational barriers for elderly patients with chronic diseases when using Internet healthcare services, including those involving sensor-supported monitoring and digital interaction. Such support enhances self-efficacy and motivates active service engagement. As self-efficacy improves, elderly individuals are more likely to participate proactively in disease prevention and chronic disease management. By maintaining an open attitude toward digital and connected health technologies, elderly users can utilize Internet healthcare platforms to access resources, update health-related perceptions, modify unhealthy behaviors, and improve their overall quality of life. In this process, sustained satisfaction with Internet healthcare services further reinforces usage intention and behavioral continuity.(8) On the basis of this chain of effects, Hypothesis 4 is proposed as below.

H4: Self-efficacy and satisfaction with Internet healthcare services play a chain mediating role between social support and the willingness to use Internet healthcare services.

3. Empirical Analysis

3.1 Scale setting

Our questionnaire comprises two main modules. The first module collects respondents' basic demographic information, including gender, age, educational level, and household registration. The second module employs a 5-point Likert scale to measure evaluation indicators related to the usage pathways of Internet healthcare platforms. The proposed Internet healthcare evaluation scale consists of four latent variables. All questionnaire items were primarily derived from relevant literature and subsequently adopted to reflect the system features and content characteristics of Internet healthcare platforms, thereby enhancing their relevance. In total, the scale includes 17 observed variables, as presented in Table 1. The utilization of Internet healthcare services was operationalized as active use behavior. Respondents were asked whether they used Internet-based healthcare services, including online registration, online medical payment, remote consultation, or health monitoring services supported by digital platforms and connected devices. Participants who reported using at least one of these services were classified as active users, while those who reported no usage were classified as non-users. The utilization rate was calculated as the proportion of respondents identified as active users among all valid samples.

Table 1
Internet healthcare evaluation scale.

Latent variable	Observed variable	Measurable variable
Social support (F1)	A1	Family support
	A2	Peer support
	A3	Volunteer or medical guide support
	A4	Community support
Self-efficacy (F2)	B1	Level of understanding of Internet healthcare services
	B2	Level of gaining about Internet healthcare
	B3	Level of acceptance of Internet healthcare
	B4	Confidence in using Internet healthcare services
	B5	Proficiency in using Internet healthcare resources
Satisfaction with internet healthcare services (F3)	C1	Timeliness of Internet healthcare services
	C2	Sharing of medical data and information
	C3	Convenience of the Internet healthcare system
	C4	Evaluation of the quality of Internet healthcare services
Active usage willingness (F4)	D1	Recommend Internet healthcare to others
	D2	Use Internet healthcare platforms to gain medical knowledge
	D3	Increase the frequency of using Internet healthcare platforms for elderly chronic diseases
	D4	Independently use Internet healthcare platforms for elderly chronic diseases

3.2 Data collection

In this study, chronic diseases were defined as physician-diagnosed long-term conditions requiring ongoing health management. The analysis is focused on the utilization of Internet healthcare services at the service-system level rather than disease-specific clinical characteristics; therefore, chronic diseases were not further categorized by type. In this study, all data were collected through a structured questionnaire administered to elderly patients with chronic diseases. The questionnaire included items on demographic characteristics, social support, self-efficacy, satisfaction with Internet healthcare services, and actual utilization behavior. On the basis of the research objectives and scope, and considering the current development of internet-based healthcare services, regional economic and social conditions, and geographical distribution characteristics, we selected elderly patients with chronic diseases from four cities in Guangdong Province: Guangzhou, Dongguan, Qingyuan, and Yunfu. A convenience sampling method was employed, where elderly patients with chronic diseases served as the target population. Inclusion criteria were as follows: (1) aged 60–70 years and (2) voluntary agreement to participate in the survey with cooperation in data collection. Exclusion criteria included (1) individuals with cognitive impairment or mental disorders; (2) patients with severe or end-stage diseases; and (3) individuals with unclear expression or communication disorders.

Participants were recruited from community settings, ensuring adequate sample diversity and representativeness. To mitigate the potential impact of common method bias (CMB), which is a common concern in questionnaire-based studies, a multistage questionnaire administration approach was adopted in accordance with the methodological recommendations of Podsakoff *et al.*[9] The formal survey was conducted over a two-month period, from early July to late August 2025. The initial sample size was calculated using presurvey data to ensure statistical rigor, with a margin of error not exceeding 5% and a confidence level of 95% (corresponding to a standard normal distribution quantile, $Z\alpha/2$, of 1.96). The required sample size was determined using the following maximum sample size calculation formula, which is commonly applied to prevent under-sampling and to ensure the reliability of subsequent statistical analyses.

$$n = \frac{t^2 \times p(1-p)}{e^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} \approx 385 \quad (1)$$

A conservative estimation was adopted by setting the hypothesized proportion (p) to 0.5, with a margin of error (δ) of 0.05 used for sample size calculation. Taking into account the characteristics of random sampling, the comprehensiveness of questionnaire items, and the precision requirements of final research outcomes, the minimum required sample size for the formal survey was determined to be 385. Questionnaires were considered invalid if they contained contradictory responses, inconsistent answers to key items, or were missing critical information. During the survey period, a total of 356 respondents participated in the survey; of these, 45 were excluded owing to invalid responses, resulting in 311 valid respondents. The effective response rate was 80.8%. The demographic and clinical characteristics of the valid sample are presented in Table 2.

Table 2
Sample characteristics (N = 311).

Demographic variable	Category	Frequency	Percentage (%)
Gender	Male	138	44
	Female	173	56
Age group	60–65 years	108	35
	65–70 years	93	30
	70–75 years	74	24
	≥75 years	36	12
Educational level	Little or no literacy	43	14
	Primary school	76	24
	Junior high school	114	37
	Senior high school/technical secondary school	58	19
	College/bachelor's degree or above	20	6
Household registration	Urban	167	54
	Rural	144	46

3.3 Empirical analysis and results

IBM SPSS Statistics 25.0 was used to perform descriptive statistical and correlation analyses. IBM SPSS Amos 28.0 was employed to conduct the serial mediation analysis based on structural equation modeling to examine the relationships among social support, self-efficacy, satisfaction with Internet healthcare services, and utilization behavior. During the data collection process, a multistage questionnaire administration method was adopted in accordance with the recommendations of Podsakoff *et al.* to minimize potential common method bias.[9] At the data level, Harman's single-factor test was conducted to examine common method variance (CMV). The results of the exploratory factor analysis (EFA) showed that the first factor accounted for 29.91% of the total variance, which is below the critical threshold of 40%, indicating that CMV does not pose a serious threat to the validity of the research findings. Reliability was evaluated using Cronbach's alpha coefficient and composite reliability (CR) based on factor loadings for each scale, with higher coefficients indicating higher reliability. As shown in Table 3, Cronbach's alpha coefficients for the social support, self-efficacy, satisfaction with Internet healthcare services, and independent usage willingness scales all exceeded 0.9, demonstrating excellent internal consistency. The model fit was assessed using multiple goodness-of-fit indices to provide a comprehensive evaluation of the proposed measurement and structural models. Specifically, the ratio of the chi-square statistic to degrees of freedom (χ^2/df) was examined to account for model complexity.

In addition, the root mean square error of approximation ($RMSEA$) was used to evaluate the model's approximate fit per degree of freedom, while the comparative fit index (CFI) was used to assess the relative improvement of the proposed model compared with a null model. The standardized root mean square residual ($SRMR$) was further employed to examine the average discrepancy between the observed and model-implied correlation matrices. Collectively, these indices were interpreted using commonly accepted threshold criteria, with χ^2/df values below 3–5, $RMSEA$ values below 0.08, CFI values above 0.90, and $SRMR$ values below 0.08, indicating

Table 3
Reliability and validity.

Latent variable	Construct	Observed variable	Factor loading	*AVE*	*CR*	Cronbach's α
Social support (F1)	Family support	A1	0.843	0.693	0.900	0.909
	Peer support	A2	0.863			
	Community support	A3	0.795			
	Government support	A4	0.828			
Self-efficacy (F2)	Level of understanding of internet healthcare services	B1	0.874	0.647	0.901	0.943
	Gaining progress of internet healthcare	B2	0.881			
	Level of acceptance of internet healthcare	B3	0.781			
	Proficiency in using internet healthcare resources	B4	0.778			
	Confidence in using internet healthcare services	B5	0.691			
Satisfaction with internet healthcare services (F3)	Timeliness of internet healthcare services	D1	0.847	0.724	0.913	0.912
	Evaluation of medical data and information sharing	D2	0.882			
	Evaluation of internet healthcare service quality	D3	0.837			
	Convenience of the internet healthcare system	D4	0.836			
Usage willingness (F4)	Recommend internet healthcare to people around	E1	0.805	0.719	0.911	0.910
	Use internet healthcare platforms to gain medical knowledge	E2	0.872			
	Increase the frequency of using Internet healthcare platforms for elderly chronic diseases	E3	0.833			
	Independently use internet healthcare platforms for elderly chronic diseases	E4	0.879			

an acceptable model fit. The measurement instruments used in this study were adopted from well-established scales developed by domestic and international scholars, thereby ensuring good content validity. Prior to testing convergent and discriminant validities, factor analysis was performed using SPSS 25.0. The Kaiser–Meyer–Olkin (KMO) measure was 0.849, and Bartlett's test of sphericity yielded an approximate chi-square value of 2466.264 ($p < 0.001$), indicating that the data were suitable for factor analysis. The *CR* and average variance extracted (*AVE*) values for each construct are reported in Table 3. All *CR* values exceeded 0.8, and all *AVE* values were greater than 0.6, confirming satisfactory convergent validity.

Social support scale: Based on the recommendations of Wang *et al.* and adapted to the study context, this scale consists of four items designed to assess the level of social support received by elderly patients with chronic diseases, including support from family members, peers, communities, and government agencies.[10] One point is assigned for each type of positive support received (emotional, informational, practical, or educational), while zero points are assigned if no support is received. Higher scores indicate higher levels of social support.

Confirmatory factor analysis (CFA) results showed good model fit (χ^2/df = 1.531, *RMSEA* = 0.06, *CFI* = 0.91, *SRMR* = 0.03). Cronbach's alpha coefficient for this scale was 0.909.

Self-efficacy scale: Drawing on the recommendations of Chen and Chan regarding Internet healthcare service operation, this scale includes five items measuring participants' understanding, learning progress, proficiency, and confidence in using Internet healthcare services.(11) Responses were recorded using a 5-point Likert scale. CFA results indicated good model fit (χ^2/df = 1.454, *RMSEA* = 0.05, *CFI* = 0.93, *SRMR* = 0.04). Cronbach's alpha coefficient for this scale was 0.943.

Satisfaction with internet healthcare services scale: Adapted from Davis, this scale comprises four items assessing satisfaction with Internet healthcare services in terms of timeliness, information sharing, convenience, and overall service quality, using a 5-point Likert scale.(12) CFA results demonstrated satisfactory model fit (χ^2/df = 2.376, *RMSEA* = 0.042, *CFI* = 0.942, *SRMR* = 0.043). Cronbach's alpha coefficient for this scale was 0.912.

Independent usage willingness of internet healthcare services scale: Referring to the recommendations of Venkatesh *et al.*, this scale includes four items evaluating willingness to recommend Internet healthcare services, the scope of use, the frequency of use, and independent usage behavior, measured using a 5-point Likert scale. CFA results indicated an acceptable model fit (χ^2/df=2.490, *RMSEA* = 0.048, *CFI* = 0.90, *SRMR* = 0.04).(13) Cronbach's alpha coefficient for this scale was 0.910.

Social support was significantly and positively correlated with self-efficacy, satisfaction with Internet healthcare services, and usage willingness among elderly patients with chronic diseases ($p < 0.05$). In addition, self-efficacy was positively correlated with both satisfaction with Internet healthcare services and usage willingness ($p < 0.05$), as shown in Table 4.

On the basis of the proposed hypotheses, a chain mediation model was constructed with social support as the independent variable, self-efficacy and satisfaction with the online environment as the mediating variables, and willingness to use Internet healthcare services as the dependent variable. With regard to overall model fit, and in reference to the fit indices adopted by Chen and Shen, the results were χ^2/df = 1.429 (<2), *SRMR* = 0.042 (<0.05), *RMSEA* = 0.045 (<0.08), *GFI* = 0.924 (>0.90), *TLI* = 0.976 (>0.90), and *CFI* = 0.980 (>0.90), as showin in Table 5.(14) Overall, the proposed model satisfies the recommended fit criteria, indicating good fit between the theoretical model and the survey data, as well as satisfactory discriminant validity among the constructs.(15,16) The path analysis results, as shown in Fig. 2, further demonstrated that social support has a significant positive effect on self-efficacy (β = 0.11, $p <$ 0.001) as well as on satisfaction with the online environment (β = 0.17, p < 0.001), and self-

Table 4
Means, standard deviations, and correlation coefficients of variables (N = 311).

Factor	Mean	SD	F1	F2	F3	F4
F1	3.9481	0.743	1			
F2	3.3198	0.854	0.382***	1		
F3	3.8467	0.848	0.343**	0.681***	1	
F4	3.9081	0.664	0.234*	0.729**	0.429*	1

Note: *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

Table 5
Model fit indices.

Fit index category	Statistical test index	Critical threshold (criterion)	Test result	Fit judgment
Absolute fit indices	*SRMR*	<0.05	0.042	Good
	RMSEA	<0.08	0.045	Good
	GFI	>0.90	0.924	Good
Incremental fit indices	*TLI*	>0.90	0.976	Good
	CFI	>0.90	0.980	Good
Parsimonious fit indices	χ^2/df	<3	1.429	Good

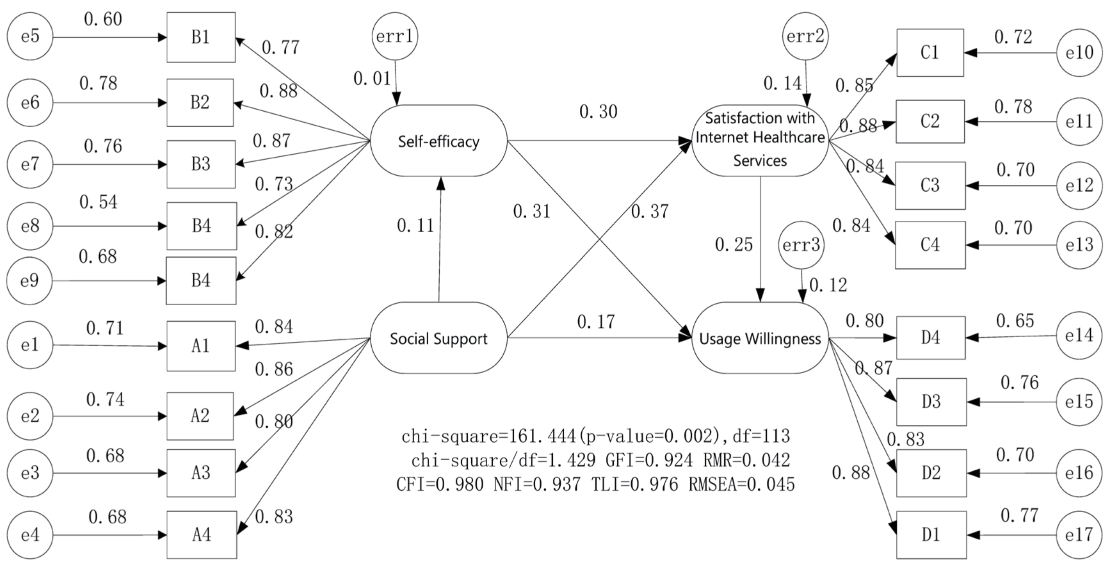

Fig. 2. Estimation results of the structural equation model for willingness to use internet healthcare platforms.

efficacy and satisfaction with the online environment both have significant positive effects on the willingness to use Internet healthcare platforms, (β = 0.37, p < 0.001) and (β = 0.25, p < 0.001), respectively.

A bootstrap mediation analysis was conducted using 5,000 resamples, and the 95% confidence intervals (CIs) for the mediation effects were calculated. The results are summarized in Table 6. The total effect of social support on elderly patients' willingness to use Internet healthcare platforms was 0.173 (p < 0.001), with a direct effect of 0.039 (p < 0.05). The total indirect effect of social support on willingness to use Internet healthcare platforms was 0.134 (p < 0.05), which consisted of indirect effects transmitted through three distinct mediating pathways.

Path 1: Self-efficacy mediated the relationship between social support and willingness to use Internet healthcare platforms, with a mediation effect strength of 0.033. This indirect effect was generated through the pathway of social support → self-efficacy → willingness to use.

Path 2: Social support indirectly affected the willingness of elderly patients with chronic diseases to use Internet healthcare platforms by affecting their satisfaction with the online

Table 6
Results of chain mediating effects and bootstrap test.

Effect	Effect size	Standard error	95% Confidence interval	Effect proportion (%)
Total effect of social support on willingness to use internet healthcare platforms	0.173***	0.063	[0.097, 0.347]	–
Direct effect of social support on willingness to use	0.039**	0.066	[0.016, 0.278]	22.54
Total indirect effect of social support on willingness to use	0.134**	0.045	[0.021, 0.054]	77.46
Social support → Self-efficacy → Willingness to use	0.033**	0.010	[0.001, 0.040]	24.63
Social support → Satisfaction with online environment → Willingness to use	0.055**	0.035	[0.023, 0.198]	40.30
Social support → Self-efficacy → Satisfaction with online environment → Willingness to use	0.046**	0.002	[0.001, 0.013]	35.07

Note: ** and *** indicate significance at the 5 and 1% levels, respectively.

environment, with a mediation effect size of 0.055. This indirect effect was generated through the pathway of social support → satisfaction with the online environment → willingness to use.

Path 3: Self-efficacy and satisfaction with Internet healthcare services exerted a chain mediating effect between social support and willingness to use Internet healthcare platforms, with a mediation effect size of 0.046. This indirect effect was generated through the pathway of social support → self-efficacy → satisfaction with the online environment → willingness to use.

None of the 95% confidence intervals included zero, indicating that the total, direct, and total indirect effects in the model were all statistically significant. The descriptive results show that 35.7% of the respondents reported the active utilization of Internet healthcare services. Among the utilized functions, online registration and online medical payment were the most frequently used services, whereas remote consultation and health monitoring services exhibited relatively low usage rates.

4. Implications and Recommendations

Using Internet healthcare platforms to access health-related information and services is conducive to improving the health status of elderly patients with chronic diseases, optimizing the allocation of medical resources, enhancing user experience, and alleviating societal healthcare burdens. Given the challenges faced by elderly patients with chronic diseases in accessing medical information and healthcare services, we propose a three-in-one solution framework encompassing the "Individual – Healthcare Platform – Social Participation" dimensions.

4.1 Enhancing self-management efficacy of elderly patients with chronic diseases

The results of Path 1 indicate that social support indirectly affects the independent usage willingness of elderly patients with chronic diseases primarily through its effect on self-efficacy. On the one hand, family members should be encouraged to actively participate in the health management of elderly individuals. This participation may include jointly formulating health plans or engaging in age-appropriate activities together, thereby fostering a mindset of proactive health management among the elderly. In daily life, family members should regularly express care and expectations regarding the elderly's health, helping them perceive the importance of their well-being within the family context and stimulating motivation for active health self-management. On the other hand, efforts should be made to improve patients' basic digital literacy. Community organizations can provide training programs on the use of Internet healthcare platforms for elderly patients with chronic diseases. Through such training, participants not only acquire practical skills for accessing and utilizing Internet healthcare services but also receive psychological support, which contributes to enhanced self-efficacy. As elderly individuals' self-management efficacy improves, their willingness to independently use Internet healthcare platforms is expected to increase accordingly.

4.2 Improving the usability of internet healthcare platforms

The findings of Path 2 demonstrate that social support indirectly affects the active usage willingness of elderly patients with chronic diseases, mainly by affecting their satisfaction with Internet healthcare platforms. Therefore, improving the usability of these platforms is particularly important. First, the interfaces of Internet healthcare platforms should be designed to be concise and intuitive. Unnecessary advertisements and complex icons should be minimized, while core functions are clearly highlighted. For example, registration interfaces should present only essential information—such as hospitals, departments, physicians, and available appointment slots—to avoid overwhelming elderly users with excessive or irrelevant content. Second, large icons and fonts should be adopted to improve visual accessibility for elderly users. Buttons should be sufficiently sized and accompanied by clear instructional text to ensure ease of recognition and operation. Third, voice-guided navigation and operation functions should be incorporated, including integrated voice assistant features that allow elderly users to complete certain tasks via voice commands. For complex medical information, such as the interpretation of examination reports, voice-based explanations can further enhance comprehension. Finally, clear and accessible explanations regarding data security and privacy protection should be emphasized. Healthcare platforms should prominently explain how personal information and medical data are protected, using plain language and illustrative diagrams to convey concepts such as data encryption and access control mechanisms.

4.3 Improving the multidimensional social support system

The results of Path 3 indicate that self-efficacy and satisfaction with Internet-based healthcare services exert a serial mediating effect on the relationship between social support and elderly patients' willingness to adopt Internet-based healthcare platforms. At the same time, social support was found to have a significant positive impact on patients' active utilization willingness. These findings highlight the importance of further improving and refining the social support system for elderly patients with chronic diseases. Specifically, multidimensional social support can affect utilization willingness through three interrelated dimensions: informational support, emotional support, and instrumental support. With regard to informational support, community organizations and family caregivers should proactively introduce the various functions of Internet-based healthcare platforms to elderly patients and provide targeted guidance. Such guidance should focus on core operational processes, including searching for medical information, scheduling online appointments, and conducting real-time consultations with physicians through digital platforms. In addition, community workers or peers may share authentic experiences of using Internet-based healthcare services, including information related to platform security measures and physician qualification verification. These practices can help reduce information asymmetry surrounding Internet-based healthcare platforms among elderly patients with chronic diseases, thereby enhancing their understanding of and trust in such services.

Emotional support plays a critical role in providing psychological reassurance for elderly patients with chronic diseases. Positive emotional support can stimulate curiosity and foster favorable attitudes toward emerging technologies. When family members acknowledge the convenience of Internet-based healthcare platforms and actively encourage elderly individuals to try them, such positive attitudes can be transmitted effectively, helping to alleviate anxiety or resistance toward new service models. With respect to instrumental support, the provision of appropriate equipment and technical assistance is essential to meeting the material and technical requirements for elderly patients with chronic diseases to use Internet-based healthcare platforms. Family caregivers can support elderly users by purchasing age-friendly smartphones or tablets, installing Internet-based healthcare applications, and offering hands-on guidance for basic operations, such as launching applications, connecting to wireless networks, and navigating key service functions. Beyond the optimization of social support systems, governmental efforts should focus on promoting the development of medical consortia to integrate regional healthcare resources. Establishing integrated medical alliances can facilitate resource sharing and complementary collaboration among healthcare institutions at different levels. At the same time, primary healthcare institutions should strengthen their capacity to refer patients with complex or severe conditions to higher-level hospitals in a timely manner, thereby ensuring continuous and comprehensive healthcare management for elderly patients with chronic diseases. Note that different types of chronic diseases may involve various healthcare needs and service utilization patterns. Although disease-specific differences were beyond the scope of this study, how chronic disease categories interact with sensor- and IoT-enabled healthcare service utilization may be further examined in future research.

5. Conclusions

In this study, we systematically investigated the mechanisms affecting elderly patients' willingness to use Internet-based healthcare services by constructing a chain mediation model grounded in SCT. Within sensor- and IoT-enabled healthcare contexts, this framework helps explain how human factors interact with digital service environments. The results indicated that social support plays a pivotal role in promoting the utilization of Internet healthcare platforms among elderly patients with chronic diseases, both directly and indirectly. In particular, self-efficacy and satisfaction with Internet healthcare services were identified as significant mediators and formed a serial mediation pathway linking social support to usage willingness. These findings confirmed that the adoption of Internet healthcare services is not solely driven by technological availability, including connected sensors and data infrastructures, but is strongly shaped by psychological and social factors. The results further demonstrated that enhanced self-efficacy improves elderly individuals' confidence in managing their health and navigating digital healthcare platforms, thereby strengthening their independent usage willingness. For sensor-integrated services, this suggests that the usability and clarity of system feedback are as important as the sensing functionality itself. At the same time, satisfaction with Internet healthcare services—closely associated with platform usability, accessibility, and perceived service quality—emerged as a key determinant of continued engagement. This is particularly relevant for IoT-based healthcare services that require sustained interaction. Together, these results highlighted the importance of integrating user-centered design, digital literacy support, and socially embedded encouragement in the development and dissemination of Internet healthcare services. Such trust is essential for the continued use of sensor-based and IoT-supported medical services. From a practical perspective, in this study, a three-in-one framework encompassing the individual, healthcare platform, and social participation dimensions is purposed. Strengthening elderly patients' self-management efficacy, improving the usability of Internet healthcare platforms, and enhancing multidimensional social support systems are critical strategies for promoting sustained adoption. Informational, emotional, and instrumental support from families, communities, and healthcare institutions can collectively reduce perceived barriers and foster trust in digital healthcare services. With this study, we contribute to the existing literature by clarifying the psychological and social mechanisms underlying Internet healthcare service utilization among elderly patients with chronic diseases. By linking these mechanisms to the utilization of sensing-enabled healthcare services, we provide user-oriented insights relevant to smart healthcare system design. The findings provide meaningful implications for policymakers, healthcare providers, and platform designers seeking to promote active aging, optimize healthcare resource allocation, and support the inclusive development of digital health services.

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