



# Bridging Technostress and Perceived Value: Why Middle-Aged and Elderly People Resist Using Chronic Diseases Management Apps

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**Abstract.** This paper aims to explore the causes of resistance to using chronic disease management APPs in middle-aged and elderly people. By integrating technostress theory and status quo bias (SQB) theory, a conceptual model was proposed to explore the resistance of information system users. A total of 290 questionnaires were collected in the middle-aged and elderly population, and the CB-Structural Equation Model was used to test the hypotheses. We found that both technology anxiety and perceived value can directly affect the resistance intention, while technology anxiety can also indirectly affect the resistance intention by significantly affecting the perceived value. We also found that switching cost has no significant impact on perceived value. The paramount contribution is the combination of technostress theory and the status quo bias theory in the study of system resistance intention and the in-depth discussion of the functional relationship between the two.

**Keywords:** Chronic diseases · elderly · Resistance intention · Technology anxiety · Perceived value

## 1 Introduction

Chronic diseases are the most serious disease that disturbs the middle-aged and elderly groups. With the popularity of smartphones, wearable devices and health record systems, mobile chronic diseases management apps provide new solutions to chronic disease management [1]. Many research results on the mobile information systems also indicate that the long-term chronic disease management intervention programs of APPs are beneficial to the rehabilitation and treatment of patients with chronic diseases [2]. However, in practice, as a group with high incidence of chronic diseases, the middle-aged and elderly are less receptive to this new form of services [3]. Chronic diseases management APPs have encountered great resistance to promotion.

Many researches discussed about why people resist using a new information system and what factors influence people's resisting behavior [4]. They found that the reasons for users adopting and not adopting new technology were significantly different [5]. The

technostress theory [6], often used in work scenarios in organizations, and the perceived value derived from status quo bias theory [7], often used in social media scenarios, are the two main theoretical explanation to users' resisting behavior. However, in marketing and psychology research, function factors, e.g. quality, and affective factors, e.g. feelings, are simultaneously associate to perceived value [8]. As previous research on adoption and resistance to new systems mostly focuses on young people, those of middle-aged and above with the great physical and psychological differences from young people are less addressed. Compared to young people, the middle-aged and elderly people are more vulnerable of using information technology, less familiar with the forms of mobile services, more susceptible to emotional experiences, and pay more attention to health status [9]. So we may find empirical evidence to bridge technostress and perceived value in this context.

This study attempts to explore the resistance intention of the middle-aged and elderly to chronic diseases management APPs. On one hand, we brought two traditional factors of resistance intention, technostress and perceived value, into a research framework for discussion and studied their relationship. On the other hand, we discussed the role in resistance intention played by group characteristics of middle-aged and elderly people.

## 2 Theoretical Background

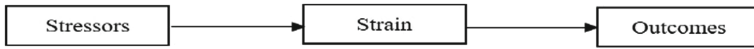
### 2.1 Resistance Behaviors and Technostress Theory

Resistance behavior is defined as explicit or covert actions that prevent the systems from implementing or using or prevent the systems designers from achieving predetermined goals. Most scholars incline to regard the resistance behavior as a psychological state, and it is found that users' resistance is not merely due to the lack of positive factors, as there is possible negative resistance inclination which may be hidden behind the surface of acceptance behaviors [10].

With the middle-aged and elderly people being disadvantaged groups of information technology, and technology being an important factor causing stress [11], the consequences of stress will bring negative effects on individual mentality and behavior, thus leading to users' resistance intention. Technostress is a psychological activity formed under the current technical social environment [11]. For the middle-aged and elderly people, technostress refers to the emotion and experience when dealing with new technology products, which is a modern adaptive disease caused by them inability to deal with new technology properly.

Many researches substantiate the claim that technostress is the negative impact of technology on people's attitude, psychology, cognition, and behavior [11]. The Stressors-Strain-Outcomes framework was proposed to elaborate the process of technostress affecting people's attitude and behavior [12]. This model is derived from the work scene, widely applied to many research fields of information technology and consists of three parts: stressors, strain, and outcomes (Fig. 1). It assumes that stress is the result of perceiving stressors and is the leading variable of the outcome, where "stressors" refer to the environmental stimuli like techno-complexity and techno-insecurity. The mediating variable "strain" refers to physiological and psychological response to stressors, including

the bad emotions such as anxiety and fear. “Outcomes” refer to psychological or behavioral consequences caused by long-term tolerance of stress and stress performance, e.g. intention to quit, etc.



**Fig. 1.** Stressors-Strain-Outcomes framework

There are many types of stressors and strain related to technical stress [6]. Techno-complexity, which describes the complexity associated with ICT (information and communication technology) that makes users feel inadequate in technical capability and urges them to spend time and effort learning and understanding aspects of ICT, and technology anxiety are considered as the stressor and strain in this study, because they are the most commonly mentioned and prominent factors and especially important for elderly [5]. Since the middle-aged and elderly people are not familiar with information technology and losing energy, it is difficult for them to use new technology, and thus they are most likely to perceive Techno-complexity.

## 2.2 Resistance Behaviors and Status Quo Bias Theory

Researchers believe that users’ resistance intention comes from rational decisions made based on comprehensive considerations between the benefits brought by new technologies and the costs of using new technologies [7]. Shang, from the perspective of users, believes that the resistance is caused by the gap between users’ desire to maintain the status quo and the change brought by the systems [13]. The SQB theory was proposed by Samuelson and Zeckhauser [14] to explain the behavior that people prefer to maintain the status quo, which explains the phenomenon that individuals tend to maintain the status quo or maintain the previous decision and choose not to act when making new decisions. The theory holds that even if the environment has changed and alternative decision plan appeared, people will carefully compare the benefit and cost of switching to decide whether to transform their status. When switching benefit is larger than switching cost, people will change their status, otherwise, they will maintain the status quo. The perceived value after integrating the switching benefit and switching cost is the key factor for people to decide whether to resist the new information systems or not [10].

Based on the above analysis, from the perspective of technostress theory, it is noted that, according to Stressors-Strain-Outcomes framework, technostress may aggravate users’ resistance intention. However, from the perspective of the SQB theory, the perceived value formed after comprehensive consideration of switching costs and switching benefits may reduce users’ resistance intention [10]. Then under the combined effects of the above two perspectives, how exactly is the resistance intention formed by middle-aged and elderly users?

Meanwhile, in the previous studies, the role of technostress theory and SQB theory in user resistance behavior was studied separately [4]. However, from the perspective of rational decision-making, there has been plenty historical evidence analyses, behavior

observations and experimental data showing that psychological stress beyond a certain level makes people unable to systematically consider all relevant solutions and fail to make rational choices [15]. For the elderly, the low capability to handle technical pressure will affect the judgment on the perceived value of using chronic diseases management APPs. Besides, bad emotions will directly decrease the perceived value in some marketing researches [8]. It is thus a sensible choice for this study to combine technostress theory with SQB theory.

### 3 Research Model and Hypotheses

#### 3.1 Constructs from SQB

**Switching Cost, Switching Benefit and Perceived Value.** The switching cost and switching benefit are derived from the SQB theory. Switching cost refers to the negative effect felt by users when they switch from the status quo to new information systems, which consists of transaction cost, uncertain cost, and sunk cost [14]. In this study, the switching cost mainly results from the switching process of patients with chronic disease from using offline medical service resources to using online medical services. Because it takes time and effort to familiarize with a new system, users have to bear a high switching cost, which leads to lower perceived value [16]. Switching benefit is defined as the utility gained after using the new systems [10]. In this study, the switching benefits mainly come from the benefits gained by reducing medical expenses, increasing the efficiency of seeing doctors, strengthening self-health management, etc. These are direct benefits to middle-aged and elderly users of chronic diseases management APPs, which increases their perceived value of the new system. Perceived value of the middle-aged and elderly users are measured by weighing the costs and benefits of change. Therefore, the following hypotheses are proposed:

**H1:** The perception of product switching cost by middle-aged and elderly patients will negatively affect the perceived value.

**H2:** The perception of product switching benefits by middle-aged and elderly patients will positively affect the perceived value.

**Perceived Value and Resistance Intention.** According to the SQB theory, the perceived value is the evaluated result of whether the gained benefit by switching from the status quo to the new state is worth of the cost [10]. When users decide to either keep the status quo or choose a new system, if the perceived value of the change is low, users are more likely to show a higher resistance intention to the implementation of the new system. Conversely, if the perceived value of the change is high, users may incline to reduce their resistance intention to the new system. Since users have a strong tendency to maximize value when making decisions [17], users may be more resistant to changes if the perceived value of changes is low [14]. However, if the perceived value is high and the user feels that the benefit is greater than the cost, it will be easier to accept the change, and the resistance intention to new technologies and products will be reduced. To sum up, the following hypothesis is proposed:

**H3:** The perceived value of middle-aged and elderly patients negatively affects their resistance intention to products.

### 3.2 Constructs from Technostress

**Technology Complexity and Technology Anxiety.** Technology complexity refers to the degree to which an individual does not have to expend effort to use the technology, representing an increase in the mental effort and learning curve required [18]. Numerous studies have confirmed a mutual influence relationship between technology complexity and technostress [11]. In this study, the middle-aged and elderly people have a low degree of mastery of information technology and are sensitive to technical complexity, hence they have a low evaluation of information technology self-efficacy, resulting in their belief of their incapability of using chronic diseases management Apps. Due to the significant influence of individual self-evaluation on the perceived stress level, technostress is generated during the subjects' use of technology, which leads to technology anxiety. Therefore, the following hypothesis is proposed:

**H4:** Technology complexity positively affects technology anxiety.

**Technology Anxiety and Resistance Intention.** Technology anxiety is related to the fear or discomfort that people experience when thinking about or actually using technology. It also refers to an individual's fear of the possibility of using technology [4]. People with technology anxiety will weaken their performance and resist using new technologies, as they perceive themselves as inefficient, focus excessively on their shortcomings, and immerse themselves much in thoughts of failure and fear. Yusop and Basar [19] Studies have found that there are quite a few students resisting using online tool Wiki which can support collaborative learning experience, in which case, the personal factors (i.e. anxiety of using the new technologies) are greater resistance factors compared with technical factors (i.e. slow network connection outside the classroom). In this study, although chronic diseases management APPs can improve health management efficiency, due to the physical and cognitive limitations of this group, their deficiencies of information technology capabilities are prominent, technology anxiety is obvious, and it is easy to generate resistance intention. Moreover, Deng et al. [3] also observed this phenomenon in the use of mobile health services. Based on this, the following hypothesis is proposed:

**H5:** Technology anxiety positively affects resistance intentions of middle-aged and elderly people.

According to existing studies, psychological pressure exceeding a certain intensity can affect the quality of decision-making [15], and individuals under pressure often fail to adhere to the rational choice. As perceived value is the result of a comparison between perceived benefits and perceived costs, individuals' state of being under pressure inevitably affects the process of rational decision-making. Middle-aged and elderly people in the state of technology anxiety could not rationally compare the benefits and costs of using chronic diseases management APPs, thus affecting the judgment of perceived value.

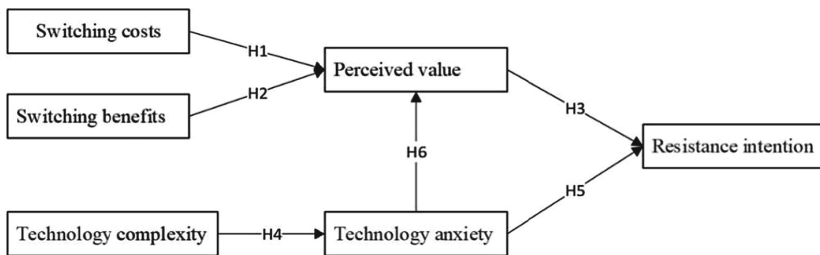
Besides, technology anxiety can be seen as a negative emotion, which are often depicted as unpleasant subjective experiences, imposes additional psychological costs on middle-aged and elderly users, and reduces the perceived value. Some empirical evidences have showed that emotional responses had a significant impact on the perceived value. Some other researches also indicated that negative emotions may prolong the

service waiting time perceived by customers, reduce their participation in purchasing, and generate a desire to retreat from the environment [20].

Moreover, anxiety is often regarded as a component of perceived value, for whom, the emotional response is included in the construction of perceived value. For example, Sánchez-García et al. [8] identified six dimensions of perceived value, including four functional values (e.g. product, price), social value, and emotional value. Based on this, the following hypothesis is proposed:

**H6:** Technology anxiety negatively affects the perceived value of middle-aged and elderly people.

The research model of this study is revealed in Fig. 2 below.



**Fig. 2.** The influencing factor model of resistance intention of the middle-aged and elderly using chronic diseases management APPs.

## 4 Methodology and Results

### 4.1 Participants and Procedure

The subjects of this survey are middle-aged and elderly people who are over 45 years old, can communicate normally, and suffer from chronic diseases (World Health Organization divides the age group over 45 years old into middle-aged and elderly people). Tiaoshanta (TST) Community Health Center and Wangjiang road (WJR) Community Health Center at Chengdu city, China, were the research sites of the field survey. In the beginning, the team members were trained on the survey's purpose and attention. Before the formal data collection, 15 middle-aged and elderly patients with chronic disease were randomly selected from the survey site as the pre-survey objects. The questionnaire was pre-tested and adjusted according to the analysis results.

Considering that middle-aged and elderly patients with chronic disease may have problems in reading or understanding the contents of the questionnaire, or even in physical movements, the whole process is conducted in a “one-to-one” manner, where one investigator faces one survey object at a time. Small gifts were distributed as an incentive measure to the middle-aged and elderly who participated in the survey. A total of 290 questionnaires were collected from the survey, including 19 invalid or missing questionnaires, and 13 questionnaires taken by those aged under 45 being deleted, making a total of 258 valid questionnaires, with a recovery rate of 88.97%.

## 4.2 Measurement Model

Descriptive statistics are mainly analyzed from demographic variables, self-perceived health status and functional needs. In this questionnaire survey, female subjects accounted for 60.9%, nearly 50% of them were people with junior high school education and below. See Table 1 for details:

**Table 1.** Descriptive statistics of demographic variables

Basic information	Statistics items	Distribution	Percentage	Effective percentage	Cumulative percentage
Gender	Male	101	39.1	39.1	39.1
	Female	157	60.9	60.9	100.0
Education background	Junior high school and below	111	43.0	43.0	43.0
	Technical secondary school or high school	72	27.9	27.9	70.9
	College degree or above	75	29.1	29.1	100.0
Age	45–49	14	5.4	5.4	5.4
	50–59	31	12.0	12.0	17.4
	60–69	93	36.1	36.1	53.5
	70–79	87	33.7	33.7	87.2
	80 and above	33	12.8	12.8	100
Health condition	very bad (1 point)	4	1.6	1.6	1.6
	Bad (2 points)	29	11.2	11.2	12.8
	general (3 points)	80	31.0	31.0	43.8
	Good (4 points)	100	38.8	38.8	82.6
	Very good (5 points)	45	17.4	17.4	100.0

Our study has six factors: Technology Complexity (UD), Technology Anxiety (TA), Switching Benefits (SB), Switching Costs (SC), Perceived Value (PV), and Resistance intention (RTC). The questionnaire items were designed with reference from a large number of related literature and slightly modified according to the results of the preliminary survey, with high content validity. SPSS 22.0 was used for statistics and the

measurement result of sample KMO is 0.956. Meanwhile, the significance value of Bartlett sphericity test is 0.000, which is very suitable for factor analysis.

As we used mature scales to measure all the factors, here we only need to perform Confirmatory Factor Analysis (CFA) to check the validity and reliability. Cronbach's  $\alpha$ , Average Variance Extracted (AVE), and Composite Reliability (CR) were calculated to examine the internal consistency reliability and convergent validity. As shown in Table 2, all the Cronbach's  $\alpha$  values were higher than 0.7, indicating a high reliability of the scales.

**Table 2.** Results of standardized item loading,  $\alpha$ , CR, and AVE

Construct	Item	Std.factor loading	t-value	Composite reliability (CR)	Average variance extracted (AVE)
Resistance Intention (RTC)	RTC1	0.856	Fixed	0.963	0.897
	RTC2	0.999	26.156		
	RTC3	0.980	25.156		
Switching Costs (SC)	SC1	0.975	Fixed	0.954	0.840
	SC2	0.985	53.231		
	SC3	0.856	25.146		
	SC5	0.842	23.674		
Perceived Value (PV)	PV1	0.982	Fixed	0.954	0.984
	PV2	0.988	45.699		
	PV3	0.961	48.254		
Technology Anxiety (TA)	TA1	0.969	Fixed	0.950	0.826
	TA2	0.966	41.219		
	TA3	0.862	24.366		
	TA4	0.831	21.804		
Switching Benefits (SB)	SB1	0.939	Fixed	0.968	0.793
	SB2	0.808	29.622		
	SB3	0.965	34.637		
	SB4	0.951	32.268		
	SB5	0.904	26.382		
	SB6	0.783	18.155		

(continued)



**Table 2.** (continued)

Construct	Item	Std.factor loading	t-value	Composite reliability (CR)	Average variance extracted (AVE)
	SB7	0.873	23.675		
	SB8	0.885	24.614		
Technology Complexity (UD)	UD1	0.808	Fixed	0.965	0.798
	UD2	0.809	20.160		
	UD3	0.850	23.128		
	UD4	0.918	30.607		
	UD5	0.962	39.618		
	UD6	0.964	39.623		
	UD7	0.926	31.654		

### 4.3 Hypothesis Testing

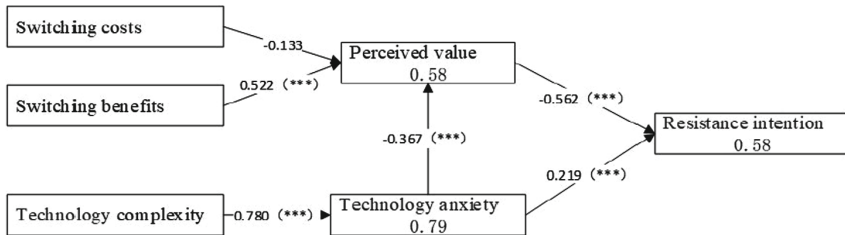
In this study, CB - SEM method was used to draw the structural equation model diagram with Amos22.0. Then, the maximum likelihood method was used to estimate parameters and standardize the model. Finally, path analysis was carried out.

**Model Fitting Degree Analysis.** The measurement results of the model fitness are shown in Table 3. It can be seen that all the fitness indexes have reached the ideal values, indicating that the modified model has a good fit with the sample data.

**Table 3.** Model fitness checklist for the whole model

Fitness index	Ideal value	Value of this model
Chi-square (CMIN)		622.956
Degrees of freedom (DF)		344
$\chi^2/df$	<3	1.811
GFI	>0.8	0.863
AGFI	>0.8	0.826
SRMR	<0.1	0.0717
CFI	>0.9	0.977
RMSEA	<0.08	0.056
NFI	>0.9	0.950
TLI	>0.9	0.973
IFI	>0.9	0.977

**Model Path Coefficient Analysis.** After empirical testing and modification, the model and path coefficients are finally obtained, as shown in Fig. 3.



**Fig. 3.** Model diagram of influencing factors of resistance intention of middle-aged and elderly people using chronic diseases management Apps (unstandardized coefficient).

#### 4.4 Common Method Bias Testing

In measurement, the artificial covariation between predictor variables and benchmark variables caused by the same data source or scorer, the same measurement environment, and the characteristics of the project itself, that is, the common method bias. Control of method factor effect without measurable method adds the common method bias to the structural equation model, which can better test and control the common method bias effect, when the source doesn't need to be identified. Therefore, we add the common method bias latent variable to the model, and compare the fitness of the model before and after adding the variable (Table 4). It can be found that after adding the common method bias latent variable, the chi-square value increased by 31.805, and the RMSEA value increased 0.002, the values of CFI, TLI and IFI didn't change, indicating that after adding the variable, the fitness of the model didn't improve significantly. Thus, there is no significant common method bias in the model.

**Table 4.** Common method bias test results

	Chi-square	RMSEA	CFI	TLI	IFI
Model without common method bias variable	1227.170	0.096	0.928	0.919	0.928
Model with common method bias variable	1450.708	0.106	0.913	0.903	0.913

## 5 Discussion and Conclusion

### 5.1 Discussion of Results

There are two main findings in this study. First of all, this study found that both technology anxiety and perceived value can directly affect the resistance intention; furthermore, technology anxiety can also indirectly affect the resistance intention by significantly affecting the perceived value, which is consistent with the results of previous works [4]. This study suggests the association may result from middle-aged and elderly users being under pressure to use new technologies with chronic diseases management APPs. On one hand, the psychological cost increases obviously, and the perception of net benefit is reduced in the comprehensive comparison process on benefits and costs; on the other hand, technology anxiety can reduce the sequence of users' instantaneous thinking activities, and the benefits brought by chronic diseases management APPs cannot be systematically justified under the influence of cognitive limitation, thus negatively affecting perceived value. This means that the rational comparison process of obtaining perceived value in this study is affected by negative emotions. In the future design and promotion of chronic diseases management APPs, the emotional responses of the middle-aged and elderly should be taken into account to reduce the negative emotions in their use.

Second, this study finds that the switching cost has no significant effect on perceived value. The reason may be that the subject group has a more consistent perception of switching costs. Previous studies have suggested that higher switching costs reduce the perceived value of the net benefit or the change to the user, as the net benefit is assessed by weighing that associated with the changing cost [16]. However, in the scenario of this study, the switching cost of the subject group people is relatively consistent and does not reflect a big change. The objects of this study basically grew up in the 1980s and before when the application of Internet technology was not yet widespread in China. Mobile applications became popular around the year 2010, when the research objects were generally devoted to work and family, had little spared energy for learning, thus could only passively accept the popularization of technology, causing the investment and cost of using chronic diseases management Apps basically the same. According to "The 52nd Statistical Report on China's Internet Development", by June 2023, there were over 400 million middle-aged and elderly Internet users in China, more than half of whom spent more than a quarter of their time on mobile phones, mainly consuming social, news and video contents; the consistency of the middle-aged and elderly population is evident. This shows that the group characteristics of middle-aged and elderly users should be considered to promote perceived value, avoiding unnecessary efforts in reducing the switching costs of using chronic diseases management APPs.

### 5.2 Theoretical Contribution

This paper contributes theoretically in the following two aspects. First, its paramount contribution is the combination of technostress theory and the status quo bias theory in the study of system resistance intention and the in-depth discussion of the functional relationship between the two. They illustrate the decision-making process of user resistance from two different perspectives: technostress and status quo bias. However, few studies

have put the two theories together to explore user resistance of information systems. In this study, we found the negative influence path of technology anxiety on perceived value, thus uncovering the connection between the two theories. This makes up for the current research gap and also further explains the decision-making path. Additionally, it reminds subsequent research on information system resistance intention to consider the influence of negative emotions such as pressure on rational decision-making.

Second, this study enriches the relevant theories of system resistance intention. At present, there is no consistent conclusion on how the benefits of new systems and the barriers to adoption affect users' resistance intention among middle-aged and elderly people. However, in the scenario of this study, switching cost has no significant impact on perceived value resistance intention, indicating that obstacles have little impact compared with benefits. This supports the research on information system resistance intention and broadens the influence mode of users' resistance intention. Among them, the characteristics of middle-aged and elderly people play a decisive role in the formation of the system resistance intention, which reminds follow-up studies on information system resistance to note the influence of the characteristics of the subject group.

### **5.3 Practical Implications**

The empirical study shows that the subject group with chronic diseases give up using mobile Apps services mainly because of technology anxiety. Thus, for those patients with chronic diseases to eventually fit better into the society, they should face the existence of technology anxiety, actively participate in skills training, and gradually adapt to the new health management model.

For those service providers of chronic diseases management APPs, they can reduce the resistance from both management and technology levels. At the management level, they can mainly increase switching benefits to weaken resistance intention and increase the perceived benefits with promotions, incentives, or promotions through the help of their trusted people. Meanwhile at the technology level, as complexity is the main cause of technology anxiety, specific measures can be implemented to reduce the complexity in the following two aspects: (1) Optimize system functions; (2) Optimize system interface and user interaction design. In this study, it was found that patients in the subject group with chronic diseases were easily confused by icons' meanings, missed messages, and forgot the operation steps when using mobile apps, as they are generally prone to have psychology problems caused by technology anxiety. Service providers can take corresponding measures, e.g. design icons in consistence with traditional medical services, and provide user-friendly message reminders such as text or voice prompts, flashing lights, easily recognized sound or vibration, and interface message reminders, etc., to compensate for the defects of people with visual or hearing impairment.

### **5.4 Limitations and Future Research**

Our study has its limitations, which may lead to future research. For the resistance intention of new technologies, this study deeply combines the reasons of the status quo bias theory and the technostress and verifies them in the mobile applications of chronic disease management for middle-aged and elderly people. Future studies can extend the

thinking, exploration mode, and conclusion to other scenarios. Besides, this study is only limited to the individual level of user resistance intentions. Future studies can further explore the resistance intentions in the organizational environment. Finally, this study mainly adopts the self-report method to measure technostress. From this perspective, the accuracy can be greatly improved if future studies adopt new technologies such as nuclear magnetic resonance imaging (MRI), EEG, etc.

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