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RESEARCH ON THE DEVELOPMENT MODEL OF SMART HEALTHCARE BASED ON BIG DATA — THE PERSPECTIVE OF THE PUBLIC'S WILLINGNESS TO ADOPT MOBILE HEALTH

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Abstract

The information technology revolution since the modern times has brought tremendous changes to human life patterns. Human needs for medical treatment and health are increasing and gradually changing. It has brought unprecedented challenges to the medical and health services industries. As a revolutionary technology that changes human lifestyle, information technology can realize the optimization of the behavior and mode of medical and health services. From initial attempts to widespread use, to the redesign of medical procedures, developed countries such as Europe and the United States have penetrated information technology into all levels of medical services. Information technology has become the driving force and source of the transformation and development of the medical and health industry, and the concept of smart medicalcare is derived from it. This study takes the mobile health app as an example to explore what factors affect the public's willingness to adopt mobile health. This research draws on previous research results and integrates the current mainstream research model. This study uses SPSS21.0 software. Based on the above results, this study puts forward relevant suggestions and enlightenments of mobile health and makes research prospects. It is hoped that it can provide some theoretical guidance and reference for the development of mobile health in China, the formulation of relevant policies and the optimization of service providers' products.

Keywords: Smart Healthcare, Big Data, Telemedicine, Service Quality.

INTRODUCTION

With the continuous development of big data technology, "Internet +" has gradually penetrated various fields of national economy and people's livelihood. At the same time, the rapid development of medical technology, the continuous optimization of communication, network, and information-related technologies, the comprehensive integration of smart medical and mobile health, new medical platforms have gradually taken shape, intelligent equipment is popular, and the public-centric medical service system has become the mainstream focus (Garritty & El-Emam, 2006; Krishna, Boren & Balas, 2009; Gamble, 2009; Johansson, Petersson & Nilsson, 2010; Agarwal, Gao & Desroches, 2010; Kim, 2012; Li, Zhao & Luo, 2015; Correia, Kon & Kon, 2015; Liu, 2017).

"Smart healthcare" refers to the use of Internet of Things technology to realize the interaction between the public and medical personnel, medical institutions, and medical equipment, promote the innovation of medical information technology, and finally achieve real-time, intelligent, automated, and interconnected dynamic services. The smart medical system based on the Internet of Things has been widely recognized due to its relatively wide range of standards, and the country has also responded and promoted the development of its field (Wu & Chen, 2013; Fang & Lin, 2014; Chen, 2015; Jiang, 2015; Hong, 2015; Shen, 2016; He, Xiong & Shang, 2016; Chen, 2017; Gong, Sun, Lin & Gu, 2017; Chen, Zeng & Shen, 2017; Luan, Ma & Tang, 2017; Fang, 2018; Li & Duan, 2018; Ni, 2019).

Smart healthcare has provided the public with accurate health monitoring and analysis, promoted the reform and innovation of the medical treatment model, and changed the traditional doctor-patient relationship has become a consensus. The rapid development of the Internet has brought new development models and opportunities to traditional industries. At the same time, the Internet has gradually penetrated into the medical field. With the popularity of PDAs and mobile phones, mobile health has rapidly developed, providing new solutions and methods for solving medical problems in various countries.

China has spared no effort to explore the "Internet + health care". In March 2015, the State Council issued the "*Outline of the National Health Care System Planning (2015-2020)*". The document pointed out that we must actively develop information technologies such as the Internet, the Internet of Things, and cloud computing, and effectively transform the medical and health mechanism to benefit the people.

In June 2016, the "*Guiding Opinions of the General Office of the State Council on Promoting and Regulating the Application of Big Data in Health Care*" pointed out that Internet technology should be used to explore new models of health care development to meet people's medical needs. Give play to the leading role of high-quality medical resources and encourage social forces to participate. Open online and offline channels standardize the management of healthcare apps and develop

Internet of Things devices. Promote the implementation of medical health consultation, online registration, mobile health payment, report query, disease tracking and other functions. Optimize the diagnosis and treatment process and create a new model of standardized, shared, and mutual trust mobile medical treatment (Ammenwerth, Buchauer, Bludau & Haux, 2000; Choudhri & Radvany, 2010; Busis, 2010; Hasvold & Scholl, 2011; Liang, Wang, Yang, Cao, Chen, Mo & Huang, 2011; Deng, 2013; Soto, Chu, Goldman, Rampil & Ruskin, 2016; Gao, 2017; Lapinsky, 2017; Liu, 2018).

In December 2016, the Ministry of Commerce, the Internet Information Office, and the National Development and Reform Commission jointly issued the "*13th Five-Year Development Plan for E-commerce*", which further pointed out that through reasonable opening of medical health and education service resources, we will actively and steadily develop medical health and education service resources. The emerging service format of e-commerce promotes the development of online services in hospitals and schools, expands service coverage, and meets the diverse medical and health and education service needs of the people.

Research Background

Smart Healthcare Has Become an Important Direction of Healthcare Reform

Smart healthcare is an emerging discipline and an interdisciplinary subject, combining life science and information technology. The key technology of smart healthcare is an important part of modern medicine and communication technology. Smart Healthcare has gradually achieved comprehensive informationization by creating a regional medical information platform centered on electronic health records and using Internet of Things related technologies to realize the interaction between the public and medical personnel, medical institutions, and medical equipment.

Mobile health has been recognized by the World Health Organization as an effective way to manage health. Mobile health services have effectively penetrated mobile technology into the medical field, helping to reduce medical costs, improve medical standards, and facilitate patients' access to medical services. The effective combination of information technology and medical care to promote personalized medicine is the biggest opportunity for mobile health services, but it also faces many problems. According to relevant reports, as of April 2015, the mobile health service user group reached 90 million, and most of the service recipients were young people, while the elderly with high medical needs were 220 million. From this data, the elderly with higher medical needs are not the main group of mobile health service usage, which causes the problem of low utilization rate of mobile health service. In addition, after the adoption of mobile health services, the low frequency of use and

the low rate of continued use have also become issues of concern to many industry insiders, experts and scholars.

Some online consultation and medical health service platforms have many users, but only a small part of them are active users. For some daily monitoring mobile health services (such as high blood sugar executives), only a few users can make daily use. Many mobile phone apps that provide medical services can play an effective role in monitoring users' sleep, diet, and exercise. Despite the ease of operation and simplicity of these services, the lack of external pressure and stimulation makes it difficult for users to use them continuously.

Through mobile technology, the medical field can improve the service level, improve the rate of diagnosis and treatment, and reduce the cost of medical treatment. Through the mobile application, you can obtain and update patient records, enter diagnosis and treatment results, monitor patients, and provide medical information to support the work of doctors and medical practitioners. Although the superiority of mobile health services is generally recognized, the widespread use of mobile health services has not yet achieved the desired results. Exploring the use of mobile health services not only has a positive impact on the development of information technology, but also has a very profound impact on the health care field.

Therefore, this study aims to solve the following research problems:

(1) How does the willingness to adopt mobile health services arise?

(2) What are the factors that influence the willingness?

Research Objective

As a new medical service model, mobile health service has received more and more attention from scholars and medical practitioners. Compared with traditional medical services, mobile health services have the characteristics of easy accessibility, personalization, and timeliness, and provide users with real-time, ubiquitous, and anytime, anywhere medical services. Mobile health services have profound significance for users, as well as the entire medical industry. The prerequisite for a service to function is to accept and use it. However, the current research on the adoption of mobile health services is not enough to reveal the mechanism of users' adoption of mobile health services. Therefore, based on the theory of adjustment focus theory, motivation theory and technology acceptance model, this study explores users' willingness to adopt mobile health services and investigates related influencing factors, revealing the formation mechanism. Thereby providing theoretical guidance and practical significance for experts, scholars and medical practitioners. The specific research objectives are as follows:

(1) According to the characteristics of mobile health services, explore different types of adoption intentions and build a theoretical model of mobile health services adoption intentions.

People's adoption of information technology will produce different types of behavior. And mobile health is a kind of special medical service that combines medical treatment and information technology and will result from different usage behaviors of other information technology services. Therefore, this study aims to deeply explore user's mobile health adoption behavior from the perspective of individual characteristics. It helps researchers, developers, service providers, medical professionals, and users of mobile health services to better understand mobile health services.

(2) From the perspective of individual characteristics, explore the influencing factors of mobile health service adoption willingness, and reveal the formation mechanism of mobile health service adoption willingness.

LITERATURE REVIEW

Predictor Variables

Perceived Usefulness

Perceived usefulness is a representative variable in the field of management information system research and is widely used in various research situations where technology is accepted (Junglas, Abraham & Ives, 2009; Wu, Morra, Quan, Lai, Zanjani, Abrams & Rossos, 2010; Alexander, Hauser, Steel, Ford & Demner-Fushman, 2014; Liu, 2014; Slight, Berner & Galanter, 2015; Hauser, Demner-Fushman, Ford & Thoma, 2014; Shang & Sun, 2016; Xi, Wang, Sun & Ji, 2017). Perceived usefulness is an important independent variable in the technology acceptance model. It means that people believe that the use of a special system will increase their work performance. In the technology acceptance model, perceived usefulness directly affects the attitude of using the system and the willingness to use the system, and this variable is also affected by the perceived ease-of-use in the model. In the context of an enterprise, employees' performance will be motivated by promotions, salary increases, bonuses, and some other rewards. If an information system is perceived to be of a higher degree of usefulness, then employees will be deemed to use the system to be closely related to their performance. Compared with other influencing factors, perceived usefulness is seen as a variable that has a stronger and more consistent relationship with behavioral will (Lindquist, Johansson, Petersson, Saveman & Nilsson, 2008; Marshall, Medvedev & Antonov, 2008; Stroud, Smith & Erkel, 2009; Cole-Lewis, 2010; Dala-Ali, Lloyd & Al-Abed, 2011; Low, Clark, Soar, Padkin, Stoneham, Perkins & Nolan, 2011; Sun, 2019).

Perceived usefulness mainly refers to the user's perceived usefulness of Internet medical treatment. Perceived usefulness is a user's subjective judgment that the application of an information system may improve work efficiency. The stronger the user's perception of usefulness, the faster it will be accepted.

In recent years, the outpatient or inpatient departments of major hospitals often have unhealthy doctor-patient relationships and unsightly and expensive medical treatment. This is the existing situation in China's traditional medical industry and has been criticized by people. The emergence of Internet medical treatment has played an important role in optimizing the medical experience and procedures. Internet medical focus includes four types: providing users with online consultation and examination information booking, medical e-commerce form, telemedicine form, and wearable devices. Through the Internet platform, health management services are provided to the public, mainly reflected in its high efficiency, time saving, convenience, and relatively easy access to resources.

Preliminary research results

Most of the existing research on the usefulness of perception is related to the research on technology acceptance.

In the research of Robert and Deigan (1986), it mainly discusses the effect of structure, environment, and interdependence on the perceived usefulness of management accounting systems. Igbaria et al. (1994) studied the effects of perceived usefulness and perceived interest on the acceptance behavior of microcomputers. The results of the study indicate that perceived usefulness is a more important variable in determining whether to accept or reject microcomputer technology than perceived interest. In the study of Saadé and Bahli (2005), the focus is on the impact of cognitive absorption on the perceived usefulness of online learning. Amoako-Gyampah's (2007) empirical research on the implementation of Enterprise Resource Planning (ERP) focuses on the interrelationships between perceived usefulness, user participation, and behavioral willingness. The results show that the perceived usefulness of users affects the willingness to adopt technology. Therefore, it is recommended that management should pay attention to factors such as improving the user's perception and usefulness of technology to promote the implementation of the ERP system. In the current research, no experts or scholars have discussed the impact of perceived usefulness on different usage behaviors of mobile medical services. Therefore, in the fifth chapter, this study introduces perceived usefulness as a proxy variable for external motivation to explore the effect of this variable on the daily and emergency adoption intentions of mobile medical services.

Outcome Variable

The outcome variable of this study is willingness to adopt.

The willingness to adopt refers to a clear activity or behavior tendency that the individual is about to take towards the target value. This study distinguishes users who have not been exposed to Internet medical treatment and may carry individual subjective judgments.

Adoption willingness is the same as behavioral willingness. Fishbein & Ajze (1975) showed that behavioral willingness refers to the subjective probability of individuals voluntarily engaging in a specific behavior. In this study, the willingness to adopt is used as the dependent variable, and the degree of subjective willingness of the public in choosing whether to adopt mobile healthcare.

Control Variable

The control variables in this study are individual characteristics. Individual characteristics are based on user subdivisions, based on empirical analysis results of a specific group of people to receive willingness analysis.

This study draws on UTAUT's theoretical model to include adjustment variables, and uses age, gender, education, and health status as individual characteristics in the study. In order to explore whether there are significant differences in the adoption of mobile medicine among people of different ages, genders, education levels and health conditions.

In the existing research, studying the influence of individual characteristics on people's behavior motivation and consumption behavior is very extensive. Zeng Ming and others discussed the factors that influence consumers' motivation for corporate social responsibility behavior from the perspective of individual characteristics. Liu Cong studied the influence of individual characteristics of fund managers on their actual investment preferences. In the research of Zhang Min et al., The users of mobile medical service APPs for consultations were mainly discussed from the perspective of patient characteristics and other perspectives. This paper discusses the social demographic characteristics of individual characteristics on the adoption behavior of online banking. Martinex et al. Found that individual characteristics significantly distinguished potential users and non-potential users among consumers of electronic products. In the current research, less attention has been paid to the individual characteristics and health perception factors that affect people's adoption of mobile medical services.

Many current studies have confirmed that individual characteristics have an impact on new product adoption behavior. Table 2-1 shows the relevant empirical research on individual characteristics and new product adoption behavior. Individual characteristics can be reflected by statistical information (such as age, education, etc.) and social activity participation status, which in turn determines people's different new product adoption behaviors. Individual characteristics are divided into social demographic characteristics and psychological level statistical characteristics. Socio-demographic characteristics, such as gender, education, age, etc., have been

extensively discussed in existing information system adoption studies. The statistical features at the psychological level have received less attention. The Comprehensive Action Dtermination Model (CADM) proposes that people's willingness to act is affected by the individual characteristics related to the individual's perceived value system. Therefore, in this study, we mainly reveal the impact of psychological features on people's mobile medical service adoption behavior.

Table 2-1 Relevant Empirical Research on Individual Characteristics and New Product Adoption Behavior

Research Methods	Research Findings	Source
Gradual Return	The adoption behavior of new products is closely related to personal characteristics (such as income and product participation).	Summers 1971
Discriminant Analysis	Personal characteristics are weak predictors of new product adoption behavior, while perceived innovation characteristics (perceived risk and related advantages) are strong predictors.	Oslund 1974
Multivariate Discriminant Function Analysis	New product adoption behavior is influenced by personal characteristics such as age, education, income, life cycle stage, and occupation.	Labay & Kinnear 1981
Factor Analysis and Discriminant Analysis	The adoption of new products is determined by demographic information and mental statistics.	Dickerson & Gentry 1983
Logarithmic Regression	Personal characteristics significantly distinguish potential and non-potential users among consumers of electronic products.	Martinex et al. 1998
Cluster Analysis, Inventory Analysis, Log-Linear Model	Personal characteristics are reflected by demographic characteristics (such as age and education) and social activities (such as social participation), which determine the difference between the adoption behavior of new products among the group of innovation communicators and other innovation classification groups.	Midgley & Dowling 1993
Logistic Regression	The relationship between personal characteristics and new product adoption behavior is determined by the type of innovation and product type.	Venkatraman 1991

Summary of Researches on Mobile Health Services

Mobile health service is a relatively new information technology, so there is little research in this field, and most of it comes from abroad. In 2001, the European Commission launched the "The Mobile Health Project" research project under the

"Information Society Technologies" plan, which triggered a wave of research on mobile health service technology by many scholars. Driven by the project, 14 partners from 5 European countries formed the Mobile Health Alliance, representing all relevant disciplines.

At present, research on mobile health services mainly focuses on technology design and development.

Istepanian and Lacal gave a brief overview of the rise and development of mobile health services. They believe that mobile health services can be interpreted as wireless telemedicine technology based on mobile communication devices. The biggest obstacle to the development of mobile health services is the connectivity and compatibility between mobile devices. With the continuous development of information technology, in the next few years, mobile health service technology will make great progress. Jones et al. Detailed the composition principle, network structure and information interaction method of BAN (Body Area Network), a standardized mobile health device under the Mobile Health Project. Jones pointed out that mobile health service technology is a combination of three technologies: portable network devices, wireless communication systems and wearable medical equipment, so that patients can move arbitrarily under the supervision of medical services. Liang et al. designed an emergency call mode in the mobile health service, which is used to extract the basic data of patients in emergency situations and send them to nearby search and rescue personnel. Through simulation, Liang verified that the emergency call mode can effectively reduce the corresponding time of emergency. Liu and others described the current status and future trends of mobile health application software from the perspective of developers.

In addition, there are many technical studies on mobile health services, which shows that mobile health services are still in the stage of technological development. In practice, mobile health service technology is also in the main stage of technology research and development, and application solutions are currently eagerly concerned. Europe has invested a lot of research money to develop mobile health equipment, mainly using computers and unlimited network technology, combined with embedded solutions, to develop medical monitoring systems that can be carried around or even worn directly.

Many well-known companies have joined the research and development craze, such as Nokia, Philips, Ericsson, and other companies are researching and developing mobile health service technology. The MobiHealth system developed by Ericsson has entered the testing stage. The system wears sensors on the patient's body to obtain the patient's health data, and then transmits the data to the doctor through the Bluetooth technology award for the doctor to perform diagnosis and real-time medical monitoring. Philips is currently researching clothing that can monitor the heart in real time, and the patient can wear it directly on the body to get medical supervision from the doctor anytime, anywhere.

The research and development of application solutions is currently the main stage of mobile health service technology, and embedded is one of the main technologies in many solutions. For example, clothes, watches, rings, etc. embedded in medical sensors, patients can easily detect various physiological parameters while wearing them. However, due to the diversity of technologies involved in mobile applications and the complexity of implementation, there are still many obstacles to the solution of mobile health service technology. As a result, the industry chain has not yet been able to achieve the creation and delivery of overall product value, and technology research and development is still under continuous exploration.

In the study of user behavior in the field of mobile health services because the technology has not been widely promoted, such research is still few, but it is not blank. Cocosila and Archer studied user acceptance of mobile health services from the perspective of patients. They believe that the user's willingness to act on the mobile health service comes from the combined effect of the user's internal and external motivations. At the same time, perceived risk has direct and indirect effects on behavioral intentions. Indirect effects are achieved through extrinsic motivation. Through empirical research, the model explains 48.7% of users' behavioral willingness, but the indirect effect of external motivation on behavioral willingness is not significant. Although the model is highly interpretable, the mobile health services involved in this article are limited to sending healthcare-related text messages to patients to increase their own medical knowledge. And this is only a small part of the mobile health service. Moreover, the survey object only includes patients, and the users of mobile health services are not just patients. Healthy people can also benefit from it, and the potential users are very wide.

As can be seen from the existing research results, the current domestic research on mobile health focuses on the types of mobile health and the impact of mobile health on patients. For example, on the basis of debates about the types of mobile health, Zhong Xiaoyan, Bai Jing and Luo Rong (2019), on the basis of consulting a large number of related literature, divided the existing model of “Internet + medical” in China into mobile health, Internet medical treatment based on regional health information platforms, telemedicine using "Internet +" technology, Internet medical treatment using Internet of Things, and Internet medical treatment under medical big data applications. Dai Jiahui and Hou Yanhong (2018) found that China currently has many mobile health applications, mainly including health management, medical seeking consultation, medical platform, doctor tools and medical e-commerce. Its operating methods can be divided into direct charges, transfer payments and revolving subsidies. At the same time, based on the classification, operation mode, and charging objects of mobile health, with individual users, professionals, medical institutions, and medical e-commerce as the entrance, the business path of mobile health was discussed. It is recommended that mobile health companies improve revenue through accurate positioning, precise services, and enhanced cooperation. Li Xiaoshan (2018) starts from the perspective of health communication and service design and conducts

classified research on the new media product form of mobile health. The research proposed four levels of progressive, mutually supportive product-level content and design elements for the basic level, service level, operation level and public welfare level. It also summarizes and refines the laws and methods of top-level design of health communication and related products from the perspective of mobile health. The special properties of mobile health cause a certain degree of risk, so patients will have certain concerns because of the risk during use. At present, some scholars have paid attention to this problem. For example, Zhang Yingxi (2018) has studied the innovation strategy of mobile health services under the trust relationship. The study proposes to accelerate the development of the mobile health industry, break the trust bottleneck in the medical service field, and continuously increase the level of trust resources in the industry. Changing the current low-frequency and passive medical treatment behaviors to high-frequency and active health behaviors is one of the important contents to promote the structural reform of the medical service supply side in the future.

METHODOLOGY

Research Design

This research mainly uses questionnaires to obtain data for data analysis and model verification. Based on the TAM and UTAUT models and introducing research on innovation diffusion theory, we design a questionnaire on public willingness to adopt mobile health.

The independent variables in this study include public perception of mobile health usefulness, perceived ease-of-use, social influence, compatibility, perceived risk, resistance to change, personal innovativeness. The dependent variable is the public's willingness to adopt mobile health. Control variables are individual characteristics.

Research Object Selection

This study uses the mobile health representative product Dr. Chunyu app as the research object and analyzes the adoption behavior and willingness of users of its mobile health service.

Introduction of Dr. Chunyu

Beijing Chunyu Tianxia Software Co., Ltd. was established in July 2011. It is a mobile Internet company with mobile health (mHealth) as its business direction. It is an Internet enterprise that entered the “Internet + Medical” industry earlier in China. Zhang Rui, Zeng Baiyi and Li Guanghui are also co-founders, and Zhang Rui serves as CEO. In November of the same year, Chunyu's handheld doctor's mobile phone

application was officially launched. Because it broke through the geographical and time limitations of traditional medical treatment, it was widely concerned by users and the pharmaceutical industry.

Dr. Chunyu is one of the earliest unicorn companies established in China's "Internet + healthcare" field. In the "health consultation" mode, Dr. Chunyu used the power of the Internet to conduct "graded diagnosis and treatment", optimizing the medical treatment process. At the same time, the big data analysis technology of the Dr. Chunyu app not only allows consumers to see similar cases briefly, but also allows consumers to accurately match the doctor.

At present, the Dr. Chunyu platform has brought together 500,000 practicing physicians and 100 million users across the country, solving an average of more than 330,000 health problems daily, covering 17 common departments such as pediatrics and dermatology. The users on the Dr. Chunyu platform can choose to get in touch with the doctor at random or for a specified fee. Communicate with doctors through text, voice, pictures, even telephones and videos, and get answers from doctors quickly and easily.

At the same time, Dr. Chunyu has conducted in-depth cooperation with enterprises and institutions in all aspects of the medical industry, including local governments, medical institutions, vertical health platforms, health product manufacturers, pharmaceutical e-commerce platforms, etc., and has become a large medical service platform.

Dr. Chunyu's Mobile Health Service Innovation

As we all know, China has a long-term medical problem of "difficult to see a doctor", and uneven distribution of medical resources and difficulty in implementing graded diagnosis and treatment are one of the main reasons. With the help of mobile Internet technology, Dr. Chunyu found an effective way to solve these problems-attracting doctors to provide medical services in idle time, maximizing the ability of doctors to provide limited services that cannot be increased in a short time.

Dr. Chunyu is committed to improving the accessibility, credibility, and reliability of Internet medical treatment. The method of providing medical information services through mobile phone applications solves the problem of access to online medical seeking services. The real-name doctor's question and answer method in real time solves the problem of credibility of information. The openness of the platform and the objective feedback mechanism guarantee the reliability of the service in both dimensions of quality and quantity.

(1) Technical innovation: big data medical assistant system

Since the birth of Dr. Chunyu, based on a million-level medical record database, he has constructed a preliminary intelligent self-diagnosis system. Users can analyze the

precipitated results based on the data and use the Dr. Chunyu app to achieve health self-diagnosis. At the same time, relying on the standardized user health file system developed by Dr. Chunyu, hundreds of millions of health data have been accumulated over the past five years. Including doctor diagnosis, treatment method, medication situation, test results and data collected by users using third-party wearable devices.

Based on the large database formed by the accumulation of self-diagnosis and consultation data, Dr. Chunyu has developed the leading intelligent auxiliary diagnosis and treatment system in China. The specific application manifests in three aspects. One is the crowdsourcing answering system. Based on the powerful big data analysis ability, Dr. Chunyu can match the question to the doctor in the appropriate department for the user in three minutes. The second is an auxiliary diagnosis system. The system can provide doctors with corresponding services such as automatic questioning and auxiliary diagnosis of symptoms according to the information provided by users. The third is the medical artificial intelligence system. There are preliminary robot diagnosis systems in specific departments, such as dermatology, ophthalmology, and imaging.

Chunyu also set up a health big data laboratory with the University of Chinese Academy of Sciences in May 2015, which will carry out research and practical applications in four directions. The laboratory hopes to use this system to realize highly intelligent and automated chronic disease management, to realize the effective use of online medical big data, and to enable technological innovation to benefit users.

(2) Service innovation: online consultation and doctors at any time

The "free question + crowdsourcing replies" mode is the basic mode for Dr. Chunyu to conduct online consultation services. This model was created in November 2011. The patient directly asked questions through the mobile phone application, and the questions were distributed to doctors in the background to answer the question, so that the medical treatment was no longer limited to the hospital. You can find the right doctor through your mobile phone, making it possible for doctors and patients to communicate instantly. The online consultation mode is still one of the main forms of health consultation in the field of smart medicine.

On the basis of "light consultation", Dr. Chunyu continued to deepen the development of this model, creating a deeper online consultation service such as "air clinics" where users can select designated doctors for payment, designated "private doctors" The most important service mode of smart healthcare.

(3) Channel innovation: connecting individual needs in multiple directions

The channels provided by Dr. Chunyu to connect doctors and patients are constantly expanding. In August 2016, Dr. Chunyu launched the "Online Examination Open Platform" and opened the online consultation service to all platforms free of charge.

All other platforms in need, such as medical e-commerce, hardware manufacturers, search platforms, insurance companies, etc., can apply for free online consultation service access in a variety of ways.

As more and more third-party platforms are connected to the open platform, in the future, users of Dr. Chunyu will be able to access Chunyu's services in various scenarios where there is a need without downloading and logging in the Dr. Chunyu app. It may also eliminate the technical threshold for mobile Internet services using apps in this stage. People of different ages, occupations and regions are likely to contact doctors on the platform of Chunyu in a familiar way, which really makes it possible to "ask doctors everywhere".

Sample Selection and Questionnaire Data Collection

The survey questionnaire mainly adopts stratified random sampling and is distributed online and offline at the same time: the questionnaire stars are used to edit the questionnaire online and promoted through QQ and WeChat. Offline is mainly distributed in various hospitals, office buildings, and streets in Shanghai by random sampling.

The author has issued a total of 350 questionnaires online and offline, including 140 offline questionnaires, 220 online questionnaires, and a total of 318 questionnaires. After the questionnaires were recovered, the invalid questionnaires were eliminated, and random questionnaires, missed questionnaires and inconsistent questionnaires were removed. Finally, 303 valid questionnaires were obtained, and the effective questionnaire recovery rate was 86.6%.

FINDINGS

Descriptive Analysis of Survey Objects

Demographic Characteristics

Among the 303 valid samples of respondents in this questionnaire, the gender ratio is equivalent. There are 158 men, accounting for 52.3%. Women 145, accounting for 47.7%.

Age distribution: Young people aged 21-30 account for 57.2%. Secondly, people aged 31-40 account for 17.3%, and the gender ratio and age distribution are in good agreement with China's demographic data.

In terms of education level: a total of 187 people with bachelor’s degree or above, accounting for 76.9%, of which 58.4% with bachelor’s degree and 18.6% with master’s degree and above, indicating that the surveyed subjects generally have higher

education level. A total of 29 respondents with a college degree accounted for 11.9%, and a total of 27 people with high school education and below accounted for 11.1%.

In terms of monthly income: respondents under 3,000 yuan accounted for 44% of the total sample, reaching 107. Second is 3000-5000 yuan, a total of 68 people, accounting for 28%. The number of people between 5000-8000 yuan and above 8000 yuan is 30 and 38 people, respectively.

Occupational distribution: The respondents were mainly employees and students, accounting for 35.4% and 35.4%, respectively. Secondly, there are a total of 32 personnel in public institutions.

Table 4-1 Basic Personal Information of Respondents

Variable	Type	Frequency	Percentage
Gender	Male	158	52.3
	Female	145	47.7
	Total	**303**	100
Age	<20	15	.49
	21-30	173	57.2
	31-40	52	17.3
	41-50	36	11.9
	>50	29	8.6
	Total	**303**	100
Education	High School and Below	34	11.1
	College	36	11.9
	Undergraduate	177	58.4
	Master's Degree	54	17.7
	PhD and Above	2	0.8
	Total	**303**	100
Income	<3000	133	44
	3000-5000	85	28
	5000-8000	37	12.3
	>8000	47	15.6

	Total	**303**	100
Occupation	Student	107	35.4
	Civil Servant	2	0.8
	Institutional Staff	46	13.1
	Enterprise Personnel	138	35.4
	Individual / Private Owner	14	4.5
	Freelancers	25	8.2
	Unemployed	5	1.6
	Other	2	0.8
	Total	**303**	100

Analysis of Physical Health

In terms of physical conditions, 187 people occasionally feel unwell, accounting for 77%, and often feel unwell, accounting for 6.6%. In terms of visits in the past six months, the number of users with 1-3 visits reached 129, accounting for 53.1%. The second is the group with 0 visits, accounting for 40.7%, which shows that the users of this survey are in good health and occasionally have uncomfortable conditions.

Table 4-2 Health Status of Survey Respondents

Variable	Types	Frequency	Percentage
Physical Conditions	Never Feel Sick	50	16.5
	Occasional Discomfort	233	77
	Often Feel Unwell	20	6.6
	Total	303	100
Number of Visits	0	123	40.7
	1-3	161	53.1
	4-6	13	4.1
	7-9	1	0.4
	>10	5	1.6

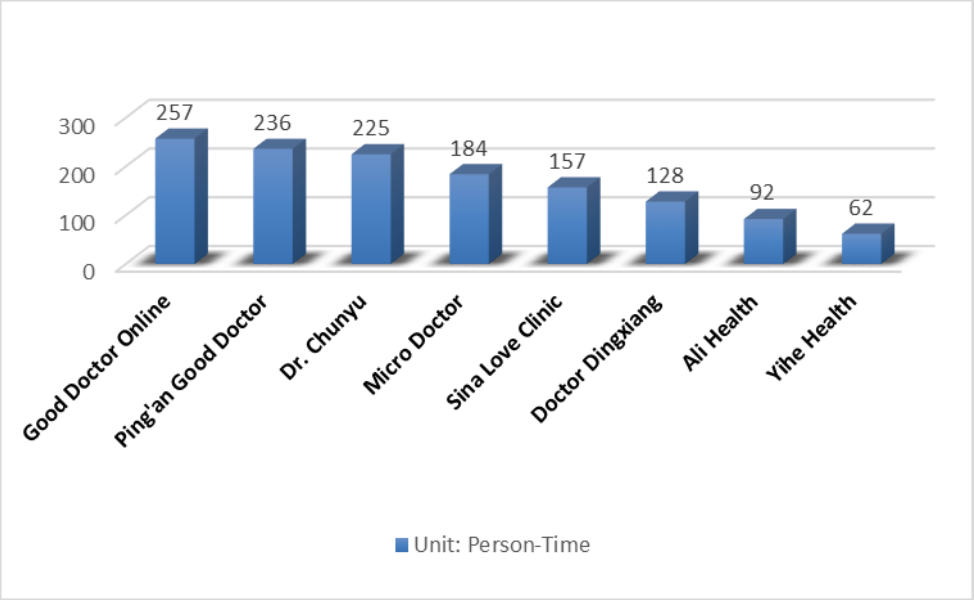
	Total	303	100

Mobile Health App Usage Analysis

The survey results show that in the use of mobile health app, Good Doctor Online, Dr. Chunyu and Ping'an Good Doctor accounted for a relatively high proportion, followed by Micro Doctor, Sina Love Consultation Room. There are also medical apps that lack effective publicity and have not been used by respondents.

It can be seen from the survey results that the Dr. Chunyu app already has a relatively wide user group.

Figure 4-1 User Usage of Mobile Health Apps



Individual Difference Analysis

In the analysis of individual differences, the main research is whether gender, age, education, income, health status and occupation will make a significant difference in adoption willingness. Gender differences were analyzed using independent sample t test, and other factors were analyzed using analysis of variance.

Gender Difference

Gender analysis uses independent sample t test, as shown in Table 4-4. Sig=0.467 <0.05, indicating that different genders have no statistical significance in adopting intentions. There is no significant difference in the adoption of mobile health between men and women, as shown in Table 4-4.

Table 4-3 Willingness to Adopt by Gender

Study Variable	Gender	N	Mean	Standard Deviation	T	Sig.
Willingness to Adopt	Male	158	3.9882	0.69712	0.728	0.467
	Female	145	3.9267	0.61061		

Age Difference

As shown in Table 4-5, Sig=0.016<0.05, there are significant differences in the willingness to adopt mobile health at different ages. Among them, the average value of 21-30 years old and 31-40 years old is the highest, indicating that the willingness to adopt is strong, which may be related to the greater medical needs of this age group. At the same time, people of this age are active in thinking and strong in accepting new things. The usage intention of people over 50 is low. Although the elderly has high medical needs, their acceptance of new things is not so strong, so the willingness to adopt mobile health is not strong.

Table 4-4 Willingness to Adopt by Ages

Study Variable	Age	N	Mean	Standard Deviation	F	Sig.
Willingness to Adopt	<20	15	3.7083	0.71377	3.112	0.016
	21-30	173	4.009	0.64368		
	31-40	52	4.0714	0.67914		
	41-50	36	3.9569	0.59787		
	>50	29	3.5476	0.61043		

Educational Difference

As shown in Table 4-6, Sig=0.036<0.05, users with different educational levels have significant differences in the willingness to adopt mobile health, and the higher the education level, the higher the adoption of mobile health. The reason may be that with the improvement of education level, the understanding and learning ability of mobile health is improved, and more advanced medical methods are preferred.

Table 4-5 Willingness to Adopt by Different Educational Backgrounds

Study Variable	Education	N	Mean	Standard Deviation	F	Sig.

Willingness to Adopt	High School and Below	34	3.8519	0.69427	2.618	0.036
	College	36	3.9052	0.64922		
	Undergraduate	177	3.9173	0.63701		
	Maste	54	4.1512	0.66175		
	PhD and above	2	5	0		

Income Difference

As shown in Table 4-6, Sig=0.035 <0.05, users of different incomes have significant differences in their willingness to adopt mobile health. The group with income of 5000-8000 yuan has the highest willingness to adopt, followed by the group with more than 8000 yuan, and the users with 3000 yuan and below has the lowest willingness to adopt. The reason may be that people with incomes below 3,000 yuan have a low education level and insufficient ability to accept new things.

Table 4-6 Willingness to Adopt by Different Incomes

Study Variable	Income	N	Mean	Standard Deviation	F	Sig.
Willingness to Adopt	<3000	133	3.8388	0.67227	2.915	0.035
	3000-5000	85	3.989	0.59135		
	5000-8000	37	4.2	0.57009		
	>8000	47	4.0526	0.73328		

Physical Health Difference

As shown in Table 4-7, according to the number of visits in the past six months, there is no significant difference between the user groups of different visits, Sig=0.993> 0.05.

Table 4-7 Willingness to Adopt by Different Health Levels

Study Variable	Number of Visits in the Last Six Months	N	Mean	Standard Deviation	F	Sig.

Willingness to Adopt	0	123	3.9242	0.66476	0.557	0.933
	1-3	161	3.9864	0.65945		
	4-6	13	3.85	0.55528		
	7-9	1	4.75			
	>10	5	4	0.73598		

CONCLUSIONS

Research Results

Mobile health services provide great convenience for patients to seek medical treatment and have important potential value (Burdette, Herchline & Oehler, 2008; Sarasohn-Kahn, 2010; Chatterley & Chojecki, 2010; Lippi & Plebani, 2011; Eysenbach, 2000; Chen, 2013; Lu, 2015; Xie & Zhang, 2016; Xie & Zhang, 2016; Wu, Ye, Sun & Ying, 2017). The main purpose of this study is to start from the perspective of individual characteristics and explore the role played by the public's individual characteristics in the process of mobile health service adoption.

Investigate the individual differences in users' adoption behavior and willingness to adopt in the field of mobile health services and conduct a detailed analysis around research questions and research objects.

Perceived Usefulness Maximizes Willingness to Adopt

Perceived usefulness can also be understood as performance expectations, which have the greatest impact on users' willingness to adopt. Products or services that can provide users with a sense of value that can help them improve efficiency and improve their quality of life are more easily recognized. Perceived ease-of-use and ease of use will be the reason for the public's willingness to accept the technology. The interface is simple and clear, the logic is clear, and the operation-friendly mobile health products will be more easily recognized.

Personal Innovativeness Greatly Affects Willingness to Adopt

Personal innovativeness largely influences the public's willingness to adopt mobile health and is the second most influential factor in this study. Personal innovativeness factors represent the user's ability to accept new things. The higher the acceptance of new information technology products by users, the easier it is to accept the mobile health researched by this institute. Individual innovation has been confirmed by some

scholars, and LIKYOUNG research shows that the individual innovation of users has a significant positive correlation with the willingness to adopt mobile travel apps.

Social Influence is the Third Largest Factor Influencing Willingness to Adopt

Social influence is the third largest factor influencing the public's willingness to adopt in this study, and there is a significant positive correlation between the two. This phenomenon is mainly caused by a certain herd mentality, which is consistent with the research conclusion of Atthew J. Wills. Social influence is positively affecting medical professionals' willingness to adopt electronic medical records. At the same time, Lau's research on the online trading of Hong Kong stocks found that social influence significantly influences willingness to adopt. Faced with a new thing, users are in an asymmetric information position, and listening to suggestions from people they trust can reduce decision costs. For reasons of trust, users are easily influenced by important people around them. When these people recommend products or services, the user's psychological defense line is easily broken through and new products will be accepted. At the same time, the influence of the news media cannot be ignored. Positive public opinion is conducive to the public's acceptance of new things.

Perceived Risk Has No Significant Effect on Willingness to Adopt

Users' trust in mobile Internet products has increased. According to previous research conclusions, perceived risk largely negatively affected mobile health's willingness to adopt, but this factor was not included in the regression in this study. On the one hand, the sample of young people has a certain dilution effect on the sample of old people. On the other hand, with the popularization of mobile payment and the continuous guarantee of information security, the public's trust in Internet products has increased. According to data from the China Internet Network Information Center (CNNIC), 38% of mobile phone netizens think it is very safe or relatively safe to use mobile phones to surf the Internet, while only 12.8% think that using mobile phones to surf the Internet is unsafe or very unsafe.

Younger People Have a Stronger Willingness to Adopt than Older People

Because young people are more receptive to new things and have a fast pace of life, they are more accustomed to reducing the travel time and queue time. And young people tend to search information online to answer their doubts.

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