ISCTE IUL

Instituto Universitário de Lisboa

Impact of Mobile Health Technology Adoption on Service Quality and Patient Satisfaction

JIN Chenhui

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

Supervisor:

Prof. Elsa Cardoso, Assistant Professor,

ISCTE University Institute of Lisbon

Co-supervisor:

Prof. XIA Weidong, Professor,

Florida International University

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Declaration

I declare that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university and that to the best of my knowledge it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed: 金晨晖 jin chenhui Date: 2019-3-18

Name:

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作者签名：金晨晖 jin chenhui 日期：2019-3-18

姓名(拼音):

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Abstract

Long registration time, long waiting time, long medication-taking time and short consultation time, also called “three long, one short”, are urgent management problems to be solved in Chinese hospitals. To this end, many hospitals have begun to actively invest in the establishment of mobile health applications (Apps), for the purpose of improving the medical environment and optimizing the clinical processes, such as making appointment, registration, consultation, payment, diagnosis and treatment, medication-taking, waiting time, and ultimately improving the quality of hospital services and patient satisfaction.

This dissertation research aims at empirically examining the mechanisms through which patients’ uses of mobile health Apps affect their perceptions of hospital service quality and their satisfaction. The study is conducted in Shenzhen Eye Hospital in China. First, based on literature review and expert interviews, a research model was developed regarding the relationships among four variables: Mobile Health Technology Use (MHTU), Clinical Process Change (CPC), Service Quality (SQ), and Patient Satisfaction (PS). Five hypotheses about the relationship among the variables were proposed and tested. Based on existing measures in the literature and field interviews, a survey instrument was developed and tested using a pilot sample. The survey was then administered to randomly selected patients in the hospital over a period of three weeks. The research model and hypotheses were tested using SPSS statistical software. Results reported in the study include descriptive analysis of patient demographic information and medical information, exploratory factor analysis, reliability and validity analysis, correlation and regression analysis.

The study results suggest that the use of mobile health Apps directly and significantly affects patient satisfaction, but it has no direct impact on the hospital service quality. Instead, it affects hospital service quality through the role of intermediate variables of perceived changes of clinical process by patients. Physician-patient Interaction is an important factor that positively affects the quality of hospital service. Convenience is one of the important dimensions for patients to perceive the quality of service in Chinese hospitals, and it has a positive and significant impact on patient satisfaction.

The above findings suggest that hospital managers should not only pay attention to the management of system usage, but also to organizational factors that affect the results of

system usage, such as the perceived changes of clinical process by patients. When evaluating the quality of hospital service, especially in the face of large-scale hospitals with large outpatient service, Convenience dimension should be considered. In addition, managers should pay attention to enhancing the initiative of physician-patient interaction, as it is an important factor affecting patients' perception of hospital service quality.

Keywords: service quality; patient satisfaction; mobile health technology; SERVEQUAL
JEL: M31; I12

Resumo

O longo tempo de registo, o longo tempo de espera, o longo tempo de toma de medicamentos e o curto tempo de consulta, também chamados "três longos, um curto", são problemas de gestão urgentes a resolver nos hospitais Chineses. Para tal, muitos hospitais começaram a investir ativamente no estabelecimento de aplicações (Apps) móveis de saúde, com o objetivo de melhorar o ambiente médico e otimizar os processos clínicos, como agendamento, registo, consulta, pagamento, diagnóstico e tratamento, tomada de medicamentos, tempo de espera e, por fim, melhorar a qualidade dos serviços hospitalares e a satisfação dos pacientes.

A investigação desta dissertação visa examinar empiricamente os mecanismos através dos quais o uso de Apps móveis de saúde pelos pacientes afeta as suas percepções sobre a qualidade do serviço hospitalar e a sua satisfação. O estudo é realizado no Shenzhen Eye Hospital, na China. Primeiramente, com base na revisão da literatura e em entrevistas com especialistas, foi desenvolvido um modelo de pesquisa sobre as relações entre quatro variáveis: Uso de Tecnologia Móvel em Saúde (MHTU), Mudança de Processos Clínicos (CPC), Qualidade de Serviço (SQ) e Satisfação do Paciente (PS). Cinco hipóteses sobre a relação entre as variáveis foram propostas e testadas. Com base nas medidas existentes na literatura e nas entrevistas de campo, foi desenvolvido e testado um questionário utilizando uma amostra piloto. O questionário foi então administrado a pacientes selecionados aleatoriamente no hospital durante um período de três semanas. O modelo de pesquisa e as hipóteses foram testados utilizando o software estatístico SPSS. Os resultados relatados no estudo incluem análise descritiva das informações demográficas e informações médicas dos pacientes, análise fatorial exploratória, análise de confiabilidade e validade, análise de correlação e regressão.

Os resultados do estudo sugerem que o uso de Apps móveis de saúde afeta direta e significativamente a satisfação do paciente, mas não tem impacto direto na qualidade do serviço hospitalar. Em vez disso, afeta a qualidade do serviço hospitalar através do papel de variáveis intermediárias das alterações percebidas pelo paciente no processo clínico. A interação médico-paciente é um fator importante que afeta positivamente a qualidade do serviço hospitalar. A conveniência é uma das dimensões importantes para que os pacientes

percebam a qualidade do serviço nos hospitais Chineses, tendo um impacto positivo e significativo na satisfação dos pacientes.

Os resultados acima sugerem que os gestores hospitalares devem prestar atenção não apenas à gestão do uso do sistema, mas também aos fatores organizacionais que afetam os resultados do uso do sistema, como as mudanças percebidas pelos pacientes no processo clínico. Ao avaliar a qualidade do serviço hospitalar, especialmente no caso de hospitais de grande dimensão com um elevado número de atendimentos em ambulatório, a dimensão conveniência deve ser considerada. Além disso, os gestores devem estar atentos para potencializar a iniciativa de interação médico-paciente, pois este é um fator importante que afeta a percepção dos pacientes sobre a qualidade do serviço hospitalar.

Palavras-chave: qualidade de serviço; satisfação do paciente; tecnologia móvel em saúde; SERVEQUAL

JEL: M31; I12

摘要

挂号时间长、候诊时间长、取药时间长、就诊时间短，是目前中国医院亟待解决的管理问题。为此，许多医院开始积极投资建设移动看病软件平台，改善就医环境，优化患者预约、挂号、就诊、付费、检查治疗、取药等流程，减少患者等候时间，以期望提高医院服务质量以及患者满意度。本研究为探索移动看病软件使用影响医院服务质量以及患者满意度的机制，以深圳市眼科医院为案例，展开实证研究。

首先通过文献综述和专家访谈，建立研究模型，确定移动看病软件使用、临床就诊流程体验变化、医院服务质量以及患者满意度四个变量，并提出变量之间的五个关系假设；再根据文献综述中的变量量表或问项以及专家建议，拟订初步问卷量表，并经过问卷前试和预实验，然后在医院随机选择患者进行为期超过三周的问卷发放和搜集。最后，应用 SPSS 统计软件对所搜集的问卷数据依次进行患者人口信息与看病信息描述性分析、探索性因子分析、信度效度分析、相关与回归分析，进而验证假设并得出研究结论。

本论文发现，移动看病软件使用可以直接显著影响患者满意度，但对医院服务质量没有直接影响，而是通过患者对就诊流程体验变化的中间变量作用来影响医院服务质量；医患互动积极性是患者就诊体验变化正向影响医院服务质量的重要因素。方便性是患者能感知中国医院服务质量的重要维度之一，且对患者满意度有正向显著影响。

以上研究发现提示医院管理者在投入新设备或系统的时候，不仅要关注系统使用管理，还要关注系统使用结果的影响环节要素，比如患者就诊体验的变化；今后在评价医院服务质量时，特别是面对规模、门诊量较大的医院，需要考虑加入方便性维度；另外，管理者应该重视提升医患互动积极性，因为它是影响患者对医院服务质量感知的重要因素。

关键词：服务质量;患者满意度;移动健康技术;SERVEQUAL

JEL: M31; I12

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Chapter 1: Introduction

1.1 The context of the study

Service quality (SQ) and customer satisfaction (CS) have always been the hot topics among marketing researchers and the important elements for corporate survival and success. In order to gain market competitive advantage, enterprises must fully consider how to improve their service quality and customer satisfaction, because compared with products, service quality contains its unique key elements. This is also the case in the health service industry, that various medical institutions emphasize increasingly the customer-driven marketing strategy which focuses on improving patient service quality.

At present, medicine has changed from a biomedical model to a bio-psychological-social medical model, and the connotation of medical quality has also changed from a single clinical medical quality to a comprehensive quality of clinical efficacy, service, time, and cost. This requires medical institutions to change the service model from “medical-centered” to “patient-centered”. In this case, the traditional medical quality assessment method shows its limitations and one-sidedness, and the patient satisfaction analysis is a new medical quality evaluation method that adapts to the medical model transformation. It is a supplement to the traditional medical quality evaluation method. In addition, with the introduction of the national medical reform program, medical institutions will face increasingly fierce competitive pressures. Especially after 2008, the openness of China's medical service market will further increase, and the market structure will change accordingly. The competition of medical service is no longer limited to its technology and quality, and how to provide the best service and differentiate it from other competitors has become an important competitive factor.

In recent years, hospitals in China, no matter private or public, have paid close attention to improving medical service satisfaction and creating patient service value. In addition, under influence of the “Internet Plus” notion, hospitals also apply modern marketing information technology tools to establish favorable physician-patient relationships, so as to ensure their market shares in the health service industry. There are mainly two reasons for hospitals’ attention to service quality (SQ), patient satisfaction (PS) and marketing strategy.

1.1.1 Health care reform in China

The goal of medical system reform is to achieve the rational allocation of resources, and to ensure that everyone, including vulnerable groups, can enjoy the government's medical services. Due to the influence of social and economic development and comprehensive national strength, as well as the management of "political integration", there are some problems in medical technology, service level and infrastructure construction in China to varying degrees. This requires government to constantly explore new ways of development.

The prelude of medical reform began in 1994 in Zhenjiang, Jiangsu Province and Jiujiang, Jiangxi Province. The pilot social medical insurance system combining social overall planning with personal accounts in both places explored experience for the reform of the national medical insurance system. Then in 1998, the government began to implement the "Three Reforms", namely, the reform of the medical insurance system, the reform of the medical and health system, and the reform of the pharmaceutical production and distribution system.

In 2000, the State Council held a conference on "Hearing the national report on the reform of the basic medical insurance system and the medical and health system for urban workers “and deployed the "Three Reforms Simultaneously". During this period, the relevant departments discussed the composition and specific content of China's health care reform, with a view to defining the scope of health care reform with Chinese characteristics (State Council of People’s Republic of China, 2000).

In January 2007, the National Health Work Conference proposed four basic systems, namely the basic health care system, the medical security system, the national essential medicine system and the public hospital management system (The Central Committee of the Communist Party of China, State Council of People’s Republic of China, 2000).

In October 2007, the report of the 17th National Congress of the Communist Party of China clearly stated the “Four Major Systems” in the field of health care, namely, “public health service system, medical service system, medical security system, and medicine supply security system covering urban and rural residents”. The "Four Major Systems" proposal not only systematically summarizes previous research, but also builds a new framework for future reforms (the 17th National Congress of the Communist Party of China, 2007).

On October 25, 2016, the Central Committee of the Communist Party of China and the State Council issued and implemented the Outline of the "Healthy China 2030" Plan. (The

Central Committee of the Communist Party of China, State Council of People's Republic of China, 2016) The "Healthy China 2030" planning outline is the action plan for promoting healthy China construction in the next 15 years. With the release of the "Healthy China 2030" Planning Outline and the deepening of the medical reform policy, China's medical service industry is also ushered in a new phase of upgrading, that is, the change from "scale" to "value". As mentioned in Chapter 8 of the Outline, (Chapter 8: To Provide Quality and Efficient Medical Services), it is necessary to establish a medical quality management and control system that is in line with international standards and reflects Chinese characteristics, and basically completes national, provincial and municipal medical quality control organizations covering major majors and introduces a number of international standardization norms.

On December 20, 2018, the National Health Commission and the National Development and Reform Commission issued the "Notice on Launching a Pilot Program for Establishing a Sound Modern Hospital Management System." (The Chinese National Health Commission, The Chinese National Development and Reform Commission, 2018). 148 hospitals were selected for pilot projects. All local and pilot hospitals are required to further focus on key areas and key links in accordance with the requirements for establishing a sound modern hospital management system, paying close attention to the implementation of various reform tasks, and ensuring that the modern hospital management system is effective and promoted. The modern hospital management system is one of the "Top Ten Trends" of China's Medical Reform in 2019. The modern hospital management system is an important part of the basic medical and health system with Chinese characteristics. It is the modernization of the hospital governance system and management capacity. It is a new mechanism for the maintenance of public welfare, mobilization, and sustainable public hospitals. By establishing a good hospital decision-making, implementation, supervision and coordination, mutual checks and balances, mutual promotion of governance mechanisms, promote the standardized, refined and scientific management of hospitals at all levels, which is conducive to the establishment of clear powers and responsibilities, scientific management, perfect governance, efficient and supervised hospital management system.

A series of medical reform policies have been put forward to draw private capital into the health service industry, which intensified the competition in medical market. The Opinions of the State Council of the People's Republic of China on Deepening the Medical and Healthcare System Reform states: "we should establish a multi-source healthcare

investment mechanism with the government as the leading force and encourage and guide private capital to develop medical and health service" (State Council of the People's Republic of China, 2009). The Opinions on Further Encouraging and Guiding Private Capital to Establish Medical Institutions emphasizes: "we should expand market access for utilizing social capital to establish medical institutions, and further improve the practice environment for such kind of institutions." (Chinese National Development and Reform Commission, Chinese National Health and Family Planning Commission, Chinese Ministry of Finance, Chinese Ministry of Commerce, & Chinese Ministry of Human Resources and Social Security, 2010). The Notice on Planning and Implementation of Deepening Reform in Medical and Healthcare System During the "Twelfth Five-Year" Period clearly states to guide private capital's multiple participation in reform of public hospitals, ease access of private capital, and give prior support to non-profit private hospitals (State Council of the People's Republic of China, 2012). It also points out that by 2015 the number of hospital bed and service volume in private medical institutions should reach 20% of the total. The Opinions on Promoting the Development of Healthcare Industry claims to further ease market access for private medical institutions and improve policies on price, finance and taxation (State Council of the People's Republic of China, 2013). It also suggests that by 2020 the overall scale of health service industry should exceed 8 trillion Yuan. From the above medical policies, it could be inferred that the monopoly position of public hospitals in the medical market will be broken. As for private hospitals, when obtaining new development opportunities, they also need to compete with technologically well-equipped public ones. Therefore, in order to survive and develop, both public and private hospitals will have to improve their medical service quality and patient satisfaction and adopt effective marketing methods.

1.1.2 Application of Internet mobile technology in medical field

Today, when the needs of life have been basically met, people's requirements for medical and health services are getting higher and higher, and the emergence of Internet of Things (IOT) technology has met the needs of the people concerned about their own health and promoted the development of the medical and health information industry. The application potential of the Internet of Things (IOT) technology in the medical field is huge, which can help the hospital realize the intelligent management of human beings and the intelligent management of the objects, and can meet the intelligent management and monitoring of medical health information, medical equipment and supplies, and public health security. The

demand for such aspects, so as to solve the problem of weak support of medical platforms, low overall medical service level, and hidden dangers of medical safety production.

The wide application of information technologies such as the “Internet Plus” in the medical and health industry has dramatically changed the philosophy of service and marketing in the industry. In March 2015, Ma Huateng, or Pony Ma, CEO of Tencent, submitted the Suggestion on Promoting China’s Innovation Development of Economy and Society Driven by the “Internet Plus” during the National People’s Congress and Chinese People’s Political Consultative Conference sessions. In this bill, he explains that “Internet Plus” means to combine the Internet with all the other industries including the traditional sectors through the platform of the Internet and information and communication technologies, so as to create a new ecosystem in a new field (Ma, 2015). On July 4, 2015, endorsed by Chinese Premier Keqiang Li, the Guiding Opinions on Actively Promoting the “Internet Plus” Action Plan was issued by the State Council (Chinese State Council, 2015), which is an important step to expand the application of the Internet from consumption to production, lift the industry development level, enhance innovation ability of all industries, and create new advantages and energy for economic and social development.

In January 2017, China Internet Network Information Center (CNNIC), released the 39th statistical report of Chinese Internet development (China Internet Network Information Center, 2017). The report shows that up to December 2016, the population of Chinese Internet users reached 731 million, equivalent to the total population of Europe, and the Internet penetration rate reached 53.2%. Mobile phone users reaching 695 million accounting, have already formed the habit of online payment through mobile devices. 50.3% of Internet users purchases by mobile payment and settlement.

One third of Internet users utilize online government services, urging the government to promote the service-oriented construction and information disclosure. The online government service users applying various social media, like Alipay, city service of WeChat, the government WeChat public number, website, microblogging and mobile phone applications (hereinafter referred to as Apps), reached 239 million, accounting for 32.7% of the total Internet users.

The information technology has been wildly applied among Chinese enterprise, and the integration of Internet and traditional industry has been accelerating quickly recently. In 2016, the computer uses, Internet use and broadband access among enterprises have been fully

popular and reached the ration of 99.0%, 95.6% and 93.7% respectively (China Internet Network Information Center, 2017).

Mobile health is the use of mobile Internet communication technology to provide health butler services such as medical examination, health care, disease assessment, medical care, and rehabilitation. Mobile health is mainly reflected in the four aspects of information, services, applications and equipment. In this industry chain, one end is a service organization such as doctors, dieticians, fitness instructors and related professionals; the other end is the users who need it; the middle is a service provider that builds bridges for both ends through various technologies and means. In the field of medical application, the “Internet plus medical care” will change the model of diagnosis and treatment, providing patients with more convenient health management services. In most cases, the technology applied in hospitals is called “Mobile Health Technology, MHT”.

Wireless LANs are superior to traditional wired networks, overcoming the limitations of space, and the wired network has been extended and supplemented. The use of wireless technology to serve clinical medical work has brought a faster and more efficient application model to the clinic. Under the premise of ensuring safety, mobile roaming technology can meet the needs of hospital mobile medical care and realize patient-centered service transformation. The patients can monitor their health data on mobile medical data terminals (such as smart phones and wearable devices) and prevent diseases. In terms of the diagnosis and treatment service, patients can use mobile Apps to make medical consultation, appointment and payment. In this way, patients will save time and expenses, and feel more involved. When the treatment is finished, by contacting with doctors through Internet, patients can still maintain the doctor-patient relations. The use of MHT is only at the beginning in Chinese hospitals, but it has developed rapidly. Along with the rapid development of China's mobile Internet technology, a wide variety of mobile medical apps have emerged based on mobile terminals, providing convenient and timely medical information and medical services for the people. According to the data of "China Mobile Medical Market Trend Prediction and Analysis 2017-2019" released by Analysys Think Tank Network Technology Co., Ltd., the scale of China Mobile Medical Market reached 10.56 billion yuan in 2016, an increase of 116.4% over the same period of last year. It is expected that the mobile medical market will exceed 40 billion yuan by 2019 (Analysys Think Tank Network Technology Co., Ltd, 2017). As an important external variable factor, MHI certainly will exert far-reaching influences on the service quality and patient satisfaction in hospitals.

1.2 The statement of the challenges

Nowadays, due to the huge popularity of China and lack of medical resources, the phenomenon of the crowed and chaos of management in hospitals usually makes the patients experience the terrible clinical process, such as spending a lot of time on registering, queuing for payment, waiting for medical treatment, etc, which easily causes the high conflicts of physician-patient relationship and low patient perceived SQ.

In order to improve PS, we should first consider improving the SQ of hospital. According to Padma, Rajendran, and Sai (2009), SQ is also called perceived SQ. In the research of health service industry, SQ refers to patients' perception of service evaluation. There is a positive correlation between hospital SQ and patient PS (Lim & Tang, 2000; Hong & Goo, 2004; Otani & Kurz, 2004; Strawderman, 2005; Padma, Rajendran, & Lokachari, 2010; Lee & Kang, 2012), which means patients' perception of hospital SQ directly affects PS. The hospital SQ is classified into two dimensions (Grönroos, 2000; Zineldin, Camgoz-Akdag, & Vasicheva, 2011): technical dimension and process/function dimension. Technical dimension refers to the accuracy of medical technology, such as diagnosis, medical procedures and technical standards; Functional dimension refers to the way of medical services and the quality of doctor-patient relationship. Since the evaluation of SQ is based on the subjective judgment of patients, so SQ is actually the gap between patients' expectations and service perception. Therefore, from the patient's perspective, the quality of service depends not only on the perception of clinical diagnosis and treatment technology, but also on the perception of many other relevant factors, such as hardware facilities, interaction with medical staff or non-medical staff, etc (Došen & Škare, 2010). It can be seen that improving or changing the patient experience can improve PS.

In order to improve the experience of the patient visit process, most Chinese hospitals began to encourage patients to use mobile medical software to seek medical treatment, and in this hope to improve hospital SQ perception and PS. Nowadays, a growing number of hospitals in China are employing MHT in the service of diagnosis and treatment to raise the efficiency of diagnosis and treatment management, save patients' time and energy and improve patient SAT. Most of them build mobile service Apps for patients to download to their cell phones or tablet computers. In this way, the patients can get information about the hospital and its medical personnel, and make consultation, appointment and payment through

Internet, which, from the perspective of hospital managers, will be an essential means of improving SQ and increasing patient SAT.

However, it is uncertain if and to what extent the patients have noticed the improvement of hospital service after using the Apps and feel satisfied with it, and how do patients perceive the SQ in terms of different dimensions. Besides, since currently in China there is no measuring tool or model for SQ, including services offered by Apps, hospital managers are unable to know specifically the degree to which the patients perceive and satisfy with the medical service in those Apps-equipped hospitals. Therefore, for better survival and development of a hospital in the new era, it is necessary to establish a new conceptual SQ framework and explore the impact of MHT adoption on hospital SQ and PS and to study relative marketing strategy.

1.3 Research questions

The primary task of a hospital is to improve the quality of medical care and service as much as possible, offer convenient and effective treatment and increase patient satisfaction, thus establishing strong physician-patient relations. However, in the context of hospital applying MHT, is it possible to satisfy the hospital's expectations and solve the current dissatisfaction caused by poor patient experience? To answer this question, there are some issues that need to be understood and resolved as follows:

1. What is the current situation of using MHT in Chinese hospitals? Does it affect the quality of hospital services? and how?

2. Does the use of MHT affect the patient's perception of changes in the clinical process? and how?

3. Does the patient's perception of changes in the clinical process affect the quality of hospital services? and how?

4. Does hospital SQ affect PS? and how?

1.4 Research review

In order to explore how MHT affects hospital SQ and PS, this study adopts a variety of empirical research methods and develops and implements the research process as follows:

Firstly, through literature review and expert interviews, the research questions, research framework and hypotheses are put forward. Literature review is based on certain research purposes. In this study, we systematically review the SERVQUAL and its improved model. We search the databases of Social Science Citation Index and scientific citation index through the interface of Web of Science and Biblioteca do Conhecimento Online (b-on). The literature is limited to articles published in English. The research contents of all articles involve information technology adoption, hospital SQ and PS. The main theories used in the literature review include technology acceptance theory, service encounter theory, SQ, SERVQUAL, SERVPERF, CS and PS. Through literature review, we can understand the main factors affecting the quality of hospital services and PS, as well as the need for further research. This method provides the knowledge of current dilemmas in related research fields, and how to establish research models and hypotheses in subsequent research.

After defining the research model, a preliminary questionnaire is drawn up according to the variables scale or questions in the literature review and experts' suggestions, and then a pre-questionnaire was completed with interviews. The interviewees include hospital management and clinical experts as well as patients. The purpose of the interview is to add and delete the measurement items of the preliminary questionnaire and increase the content validity of the questionnaire. We randomly selected outpatient patients for interviews and asked for suggestions for revision, focusing on whether patients can understand the questionnaire questions, wording, structure concepts and dimensions of the questionnaire.

After the pre-test of the questionnaire, the pilot-test and large-scale survey are conducted. The questionnaire is distributed to the outpatients and some inpatients in a public specialized hospital, Shenzhen eye Hospital. A total of 100 questionnaires were distributed in pre-test and 76 valid copies are reclaimed. After exploratory factor analysis and reliability and validity analysis, the results were satisfactory and consistent with the expected results. Therefore, the questionnaire is not revised anymore and directly sent to a large-scale survey. Finally, 618 valid copies are reclaimed for further analysis.

Finally, using SPSS statistical software, the collected questionnaire data are analyzed by descriptive analysis of patient demographic information and medical information, exploratory factor analysis, reliability and validity analysis, correlation and regression analysis, and the evaluation of measurement indicators and the measurement of the relationship between variables, then the hypothesis is verified, and the research conclusions are drawn.

1.5 Research contributions

After consulting Chinese and foreign literatures, no relevant reports related to the problems stated in this study have been found. Therefore, this study can contribute to the academic and practical aspects of hospital management in China.

In terms of practical contributions, there are two main points:

Many hospitals in China are encouraging patients to use the MHT software platform. The actual use of the software platform can be fully understood through this study.

When using new equipment or technology system, it is suggested that Chinese hospital managers should adopt the management mode of evaluation of system-using process instead of system use. The purpose of investing in mobile medical software system is to improve PS. However, there are some progressive factors in the process of patients' satisfaction perception after using the software system. For example, after using software, patients first feel the changes in the process of visiting a doctor, then perceive the changes in the quality of hospital services, and ultimately affect the changes in satisfaction. For hospital managers, when a set of equipment or system software is put into use for a hospital, it is necessary to understand that the result of the use of the equipment or system software is not necessarily caused by the use of the equipment or system software itself, or may be related to the patient's perception of changes in the clinical process after using the system, the perception of hospital service quality and other factors. Therefore, when hospital managers invest in equipment or system, they should not only pay attention to the management of system use, but also pay attention to the factors affecting the results of system use.

In terms of academic contributions, there are four main points:

1) To adapt the clinical environment in China, we redefine the relevant research variables and improve or develop the corresponding scale. There are many studies on the use of information systems in the medical environment abroad, taking into account the particularities of Chinese clinical environment, such as the rapid development of mobile information technology, the overcrowding caused by a large number of patients and the confusion of management of the treatment process, etc, therefore, some research variables, such as system use, clinical process experience, SQ, PS, etc., will be different from foreign variables in terms of definition, content and measurement.

2) After using the information system, the variable, change in the clinical process is introduced from the patient's point of view, and as an intermediary variable to study the impact on the SQ and PS. There are many reports about SQ and PS at home and abroad, but it is the first time to take the clinical process change as a variable affecting SQ and PS. In addition, there are many factors or variables in the literature that affect PS. These variables are usually direct independent variables whose content is related to the quality of service or the use of information systems. For the first time, this study uses the clinical process change as a mediator of information system use affecting SQ and PS, which has never appeared in previous literature reports.

3) In the special clinical environment in China, this study is the first to study the relationship between the four variables of information system use, clinical process changes, SQ and PS. Past literature reports mainly focus on these variables, such as how system use affects SQ, the relationship between SQ and PS.

4) Under the background of hospital applying information system in China, the measurement dimension of SERVQUAL has been increased. Considering the poor patient experience caused by overcrowding in Chinese hospitals, and combining with literature review, this study adds a dimension to the traditional SERVQUAL measurement model: Convenience, which is another innovation of this study.

1.6 Thesis structure

The study is divided into six chapters, the main contents are summarized as follows:

Chapter 1, Introduction. This chapter firstly introduces the research background of the impact of MHT software on hospital SQ and PS. By analyzing the medical market competition intensified by China's medical reform and the vigorous development of MHT, which are widely used in clinical process management, this study defines the dilemma to be solved and the questions to be answered urgently, summarizes the research methods to solve the problems and puts forward the practical and theoretical contributions of the research, and finally introduces the writing structure of the thesis.

Chapter 2: A review of theoretical literature. This chapter describes and summarizes the concepts and contents of CS and PS, SQ and SERVQUAL, service encounter theory through literature review, and extracts the concepts of the variables in this study and the relationship between the relevant dimensions and research variables.

Chapter 3, Establishment of research frameworks and assumptions. Based on the results of the literature review in Chapter 2, this chapter establishes a research model and proposes and explains four research variables: mobile information technology use (MHT Use), clinical process change (CPC), hospital service quality (SQ) and patient satisfaction (PS). Then, according to the relationship between variables supported by literature, the relationship between MHT Use, SQ and PS, the relationship between MHT Use, CPC and SQ, and the relationship between SQ and PS, are discussed and assumed respectively.

Chapter 4: Research methods. This chapter first describes the design and structure of the questionnaire, and then introduces the data collection and analysis methods, including case selection, patient sampling, questionnaire issuance process and data analysis methods.

Chapter 5: Data analysis and hypothesis testing. This chapter mainly carries out descriptive statistical analysis, scale reliability and validity test, correlation analysis, regression analysis and model hypothesis test based on the collected questionnaire data.

Chapter 6, Conclusions and future research. This chapter summarizes the data analysis results of the previous chapter, points out the practical and theoretical contributions and innovations of the study, and states the limitations and shortcomings of the study. Finally, the future research directions are prospected.

Chapter 2: Review of Literature

2.1 Customer satisfaction

2.1.1 Definition of customer satisfaction

Customer satisfaction (abbreviated as CS) is a term often used in marketing, usually to measure how products and services offered by a company satisfy or exceed customer expectations. In the competitive market where companies compete for customers, customer satisfaction is seen as a key differentiating factor and is increasingly becoming a key element of corporate strategy (Gitman & McDaniel, 2005).

The research about customer satisfaction started in the 1930s, and Lewin (1936) pioneered the study of customer satisfaction theory in the field of social and experimental psychology. Since the mid-1960s, many in-depth studies on customer demand and customer satisfaction have been carried out in academia. Cardozo (1965) first conducted an experimental study on customer satisfaction in the field of marketing, focusing on the re-purchase behavior resulting from customer satisfaction. Howard and Sheth (1969) pointed out that when consumers consume, they will judge the reasonableness of what they pay and what they get. This cognitive state is called customer satisfaction. The main concern is whether the relationship between pay and return is reasonable.

Oliver (1980) proposed that customer satisfaction is a surprising assessment of product acquisition and consumer experience. Westbrook (1980) proposed that customers' subjective preference for different results and experiences during the period of using products is called customer satisfaction, which mainly emphasizes experience and results. Quelch and Takeuchizz (1981) proposed that factors related to the three stages of consumption, namely before, during and after consumption, will affect customer satisfaction. Farris, Bendle, Pfeifer, and Reibstein (2010) define CS as: how many or proportionate of customers experience a company's products or services beyond their specific satisfaction goals.

Day (1984) defined customer satisfaction as an evaluation response to perceived differences between expectation and actual product performance. Fornell (1992) pointed out

that customer satisfaction is a comprehensive evaluation of consumers after consuming. Oliver (1993) considered “satisfaction” as a result of consumer satisfaction responding to the product and can further determine how satisfied the consumer is with the product, service attributes, or service and product itself and also pointed out that customer satisfaction does not exist independently, but coexists with other consumer emotions, which is one of the main attributes of customer satisfaction, and Kotler (1995) argued that by comparing the expected performance of a product with the outcomes and people's expectations, it would produce "satisfaction" and reflect people's perception level. Woodruff (1997) pointed out that the criteria for comparing satisfaction should be based on the expected value of customers. The expected value of customers is determined by the attributes, functions and results of using products, while the expected value of products before purchase is the main consideration of customer satisfaction.

Customer satisfaction has not yet been defined uniformly. At present, the concept of customer satisfaction, which is generally accepted by academia, is put forward by Oliver, that is, customer satisfaction is the psychological reaction when customer needs are satisfied, and it is also the customer's judgment on the characteristics of products and services or the degree to which they meet their own needs.

2.1.2 Customer satisfaction characteristics

We conclude the five characteristics of customer satisfaction based on the definition of each author above as follows:

(1) Customer satisfaction is the combination of cognition and affection.

People's understanding of objective things is first a cognitive process, then an affectional process. When judging a product or service, you only need to compare your feelings with the original expectations, which is exactly called customer satisfaction. Customer's experience of service is not only a cognitive experience, but also an affectional experience. Therefore, the evaluation level by customer is related to customer's affectional state. When a customer has a good mood, even if the actual performance is less than expected, the customer is not necessarily unsatisfied, just as a good mood consumer may forgive the service staff for minor mistakes, on the contrary, when the customer has a bad mood state, even if the actual performance is greater than expected, the customer may not necessarily be satisfied. For example, the evaluation of medical staff's service is often much lower than that of family

members. The reason is that patients feel depressed because of illness, not because of inadequate medical and nursing services.

(2) Customer satisfaction is a comprehensive cognition of quality and price.

People's understanding of objective things is a process of cognitive and emotional cognition. Comparing the perceived quality of their own experience with the initial expectation is customer satisfaction. Churchill and Suprenant (1982) believes that customer satisfaction has two important factors: quality and price. From the perspective of cost-effectiveness, money cost, time cost and energy cost are the important components of the cost paid by customers, and customers are most impressed by the perceived quality. If we analyze the service performance expectation from the perspective of customer expectation, the expectation of service performance is largely based on the cost paid by customers, which significantly influence customer satisfaction. If we could reasonably estimate the customer's expectation level, a customer requests a product with relative low value could also perceive the performance of a product with relative high value.

(3) Customer satisfaction bears the characteristic of integrity.

Customer satisfaction evaluation of services provided by enterprises is holistic, including quality, price, consumption, environment and other aspects, not just for a single quality or service. In the process of customer receiving products and experiencing services, any link of the process will affect the final satisfaction or unsatisfactory evaluation of customers.

(4) Customer satisfaction bears the characteristic of ambiguity.

The ambiguity of customer's evaluation of service satisfaction may be reflected in the uncertainty of the judgment of satisfaction and dissatisfaction, or in the expression of satisfaction. Customer satisfaction is a kind of cognitive and emotional expression. From the perspective of cognition, the uncertainty of customer expectations directly leads to the uncertainty of customer service cognition: from an emotional point of view, emotion itself may be vague and inconspicuous. In fact, people often cannot fully evaluate their own emotions, which means that people often cannot find the right words to express their emotions, and sometimes the process of seeking expression itself could change this emotion to some extent. Therefore, from both cognitive and emotional perspectives, satisfaction itself has a greater ambiguity. For each individual, it is difficult for customers to accurately distinguish which situation is satisfactory or unsatisfactory, such as phenomena of "either one or the other" or "neither one or the other".

(5) Customer satisfaction is the unification of subjectivity and objectivity.

Customer satisfaction as individual cognition and emotion is the result of customer subjective perception. Customer satisfaction has a strong subjective character. Different customer personality characteristics and changes in the same customer's psychological state will lead to different satisfaction evaluations for the same service. People may have a positive or negative attitude towards the same thing and phenomenon, accepting or rejecting it. Under certain service conditions, the evaluation of a certain service by customer groups tends to be an average value. Although individual customers will have opposite evaluation of the same service attribute, the overall evaluation of all customers will tend to be an average value. At the same time, human emotion is the reaction of objective things, and the objective world is the source of emotion. In short, customer satisfaction is the unity of subjectivity and objectivity. It is based on objective facts and reflects the overall level of service.

2.1.3 Customer satisfaction theory model

The important theories of customer satisfaction include expectation-disconfirmation theory (Oliver, 1980), cognitive-performance theory (Churchill & Suprenant, 1982), proposing that the consumer compares his or her perception of a product or service with a pre-purchase expectation. There are four structures that can describe traditional disconfirmation model, namely expectations, performance, disconfirmation and satisfaction. The consumer satisfaction is adjusted by the size and direction of disconfirmation - the difference between the individual's pre-purchase expectations and the performance or quality of the product or service. The disconfirmation is negative when the product performs worse than expected. When the product exceeds expectations, the disconfirmation is positive. Satisfaction is seen as the result of purchase and use, as the consequence of customer’s comparison between the expected reward and the expected cost of purchase.

Oliver (1993) put forward the theory of "combined cognitive and affect augmented disconfirmation" on the basis of his own and other researchers' work. The theoretical model includes the factors that influence the satisfaction, like expectations, attribute performance, disconfirmation, positive and negative affect, attribution, and equity/inequity. Positive and negative affect refer to the emotional state of consumers when they purchase products and services. If consumers are emotionally stable and happy, they have a positive impact on the performance of products and services and improve satisfaction. If consumers are depressed, there will be negative feelings about the performance of products and services, amplifying

small problems and leading to a decline in satisfaction. Attribution refers to the consumer's self-explanation that the service is better or worse than expected, that is, the consumer's own perceived reason. When consumers encounter problems with products and services, if attribution explanations are positive and can be partly forgiven, then satisfaction will not be too bad. If attribution explanations are negative and the responsibility is all product and service providers, then satisfaction will be very bad. Equity refers to whether consumers feel treated equally when they receive products and services, such as products and services at the same price, which will greatly affect customer satisfaction. In this theoretical model, both expectations and performance can directly affect satisfaction or affect satisfaction through disconfirmation perception. Positive and negative affect play a mediating role in attribute performance directly affecting satisfaction. Attribution can affect consumers 'positive and negative affect, and directly affect satisfaction. Equity affects satisfaction independently but has no correlation with other factors.

2.1.4 Customer satisfaction index

Since the 1980s, some complex customer satisfaction models have been developed. These models not only clarify the causes of customer satisfaction, but also explain the whole process and results of customer satisfaction formation. More importantly, quantitative research on customer satisfaction has been carried out since this period. It mainly uses appropriate means to construct satisfaction model and generate satisfaction index, so as to promote the research on customer satisfaction to enter the stage of Customer Satisfaction Index (CSI). Among them, the most influential is the causal-based customer satisfaction index model built by Dr. Fornell, who is from the National Quality Research Center, the University of Michigan Business School. Fornell (1992) proposed the first customer satisfaction index model, the Swedish Customer Satisfaction Barometer (SCSB). In 1990, the American Quality Association and the American Quality Research Center, commissioned by the American National Economic Research Association, began to study and establish the American Customer Satisfaction Index (ACSI) model. The index model was launched in 1994 and is currently the most widely used customer satisfaction index model in the world. In 1992, Germany began to establish its own customer satisfaction model (Deutsche Kunden-barometer, DK). Since 1995, Canada, New Zealand and Taiwan, China, have also begun to build industry customer satisfaction index model. By 1998, Korea had reformed the ACSI model and put forward the Korean Customer Satisfaction Index Model (KCSI). In 1998, a

number of countries began to develop plans for customer satisfaction indices, including Singapore, Malaysia, Mexico and Brazil. Europe also officially launched its European Customer Satisfaction Index (ECSI) in 2000. The SCSB, ACSI, and ECSI models are typical satisfaction models, and the ACSI model is the most widely used. We briefly describe the four classic models respectively as below, including the Swedish Customer Satisfaction Barometer (SCSB), the American Customer Satisfaction Index (ACSI), the European Customer Satisfaction Index (ECSI), and the Norwegian Customer Satisfaction Barometer (NCSB).

(1) SCSB model

The SCSB model was the first global customer satisfaction index model established by the Swedish Statistical Bureau with the help of the National Quality Research Center, Michigan University in 1989. It was used to investigate and analyze more than 100 companies in 32 industries in 1989.

The SCSB model is a structural equation model, which mainly includes five latent variables (i.e., not directly available, but needed to be estimated by one or several measurable variables), namely customer expectation, perceived performance (value perception), customer satisfaction, customer loyalty, customer complaint) and 10 corresponding observable variables (i.e., measurable variables).

In SCSB model, customer expectation refers to the customer's evaluation of the performance or value of a service or a commodity before deciding to accept a service or purchase a commodity. It is a subjective prediction rather than an objective judgment. Performance perception mainly includes two kinds of explicit variables, one is the reflection of quality under the known price, the other is the reflection of price under the known quality, that is to say, performance perception is mainly the measurement of customer's value of goods or services (performance). It can be said that the higher perceived value, the higher customer satisfaction.

The causal variables in SCSB model are customer expectation and perceived performance, and the outcome variables are customer loyalty and customer complaint. Some of its main points of view are as follows: customer satisfaction is mainly determined by the expectation before purchase and the feeling during and after purchase, which will lead to customer loyalty or complaint.

(2) ACSI Model

The ACSI model was commissioned by the National Quality Research Center and the American Quality Association in 1990 and was officially launched in 1994. In 1998, 200 enterprises in 34 industries of 7 departments in the United States began to use the customer satisfaction index widely. ACSI model is built on the basis of SCSB model. The model includes six latent variables (customer expectation, quality perception, value perception, customer satisfaction, customer complaint, customer loyalty) and 14 corresponding observable variables. It is also a structural equation model (Fornell, Johnson, Anderson, Cha, & Bryant, 1996).

The main difference between ACSI model and SCSB is that the former adds a latent variable to the latter, namely perceived quality, which mainly includes three measurable variables: customer quality, reliability quality and overall quality. In 1995, ACSI model modified and expanded perception quality, which became service perception quality and product perception quality. Resembling the SCSB model, the structure of perceived value also contains two measurable variables: quality under known price and price under known quality. Customer expectation includes three measurable variables: total expectation, customization expectation and reliability expectation. Customer loyalty includes two measurable variables: customer repurchase possibility and price endurance; customer complaint is the same as that of SCSB model, and only includes one measurable variable - customer complaints about products and services purchased formally or informally.

At present, ACSI model is a universal model to measure customer satisfaction all over the world. In this model, the causal variables include customer expectation, quality perception and value perception, and the outcome variables include customer loyalty and customer complaints. The view of ACSI model is that customer satisfaction is mainly determined by the actual perception of product quality and value generated by customer experience in purchasing and using products, and by comparing this perception with previous expectations.

(3) ECSI Model

In 1999, the European Quality Organization and the European Quality Management Foundation established the ECSI model, which was applied to the evaluation of customer satisfaction index in 12 EU countries in the same year. The ECSI model improves the SCSB model and ACSI model to some extent by adding the latent variable of brand image and its corresponding measurement variable, removing a latent variable - customer complaint, and dividing quality perception into perceived quality of hardware and perceived quality of software.

ECSI is also a structural equation model, which includes seven latent variables: brand image, customer expectation, perceived quality (hardware), perceived quality (software), perceived value, customer satisfaction and customer loyalty, which are explained by 20 measurable variables. Customer expectation includes two measurable variables: one is customer overall expectation of product or service, the other is customer expectation of communication between organization and themselves; perceived value, like that of SCSB and ACSI, has two measurable variables, but the content is different. It includes two measurable variables: one is the value measured by money, the other is the value measured by comparing with competitors of the same trade; customer satisfaction includes three measurable variables: the total customer satisfaction on products and services, and the second is the extent to which actual value (performance) meets customer expectations. The third is customer satisfaction comparing with ideal products or services, which is exactly the same as that of SCSB and ACSI models. In the ECSI model, customer loyalty mainly refers to whether customers have a particular preference for the brand product or service. It mainly includes three measurable variables: customer repurchase intention, customer cross-purchase intention and recommendation intention.

In the ECSI model, the causal variables include customer expectation, brand image, hardware perceived quality, software perceived quality and perceived value. The outcome variable is customer loyalty. The main viewpoint of the Model is that perceived quality is refined into hardware perceived quality and software perceived quality. Hardware perceived quality refers to customer perception of product and service quality, while software perceived quality mainly refers to customers perception of communication quality with enterprises.

(4) NCSB Model

Investigating and analyzing the advantages and disadvantages of ECSI, SCSB and ACSI models, Johnson (2001) proposed a new Norwegian Customer Satisfaction Barometer (NCSB). NCSB model adds three intermediate variables between customer satisfaction and customer loyalty: affective commitment, corporate image and computational commitment. The results show that customer satisfaction and customer loyalty are both directly affected by price index. Norway's new customer satisfaction barometer not only refers to the classical Swedish customer satisfaction barometer, American customer satisfaction index and European customer satisfaction index model, but also combines the satisfaction theory of the latest development results. On this basis, it extends and modifies the classical models of American customer satisfaction index and European customer satisfaction index.

2.2 Patient satisfaction

2.2.1 Concept of patient satisfaction

In abroad, the research on the theory and method of patient satisfaction evaluation started earlier and was generally concerned. In the field of medical treatment, patient satisfaction is an extremely important evaluation index of medical quality (Salisbury, Burgess, Lattimer, Heaney, Walker, & Turnbull et al., 2005). Its content includes various services provided by hospitals, such as technology, function, hardware facilities, hospital-patient interaction and environment (Zineldine, 2006). From this, we can see that the content of patient satisfaction can be summarized as two aspects: one is the experience of patients on the process of medical service and the medical staff's diagnosis and treatment behavior; the other is the technical value of patients from medical services, such as the level of hospital in diagnosis, treatment, medicine and medical equipment.

In the application research of the medical service industry, the initial introduction of customer service satisfaction by improving service quality. In 1956, the United States first tried to apply patient satisfaction to evaluate the quality of care services. Donbedian (1996) proposed that patient satisfaction is one of the results of nursing services but has not yet given a clear definition.

Since the early 1970s, a large number of studies have been conducted on patient satisfaction abroad, and many scholars have proposed some concepts about patient satisfaction. Risser (1975) defines patient satisfaction as the degree to which a patient's care about the ideal state is consistent with the patient's actual experience. Ware, Davies-Avery and Stewart (1978) think that patient satisfaction is designed to measure the satisfaction of patients with medical service facilities and various medical service personnel. Sitzia and Wood (1977) suggested that the patient satisfaction study should be called patient satisfaction and experience research, which means that it is not enough for the manager to know whether the patient is satisfied or not, and also to find out why the patient is satisfied.

In the 1980s, attention to patients' opinions was increasing around the world. Modern management concepts and social movements prompted governments and medical institutions to gradually establish the concept of treating patients as customers. International research has gradually turned to customers-centered on the quality of medical services. Many scholars recognize that patient satisfaction is an important indicator of the quality of hospitals. The

patient's satisfaction with the hospital can often determine which hospital they choose to see, and what kind of response will be made to the outcome of the treatment. During this period, some scholars conducted patient satisfaction research based on the perspective of medical service quality: (1) Donbedian (1988) defines patient satisfaction as "the patient's representation of all aspects of the quality of care, especially the process of interpersonal relationships"; (2) Kathleen (1989) uses patient satisfaction, patient-doctor relationship and quality of life measurement as new medical service evaluation indicators. Evans, Martin, and Winslow (1998) distributed a patient satisfaction questionnaire with 54 questions to 318 patients in a large hospital in the Midwestern United States. Through the study of patient satisfaction, the quality of medical care was shown as the most important aspect of the overall assessment in the hospital.

In the early 1990s, the academic report began to refer to patients as consumers (or customers), and some management experts gave health service objects a broad and neutral name: customers or service users. The academic report introduces the method of customer satisfaction to test the defects of the service into the medical and health industry. And customer satisfaction is called patient satisfaction. Patient satisfaction refers to the judgment of patients on whether medical services meet their expectations (Palmer, Donabedian, & Pover, 1991). At the 12th International Conference on Medical Quality Assurance, the measurement methods and related theories of patient satisfaction were discussed as one of the important contents. It was considered that patient satisfaction was an important measure to measure the outcome of treatment and the quality of medical services, and a key indicator to reflect social benefits. Experts in many countries believe that in the activities of improving medical quality, patient participation is helpful to guarantee medical quality, and the evaluation of patients' satisfaction plays an important role in improving medical quality. Bond and Thomas (1992) pointed out that the measurement of patient satisfaction plays an important role in the quality management of medical service from the perspective of patient observation and health service evaluation. Some developed countries such as the United States and the United Kingdom have legislative protection for patient satisfaction assessment, and even as a prerequisite for hospital operation, patient satisfaction has gradually become an important indicator for evaluating the quality of medical care.

Throughout the process since the beginning of patient satisfaction research, the research work of foreign scholars can be roughly divided into the following aspects.

In the study of patient satisfaction theory, many scholars have put forward many views on the concept of patient satisfaction based on different experiences and concepts. Pascore

(1993) believes that patient satisfaction is a reflection of their medical experience associated with their subjective feelings, and the experience values form the level he believes medical services should reach. Jung, Van, Wensing, Hearnshaw, and Grol (1998), through a study of patient priorities in basic medical services (including 57 studies), found that patients in medical services are most concerned with medical skills, communication between doctors and patients, patients' right to know, nursing time and so on. Druse and Rosenheck (1999) and others proposed that patient satisfaction is an important content reflecting the quality of medical services and treatment outcomes, and also a new evaluation method of medical quality adapting to the change of medical model. Johansson, Oleni, and Fridlund (2002) considered patient satisfaction as a subjective evaluation of patients and a cognitive and situational response of patients after comparing their expectations and actual perceptions of medical services. Copeland, Koeske, and Greeno (2004) argue that patient satisfaction is the perception and evaluation that patients make by comparing their initial impression with the actual situation and according to the communication between medical staff and patients.

2.2.2 Factors affecting patient satisfaction

In terms of the evaluation theory of patient satisfaction, some scholars have carried out a large number of factors related to patient satisfaction and their relationship. Linder (1982) pointed out through research that people's desire for health affects patient satisfaction. Antil (1984) found that patient satisfaction was related to the involvement of a service, and improving patient-patient interaction was a good way to improve patient satisfaction. Wasserman, Brody and Markson's studies have come to the same conclusion. De Kluyver and Pessemier (1986) and other scholars found that there is a positive correlation between patient satisfaction and hospital income. Roter and Hall (1989) further pointed out that patients' satisfaction with feelings is related to the amount of information they receive from doctors (especially general rather than technical information). Woodside, Frey, and Daly (1989) pointed out that patient satisfaction was significantly associated with the willingness to visit the hospital again. Rogut, Newman, and Cleary (1996) argued that background factors such as patient's age, race, income level, insurance, self-perceived health status, and having a fixed doctor would affect patient satisfaction. Beck and Larrabee (1996) found that patients' satisfaction with nursing work is highly correlated with hospital service satisfaction, which means that the role and behavior of nursing staff determines patient satisfaction rate. Junya and Yuichi (2000) and other studies believe that medical technology and service attitude are

important aspects affecting patient satisfaction and have a strong positive correlation with satisfaction. Lumby and England (2000) research shows that in general, elderly patients are more satisfied with nursing services than young patients, male patients are more satisfied with nursing services than female patients, and patients with lower education level are more satisfied with nursing services than those with higher education level. Dozier and Kitzman (2001) believes that patients need to compare their experiences with their expectations to form a judgment of satisfaction. Press (2002) and other scholars found that higher service quality and employee satisfaction are required to satisfy customers in medical services, which will lead to better risk management. Urden (2002) pointed out that patient satisfaction can objectively reflect the quality of medical services and is the golden standard to measure quality management in modern hospitals. The study of June et al. (2003) pointed out that patient satisfaction is affected by many factors, among which patient perceived nursing quality has the greatest impact on satisfaction, with a cumulative contribution rate of 59%. Ferguson, Paulin and Leiriao (2006) pointed out that employee job satisfaction and patient satisfaction are related to the willingness to communicate and should pay attention to the role of word of mouth. Hudak, McKeever, and Wright (2007) found that there is a positive correlation between patient satisfaction and hospital benefits, and higher patient satisfaction leads to better risk management for healthcare organizations. Bautista, Glen, and Shetty (2007) found through research that education level and quality of life have a significant impact on patient satisfaction.

As can be seen from the above studies, patient satisfaction is a very complex concept, which is related to many factors such as personal life experiences and concepts, even if the same person has different definitions of satisfaction at different times. Patient satisfaction, which varies from person to person and from time to time, creates difficulties in seeking a unified definition. Although many medical service models have been established so far, it is difficult for scholars to give a precise definition of patient satisfaction. Although most scholars agree that the best definition is patient's evaluation of medical services based on their expectations of medical institutions and staff. Some scholars have questioned the limitations of patient satisfaction assessment. MacMillan believes that there is a positive bias in the patient satisfaction survey because patients are not able to express their dissatisfaction to the hospital openly and honestly. Fitzpatrick and White (1992) shows that at least 80% of patients will be satisfied with any questions in the questionnaire because of patient considerations, while the voices expressed by patients after discharge from hospitals are difficult to report back to the hospital. Williams points out that because patients only express their

dissatisfaction when extreme negative events occur, a good patient satisfaction survey does not indicate that the service is good, but that no very bad things happen.

2.2.3 Difference between patient satisfaction and customer satisfaction

The concept of Patient Satisfaction is derived from the concept of customer satisfaction. From a commercial point of view, patient satisfaction in medical services has many similarities with customer satisfaction in any other products and services. It also undergoes a process from simple scoring to comprehensive evaluation using an exponential model.

Pascoe (1983) extensively reviewed the literature on patient satisfaction models and found that most of the research models on patient satisfaction are based on expectations, and patient satisfaction is conceptually based on the theory of “expectation-disconfirmation”. For example, Oliver (1980) examined influenza vaccines and found that positive disconfirmation (i.e., perceived performance is higher than expectation) increased patient satisfaction, while negative inconsistencies (i.e., perceived performance is lower than expectation) reduced patient satisfaction.

But after all, the medical service industry has certain special characteristics after all. The concept of consumers cannot be directly introduced into the medical service field from the field of economics. However, some researchers believe that the "expectation- disconfirmation " theory may not be fully applicable to the medical field. Linder (1982) claims that there are two main findings in a study of the interaction between patient expectations and perception. One finding is that there is little evidence that satisfaction is largely the result of meeting expectations and medical performance. Another finding is that expectations have a decisive impact on satisfaction despite other variables, which means that patients expectations can play a significant role in how they evaluate hospital medical services in the future. For example, before a patient comes into contact with a doctor, trust in the doctor can determine the final patient's evaluation of the doctor, and the evaluation is not even related to what the doctor actually did to the patient. In this regard, Zeithaml, Parasuraman, and Berry (1990) point out that although consumers ultimately judge service quality based on their perception of the technical results of products or services and the way hospitals provide services (process quality), many professional services are complex and the results are not always obvious. For example, this is true for many medical institutions, because the technical quality of medical services is difficult for patients to judge. Consequently, the factor that influence the patient

satisfaction is a complex mixture of emotion, the tangible and the intangible, and patient satisfaction cannot be viewed in completely the same light as that for a consumer product such as a mobile phone or a computer.

From the sociological point of view, doctors' service orientation and their special knowledge system, power and prestige make it difficult to integrate patients' views with those of medical experts. The theory and method of evaluating patients' satisfaction are different from that of the general industry, which is mainly due to:

(1) The information between doctors and patients is highly asymmetric. Poor doctor-patient communication will affect patient satisfaction to a certain extent.

(2) The high risk of medical services. It is difficult for medical staff to give patients a definite commitment and prediction about the outcome of medical services, and patients' lack of awareness of the high risk of medical services is often an important cause of patient dissatisfaction.

(3) There is a difference in the demand for medical services. An important difference between medical services and other traditional services is that patients' own conditions and expectations for medical services vary, and their perceptions and evaluations vary widely. For example, patients with common limb trauma and severe brain trauma have different expectations for medical services. The former will be higher, while the latter will be low. Even if the treatment is ineffective for patients who have brain trauma, family members will rarely be dissatisfied.

(4) Patients are not aware of whether the outcome of medical services is good or bad. Because of the high technical content of medical services, it is difficult for patients to evaluate medical services, so the performance of medical services cannot be accurately judged.

(5) Negative emotions of medical service clients. Negative emotions of medical service clients. Because of their own illness, most patients have negative emotions such as depression and anxiety in varying degrees, unlike customers in general industries, they spend more in a happy mood. Such negative emotions may affect patients' evaluation of medical services.

(6) Patients have high expectations for medical services. Because medical services are directly related to the life and health of patients, people tend to be blame-seeking when pursuing the quality of medical service. Once there is a distance from their expectations, patients will have unsatisfactory evaluations.

Therefore, the concept of patient satisfaction and its evaluation theory and evaluation methods cannot simply copy the theory of customer satisfaction in the field of economics directly into the field of medical services.

2.3 Service quality

2.3.1 Definition of quality and service quality

To articulate the definition of service quality, we first need to understand the implications of quality in general, then to identify the characteristics of service quality. Juran (1974) defined the quality as the fitness for use based on user preference in the field of economics, marketing and operations management. The quality was argued by Crosby (1979) as the products' conformance to specifications and "making it right the first time" from the supply-side point of view. Garvin (1983), in earlier time, proposed the quality can be measured by calculating the incidence of "internal" failures and "external" failures in production, which respectively refer to the products identified unqualifiedly before leaving factory and after using by clients. Then, based upon above views, Garvin (1984) summarized that the concept of quality was composed of eight dimensions, namely, performance, features, reliability, durability, conformance, serviceability, aesthetics and perceived quality. Of the dimensions, the first five, relatively easy to measure, are classified into product-based and manufacturing-based definition approaches, also called objective quality (Garvin, 1983; Hjorth-Anderson, 1984), while the last three, serviceability, aesthetics and perceived quality, normally hard to evaluate, are classified into user-based definition approach, which is within the concept of service quality.

To illustrate the concept of service quality in depth, there are three characteristics needed to be addressed: intangibility, heterogeneity, and inseparability of production and consumption (Parasuraman, Zeithaml, & Berry, 1985).

The intangibility refers to that the service quality can't be easily judged by consumers before experiencing the process of service (Zeithaml, 1981). The customers who are purchasing goods can easily assess the quality of goods by judging its appearance, such as color, weight, style, label, etc. but for the service purchasing, the customers have few tangible cues to judge the quality, except for the equipment, facility and staff of service providers.

The heterogeneity means that service personnel has difficulties to offer identical service

performance to different customers, especially in intensive labor services (Booms & Bitner, 1981). Hence, some investigators suggested that the service quality can be measured by comparing the customers' expectation with the service actual performance (Grönroos, 1982).

The inseparability is the attribute that the service quality can only be observed during the interaction between the customers and service providers (Lehtinen & Lehtinen, 1982). That is, the service quality is not only evaluated by the outcome, but also by the service process. Sasser, Olsen, and Wyckoff (1978) proposed a model of service performance including three dimensions: material, facilities, and personnel, which implied the service quality contained more than outcomes. The way of service delivery should also be considered. Similarly, Grönroos (1982) defined two types of service quality: technical quality, which describes what the customer receives from the service, and functional quality, which describes how the service is delivered.

2.3.2 SERVQUAL model

Based on the early claims by some researchers (Grönroos, 1982) that service quality is comparison between customer expectation and perception of service performance, Parasuraman, Zeithaml, and Berry (1985, 1988), proposed a conceptual model of service quality and develop a service quality measuring instrument, called SERVQUAL scale. it defines service quality as the judgment and assessment of the firm's service level, and also as the gap between the customers' expectations of service and their real experience of the service. The model is quite often used tool to study service quality and a powerful measuring instrument for service quality in various service sectors.

The development of the model started in 1983, then got involved and modified in the SERVQUAL instrument in 1988. The initial research identified approximately 100 items used in the first round of consumer testing. The preliminary data analysis by using factor analysis reveals that these items are loaded into ten dimensions (or components) of service quality. The ten dimensions that are considered to represent quality of service are: Competence, Courtesy, Credibility, Security, Access, Communication, Knowing the customer, Tangibles, Reliability and Responsiveness. Further tests had shown that some of the ten preliminary dimensions of service quality are closely related or autocorrelated. As a result, ten initial dimensions were reduced and modified to accurately reflect the revised dimensions. By the early 1990s, the authors had refined the model into five dimensions that appeared to be relatively stable and robust in the test. These five dimensions are Tangibility, Reliability, Responsiveness,

Assurance and Empathy. The definition of each dimension are described as follows (Parasuraman et al., 1988):

Tangibility refers to the lists of the actual facilities, equipment and service staff.

Reliability refers to the ability to implement service commitment in a reliable and accurate manner.

Responsiveness refers to the willingness to help customers and to improve service.

Assurance refers to the employees' related knowledge, etiquette and ability to show confidence and reliability.

Empathy refers to the care for the customers and provide them with customized service.

The content of the SERVQUAL model consists of two parts: The first part contains 22 items that measure the customer's expectations for representative companies in a particular service industry. The second part also includes 22 items that measure how consumers feel about a particular company in the industry. Therefore, SERVQUAL is a scale with 44 items. The evaluation of the company is conducted comparing the results obtained in these two parts to get each "gap score" of the five dimensions. The smaller the gap is, the higher the level of service quality is. The scale of instrument is based on Likert 7 points, from 1 to 7. 7 means strongly agreement, 1 means strongly disagreement.

The definition of SERVQUAL is based on the concept of comparison between expectations and performance. Its traditional five dimensions cover two main aspects of service performance. Tangibility, Reliability and Assurance are used to describe the level of hardware, medical technology and medical staff's ability in hospitals, while Responsiveness and Empathy are used to evaluate the level that how the process of clinical service influence the patient's attitude to service performance, which belongs to the aspect of patient-physician encounter. The two aspects indeed can generally explain the definition of service quality quite well and incorporate the dimensions of service quality in meaning defined by other early distinguished authors. For example, Sasser, Olsen, and Wyckoff (1978) define the service quality with the dimensions of material, facilities, and personnel, which match with the Tangibility, Reliability and Assurance. Grönroos (1982) classify service quality into two sorts, technical quality (corresponding to Tangibility, Reliability and Assurance) and functional quality (corresponding to Responsiveness and Empathy). Lehtinen and Lehtinen (1982) define the service quality with physical quality, corporate quality and interactive quality. Similarly, physical quality and corporate quality match with Tangibility, Reliability and

Assurance; interactive quality match with Responsiveness and Empathy. So, we may conclude that the dimensions of SERVQUAL basically include all the meaning of the other conception of service quality.

2.3.3 SERVQUAL Vs SERVPERF

However, Cronin, and Taylor (1992) disagree with the SERVQUAL, proposing a new service quality measuring scale, called SERVPERF. Both SERVQUAL and SERVPERF are based on the same conceptual definition that service quality offered by the firm is a gap between expectation and performance from customer's perception. The main difference is that SERVQUAL measures both customer's expectation and performance, while SERVPERF measures performance alone. The reason for SERVPERF only measuring performance is that the respondents normally give their evaluation by naturally comparing performance perceptions with performance expectations. Thus, there is no need measuring expectation of service quality again. The argument discussed most between two tools is that which one is the better predictor of service quality. There are many studies have different results. One of them, Carrillat, Jaramillo, and Mulki (2007) apply a meta-analytic view of 17 years of research to investigate the difference between SERVQUAL and SERFPERF's predictive validity of service quality. The main findings are as follow:

- Both SERVQUAL and SERFPERF can equally and validly predict the service quality, as the results of meta-analysis show (Cohn & Becker, 2003);
- SERVQUAL is more suitable for practitioners to apply because of its diagnostic advantage (Parasuraman et al., 1994);
- The greater effort needed in modifying SERVQUAL scale for certain context than SERVPERF;
- SERVQUAL applied in non-English speaking countries has a higher predictive validity on service quality;
- The highest predictive validity of SERVQUAL on service quality happens in the firms emphasizing the service both on process and product (i.e., service shop, hotel, bank).

Based on the above research results, considering the advantage of SERVQUAL, such as better predictor on service quality after modification, more suitable applied in service characterized with both process and product, we believe it is proper to apply modified SERVQUAL measuring service quality in the sector of hospitals in China. One of reasons is

that the service of the hospitals includes the both characters of process and production. The former is about how medical staff treat the patient, and the latter is about the tangible objects and clinical outcomes that the patients perceive. Another reason is that original SERVQUAL must be modified in terms of language translation before using in China.

2.4 SERVQUAL application in hospitals: a systematic literature review

For this part of literature review, we intend to focus on the general clinical process of hospital, investigate the patient demographical information and variables affecting service quality and the relationships between them, and also explore how different dimensions of SERVQUAL and assess the impact of each dimension on service quality among the literatures. We have great interests to know how could service process change and adoption of new information technology influence the service quality. Under the trend of introduction of social media in hospitals, such as mobile health Apps, Will MHT use influence the clinical process change? will this change is going to promote the service quality or patient SA? If answer is yes, which dimension of perceived quality does contribute to service quality most. Then we may conclude a new research model about how does the MHT use influence the service quality and patient satisfactions in hospitals.

We search the primary studies used in this review through databases of service quality researches that meet the following criteria:

- Includes the peer-reviewed journals articles.
- Includes no restricts on the publication time of literatures.
- The interface where we search literatures were: web of science and Biblioteca do Conhecimento Online (b-on). The databases are social science citation index and science citation index.

The database searches resulted in a great deal of candidate articles, which are necessarily to further narrow the search range by the inclusion/exclusion criteria.

The inclusion criteria are employed as: service quality measurement instrument used by SERVQUAL (original and adapted models); studies conducted in the context of healthcare; evaluation on service quality in healthcare sector constricted to the clinical process and the use of information technology or MHT, such as mobile applications.

The exclusion criteria are employed as: studies written in other languages apart from

English; study findings with unclear and ambiguous results; short papers, mini-tracks.

The inclusion/exclusion criteria were carried out by:

- Reading the title, abstract and keywords to exclude any irrelevant studies.
- Reading the rest of studies and keeping only those that raised the research questions.

At the very beginning, we, three investigators totally engaged, enter into the interface of Biblioteca do Conhecimento Online (b-on) to search the studies in healthcare sector by two groups of search strings restricted to keywords in the texts, i.e., servqual <and> mobile health <and> hospital <and> information technology(group1), servqual <and> hospital <and> service quality (group2). The results turned out 125 and 1,404 articles respectively. To make the review task more feasible, we decided to restrict the "servqual" to the title in the second group. Then, the result of second group is 79. These totally 204 articles read through the title and abstract, were selected based on the exclusion/inclusion criteria eventually. Excluding the irrelevant articles, there are 38 left to be reviewed in detail. Yet, among the reviewed articles, there are only nine articles concerning with both the information technology and SERVQUAL. Thus, for exploring more studies, we plan to go back to search the relevant articles based on the nine articles. Through scrutinizing the first 20 relevant articles of each of nine articles, we acquire 13 articles close related to the application of information technology or mobile technology in hospitals. But the aims of all 13 articles is to explore the factors affecting patients' acceptance of new technology, which is irrelevant to this review's intention.

Then we explore potentially relevant articles in the database of social science citation index (SSCI) and science citation index (SCI) via the web of science. The search strategy uses the SERVQUAL as the keyword in the title and 82 articles are turned out. Yet all the articles have been already identified. Then we notice that there is one earliest published article (Babakus & Mangold 1992), cited by other 202 articles, concerning with the SERVQUAL firstly adapted in assessment of service quality in hospitals. Among the 202 articles, there are another new 14 articles identified belonging to the group2. All these 52 articles are labelled in number.

In addition, we search out another most relevant 10 articles about the relationship between various constructs and service quality, by exploring studies with respect to prior 52 articles. Eventually there are 62 articles labelled in numbers.

2.4.1 Studies search and data extraction

We searched out most relevant 62 articles, labelled in numbers. Of them, 52 articles are divided into two groups, i.e., group1 and group2, by two different searching strategies. The group1, where the studies are conducted in the hospitals with the clinical process possibly changed by applying information technology, has 12 articles, and the group2, where the studies are conducted in the hospitals with the traditional clinical process, has 40 articles.

To identify how many dimensions of service quality involved in each study and which dimension mostly influences the overall service quality of each article, we label each article with unique identified number. The items of each study include objective, methodology/approach, major findings, service quality dimensions and observed most influential dimensions to overall service quality. To facilitate analyzing and comparing the results of articles between the studies conducted in the context of using information technology and not, we divide the articles into two groups and display the relevant information in Table 2-1 and 2-2.

To explore the impact of each dimension of service quality, we built Table 2-3 to calculate how many articles are there in each of eight most influential dimensions. Also, to see whether information technology or MHT applied in hospital contribute to the promotion service quality, we classify the 52 articles into two areas, which are those involving information technology (Research Area1, nine articles) and not (Research Area2, 43 articles). Three of articles, No.9, 10 and 11 from searching Group1, are identified not involving the information technology related to the patient service quality and so are classified in the Research Area2. The same most influential dimensions of service quality among studies are summed up as the subtotal and total number, standing for the impact of each dimension.

To explore the relationship between patient demographics and service quality in all the studies reviewed, we find the diverse results from 11 articles, as shown in Table 2-4.

Further, to study how many variables or factors affecting service quality or affected by the service quality have been already explored by the investigators, we set up Table 2-5and Table 2-6 to examine the relationships between SERVQUAL or its adapted and other constructs/variables among the selected empirical studies. We collect the articles classified by involving SERVQUAL or its adapted as dependent variable and independent variable. In addition to prior 52 articles reviewed, there are another ten articles, labelled number from 53 to 62, involved by searching the relevant studies of 52 articles.

2.4.2 Relationship between patient demographical information and service quality

Most of studies claims that age has no impact on service quality, while others conclude that the younger patents are, the more gap between expected and perceived service quality (Papanikolaou & Zygiaris, 2014). As for gender, Meesala and Paul (2016) find that women satisfied with service are easier to revisit the hospitals. Geertzen, Gankema, Groothoff, and Dijkstra (2002) observe the significant differences in the overall satisfaction between men and women. Güllü, Tekindal, Tekindal, and Yazıcı (2017) reveal that the lower-educated patients have a higher perceived service quality compared with the higher-educated patients. Marital status has no impact on service quality, which is supported by Meesala and Paul (2016) and Oliaee, Jabbari, and Ehsanpour (2016).The income is associated with service quality (John et al., 2011). The more patients earn, the higher service quality patients will perceive (Güllü et al., 2017).

In general, the impact of patient demographical information on service quality varies across different studies. The researchers need consider the influence of patient personal details on service quality in specific context.

2.4.3 Dimensions of service quality applied in literature

Table 2-1 and Table 2-2 present different methods to measure service quality among 52 articles. Most of the service quality measurement approaches, mentioned by totally 42 articles, are based on the SERVQUAL or its adapted, i.e., the SERVQUAL scale is added in extra dimensions or changed with different dimension name. Others, up to ten articles, are based on the research models developed by the investigators themselves. In measuring service quality, there are totally 31 studies using the exact same five dimensions of SERVQUAL as Parasuraman, et al. (1988) firstly proposed and Babakus and Mangold (1992) firstly put forward in hospital context.

Besides SERVQUAL model, the models applied by the investigators to measure service quality also have Technology Acceptance Model (Chang, Pang, Tarn, Liu., & Yen, 2015), Service Encounters Evaluation Model (Chang & Chang, 2008) and Information Systems Success Model (Akter, D'Ambra, & Ray, 2013). In these models, there are many dimensions applied, where the most influential those on service quality are Convenience, Interaction and Care process.

Therefore, we might draw a conclusion from above that the five dimensions of SERVQUAL is still wildly used and effective service quality measuring scale in healthcare

sector and newly emerging dimensions, such as Convenience, Interaction and Care process, are close related to human connectivity, which indicates that the effectiveness and efficiency of patient-physician encounter are supposed to be seriously considered by the researchers and managers in later investigation.

2.4.4 Most influential dimensions of service quality in literature

In Table 2-3, for Research Area1, the Interaction is the most influential dimension of service quality in the studies, followed by the Convenience dimension. Whereas, no article indicates the Tangibility is the most influential dimension. Among the 43 articles of Research Area 2, the dimensions of Tangibility are involved in 13 articles which is the most while the Interaction is not involved in any article. We notice that there is not much difference in the number of the articles involved among the five traditional dimensions of SERVQAUL, which means that all five dimensions have the same impact on service quality among different studies.

All five dimensions of classic SERVQUAL, i.e., Tangibility, Reliability, Responsiveness, Assurance, Empathy, and another three dimensions, i.e., Convenience, Interaction and Care Process, totally eight, are mentioned among 52 articles as the most influential dimensions. The most influential dimensions concluded from the most studies (the studies not involving information technology) are Assurance and Tangibility, which indicates that the patients care most about the advanced level of hospital's hardware and doctor's clinical technics.

Tangibility is not mentioned as the most influential dimension even by one article in the context of study involving information technology adoption by patients or hospitals. The dimensions of Convenience and Interaction are considered most importantly by patients in clinics who adopt information technology, such as hospital-in-the-home unit (HHU), web-based appointment system, technology-based service encounters or other mHealth/ teleHealth technology (Chang & Chang, 2008; Cegarra-Navarro, Wensley, & Sánchez-Polo, 2011; Akter, D'Ambra, Ray, & Hani, 2012; Akter et al., 2013, Chang et al., 2015; Johnson & Russell, 2015; Joseph & Ganesan, 2015; Lanka, 2016; Yin, Huang, Shieh, Liu, & Wu, 2016).

Table 2-1 Literature on healthcare studies by searching group 1

Study		Objective	Methodology/approach	Major findings	Service quality dimension	Observed most or least influential dimensions
1	(Akter et al., 2012)	To model the impact of mHealth service quality on satisfaction, continuance intentions and quality of life.	The conceptual model is rooted in the traditional cognition–affective–conation chain but explicitly incorporates convenience, confidence, cooperation, care and concern as the primary dimensions of mHealth quality. The model is validated in the context of a business-to-consumer mHealth services using partial least service qualityuares path modeling.	The 'convenience', the dimension of service quality, emerges as the strongest component, suggesting that patients must have instant access to this healthcare delivery platform. The 'confidence' as a key component of overall service quality, suggests that the behaviours of the provider must establish confidence among the patients. This finding is consistent with other satisfaction studies, indicating that more assurance from physicians can improve the level of overall quality perception (Andaleeb 2001).	convenience, confidence, cooperation, care and concern/privacy	The 'convenience' emerges as the strongest dimension of service quality.
2	(Akter et al., 2013)	To explore service quality in mHealth to develop a scale for health services.	To theoretically conceptualize and empirically validate a multidimensional service quality scale in the mHealth context.	The mHealth service quality consists of three primary dimensions and eight subdimensions (System quality: reliability, efficiency and privacy; Interaction quality: cooperation, confidence and care; Information quality: Utilitarian benefits and	System quality: reliability, efficiency and privacy; Interaction quality: cooperation, confidence and care; Information quality: Utilitarian benefits and Hedonic benefits	Interaction quality: cooperation, confidence and care; Information quality: Utilitarian benefits and Hedonic benefits influence more on service.

				Hedonic benefits). The mHealth service quality scale is more effective at predicting satisfaction and continuance.		
3	(Cegarra-Navarro et al., 2011)	To examine crucial links between health information technologies (HITs) and quality of service provided through an empirical investigation of 252 patients in a hospital-in-the-home unit (HHU) in a Spanish regional hospital.	To test the relationship between HITs and the quality of service using factor analysis and structural equation modeling (SEM) to investigate how HITs mediate effects of organizational learning on quality of service.	Improved quality of service and more successful implementation of HITs can be achieved in other healthcare settings if patients are directly involved in organizational learning process (exploration and exploitation of knowledge).	physical facilities; service performance ability; prompt and helpful service; ability to inspire trust and confidence; and caring individual attention.	Interaction-related dimensions most affected by information technology on service quality.
4	(Chang et al., 2015)	To investigates the factors affecting the user acceptance of web-based appointment system (WAS) by integrating the Technology Acceptance Model (TAM) with the constructs of service quality.	To proposes a research framework that describes the user acceptance of WAS, which is verified via an empirical survey	Regardless of whether the users are veterans or novices of the Internet, web site quality will substantially influence the success and failure of WAS.	User experience, website quality, service quality (website presentation efficiency, response time, speed of providing services, and system security and effectiveness)	Weibsite quality (Convenience) influence the WAS most
5	(Chang & Chang, 2008)	To investigate whether technology-based service encounters have a positive impact on service quality and patient satisfaction; To scrutinize whether network security contributes a moderating effect between service quality and patient	To implement the Service Encounters Evaluation Model, the European Customer Satisfaction Index, the Attribute Model and the Overall Affect Model for model inference and use SPSS 11.0 and the Linear Structural Relationship	the impact of electronic workflow (online appointment system service) on service quality was greater than electronic facilities (electronic medical record systems) in technology-based service encounters. Convenience and	Reliability, Credibility, Customization, Convenience	Convenience and credibility are the most important factors of service quality in technology-based service encounters that patients demand.

		satisfaction.	Model (LISREL 8.54) to analyze and evaluate the data.	credibility are the most important factors of service. Network security contributes a positive moderating effect on service quality and patient satisfaction.		
6	(Johnson & Russell, 2015)	to determine which process attributes, affect overall patient satisfaction.	Quality service was measured by five dimensions and related constructs. Confirmatory factor analysis and structural equation modeling were applied to identify the factors that impact overall patient satisfaction at the clinics from 18 diverse medical clinics in a rural, Midwestern U.S. healthcare system.	strongest impact is the care provider's interaction with the patient.	Administrative processes, patient flow, patient safety and health, care provider and nurse	strongest impact is the care provider's interaction with the patient.
7	(Joseph & Ganesan, 2015)	to understand the different criteria that are discriminates the cluster of patients based on satisfaction.	Reliability and validity test were conducted, and cluster and discriminant analysis were applied to test the hypotheses.	Service encounter, core service, reputation, image, technology, and pricing are the major factors which discriminate between low and medium satisfaction groups/clusters. Convenience and recommendation are the other set of factors that discriminate moderate to high satisfaction clusters.	Service encounter, core service, reputation, image, technology, pricing, convenience, recommendation.	Service encounter, core service, reputation, image, technology, and pricing had more influences on low and medium satisfaction groups/clusters while convenience and recommendation on moderate and high satisfaction clusters.

8	(Lanka, 2016)	attempts to determine factors affecting patient satisfaction in public health service organizations (PHSOs)	To create a mathematical equation model for factors of patient satisfaction, which is core services, human element, non- human element and servicescape. Then to test reliability and validity of items & factors of patient satisfaction.	core services, human element of the service and non- human of the service factors explain 94% of total variation for patient satisfaction.	core services (Core benefit, problem solving and core feature), human element (Reliability, responsiveness, assurance, recovery, empathy, critical incidence), non-human element (Process, procedure, system) and servicescape(Sign/ symbol, space, layout of units, interior décor, exterior décor, entertainment/ music, food, condition of bed sheet & pillow)	responsiveness, process, system, technology and music had more impaction on satisfaction.
9	(Meesala & Paul, 2016)	To identify the most critical factors in hospitals related to service quality	Data were from the patients who received services from 40 different private hospitals in Hyderabad, India. Five dimensions of SERVQUAL, patient satisfaction and loyalty to the hospital were analgised on AMOS V20 to calculate path coefficients, direct and indirect effects of the variables on patient's satisfaction and loyalty to the hospital.	reliability and responsiveness (not empathy, tangibility, and assurance) impact patients' satisfaction. Patient's satisfaction is directly related to patients' loyalty to the hospital.	tangibility, reliability, responsiveness, assurance and empathy	reliability and responsiveness impact patients' satisfaction most.
10	(Panchapakesan, Sai, &	to investigate the moderators and mediators	To employ a questionnaire-survey approach to obtain the	Attendants provide physical and mental support to	Infrastructure, personnel quality,	Infrastructure and clinical care acquired

	Rajendran, 2015)	in the context of healthcare service quality from the perspectives of patients and their attendants in India.	perceptions of patients and attendants.	patients, which result in patients' satisfaction with the hospital's services.	process of clinical care, administrative procedures, safety indicators, hospital image, social responsibility, trustworthiness of the hospital.	highest scores from both perspective of patients and attendants.
11	(Kim, Cho, Ahn, Goh, & Kim, 2008)	To explore the factors of quality affecting the value of care and patient satisfaction, and test the correlations among the value of care, patient satisfaction and intention to re-visit in large-size hospitals.	To use interview data obtained from outpatients in a large-sized university hospital located in Seoul, Korea with approximately 1000 hospital beds. In addition, this study uses the causal relationship model for the analysis.	Medical services quality is shown partially to precede the value of care, and the value of care is shown to have a significant influence on patient satisfaction and re-visit intention.	Medical doctor, Procedure of care, Hospital facility, Reliability	only reliability and procedure of care are shown to have a positive effect upon the value of care. only the medical doctor, reliability and procedure of care, exclusive of hospital facility, are shown to have a positive effect upon patient satisfaction.
12	(Yin, Huang, Shieh, Liu, & Wu, 2016)	to evaluate patients' attitudes and perceptions toward the use of telehealth services.	To combine service quality model and importance-performance analysis to evaluate telehealth services provided by a case hospital.	The tangibles play less importance in patient perceived quality while reliability, empathy and assurance do most.	tangibility, reliability, responsiveness, assurance and empathy	The tangibles play less importance in patient perceived quality while reliability, empathy and assurance do most.

Table 2-2 Literature on healthcare studies by searching group 2

Study		Objective	Methodology/approach	Major findings	Service quality dimension	Observed most or least influential dimensions
13	(Aghamolaei et al., 2014)	to determine the service quality gap of the main hospital of Hormozgan province.	This cross-sectional study was conducted in 2013 in Bandar Abbas ShahidMohammadi Hospital in the south of Iran. All 96 participants of this study were provided by SERVQUAL questionnaire. Data was analyzed by Wilcoxon and Kruskal-Wallis tests.	The highest perception was in assurance and the highest expectation was in Responsiveness and assurance. Also, the lowest perception was in responsiveness and the lowest expectation was about empathy.	responsiveness, assurance, reliability, empathy and tangibility	The highest perception was in assurance and the highest expectation was in Responsiveness and assurance. Also, the lowest perception was in responsiveness and the lowest expectation was about empathy.
14	(Ajam et al., 2014)	to determine the quality gap in healthcare services provided by Shahid Elmi Field Hospital	100 patients admitted to the hospital in 2011 were selected randomly for the study. The data were gathered through SERVQUAL Standard Questioner	The processes related to delivery of services, in all dimensions of services' quality particularly responsiveness and assurance, should be identified and reengineered.	responsiveness, assurance, reliability, empathy and tangibility, access	In responsiveness and access, the highest gap existed between expectation and perceived performance.
15	(Al-Borie & Damanhouri, 2013)	to provide guidelines to the on-going Saudi Arabian health service reorganization	To employ a stratified random sample (1,000 inpatients) from five Saudi Arabian public and five private hospitals. Data were collected through questionnaire	the SERVQUAL instrument proved to be reliable, valid and appropriate. The results showed that sex, education, income and occupation were statistically significant in influencing inpatients'	tangibles, reliability, responsiveness, safety and empathy	The best and worst service quality dimension in public hospitals were tangibles and medical specialization. accessible locations and

			using the SERVQUAL scale.	satisfaction		patients' individual interest respectively in private hospitals. sex, education, income and occupation were statistically significant in influencing inpatients' satisfaction.
16	(Al-Neyadi, Abdallah, & Malik, 2016)	to evaluate the quality of healthcare services by investigating the factors affecting patient satisfaction in private and public hospitals in the UAE	A modified SERVQUAL questionnaire was used to gather the research data. The respondents of the study consisted of 127 patients who have been admitted within the last 6 months prior to the onset of the investigation.	assurance was rated the highest while responsiveness the least	tangibles, reliability, responsiveness, assurance and empathy	assurance was rated the highest while responsiveness the least
17	(Altuntas, Dereli, & Yilmaz, 2012)	To measure hospital service quality by using analytic hierarchy process (AHP) and analytic network process (ANP)	our hospitals are selected randomly for each class and then, a questionnaire based on the SERVQUAL model is conducted for each class to measure perceived service quality with respect to five major criteria, namely tangible, reliability, responsiveness, assurance and empathy	empathy is the most important service quality dimension	tangible, reliability, responsiveness, assurance and empathy	empathy is the most important service quality dimension

18	(Artt, Metodolojisi, Skalas, Yakla, & Uygulama, 2012)	to develop a methodology to improve the quality of healthcare service sector by adapting the SERVQUAL scale parameters to TRIZ in the light of the study by Su et al. (2008).	Firstly, to confirm determinants of SERVQUAL scale with the analogical explanations of the 39 TRIZ engineering parameters. Then, Questionnaire was applied to ten doctors (three of them are Professors (academic) and the rest of them are regular doctors) at the Atatürk University Hospital in Turkey. Finally, a case study was conducted to show how to apply this new innovative approach.	To provide an alternative solution to improve the quality of healthcare service easily with promising future with future study.	Competence, communication, courtesy, credibility, responsiveness, security, understanding and tangibles	Responsiveness need be improved and contradicted with security
19	(Anbari, Mohammadi, & Taheri, 2014)	to determine the different dimensions of service quality in hospitals of Iran and evaluate the service quality from patients' perspective.	A cross-sectional study was conducted during November and December 2012. The study sample was composed of 385 patients randomly selected from 3 general teaching hospitals in Arak, Iran. SERVQUAL questionnaire which covers service quality dimensions was employed to collect data.	The highest expectation and perception were related to the responsiveness dimension while the lowest expectation and perception were related to the reliability dimension.	tangible, reliability, responsiveness, assurance and empathy	The highest expectation and perception were related to the responsiveness dimension while the lowest expectation and perception were related to the reliability dimension.

20	(Ayoubian, Dopeykar, Mehdizadeh, Hoseinpourfard, & Izadi, 2015)	to analyze the gap between the expectations and reality on five dimensions of health care in a military medical center.	This cross-sectional study was carried out in a military medical center in 2013. A random sample of 104 patients were enrolled. Data gathering was done using a standard SERVQUAL questionnaire.	The service quality gap needs greater attention especially in the accessibility dimension.	tangible, reliability, responsiveness, assurance and empathy	the highest gap was considered in the Accessibility dimension and the lowest gap was considered in the Assurance dimension.
21	(Babakus & Mangold, 1992)	to report the results of a study that examined the usefulness of the SERVQUAL scale for assessing patients' perceptions of service quality in the hospital environment.	The scale was subjected to extensive reliability and validity assessment.	SERVQUAL, a standard instrument for measuring functional service quality, is reliable and valid in the hospital environment and in a variety of other service industries.	tangible, reliability, responsiveness, assurance and empathy	Patints have the highest expection in Assurance dimension
22	(Christoglou, Vassiliadis, & Sigalas, 2006)	to use the SERVQUAL and the Kano research techniques to test hospital service quality.	a Kano analysis of 75 patients from the General Hospital of Katerini in Greece is presented. The service quality criterion used satisfaction and dissatisfaction indices.	the courtesy of the hospital employees and their ability to convey trust and confidence play key role in enhance service quality	tangible, reliability, responsiveness, assurance and empathy	Tangible and assurance are proved to be higher in importance
23	(Gholami, Kavosi, & khojastefar, 2016)	to evaluate health care services quality in this unit to find out whether the patients have different expectations from health care providers and if they perceive some dimensions of care more important than	the SERVQUAL scale method was used in this cross-sectional study on 100 patients in June 2015. Statistical analyses included descriptive statistics, paired and independence sample t-	the hospital management should provide appropriate facilities, reduce waiting time, increase in attention to ordering system based on the patients' condition	tangible, reliability, responsiveness, assurance and empathy	the largest quality gap was responsiveness and the lowest belonged to assurance

		others.	test and ANOVA at the significance level 0.05.			
24	(Güllü et al., 2017)	to examine the quality of service provided by a private physical therapy and rehabilitation center located in the provincial center of Ankara, Turkey, and to evaluate patient satisfaction there with the SERVQUAL scale.	to evaluate the quality of the service provided by the private physical therapy and rehabilitation center by SERVQUAL	physical appearance represents an important dimension of the quality of service	tangible, reliability, responsiveness, assurance and empathy	Except for tangible, the rest of dimensions are much lower.
25	(Lam, 1997)	to demonstrate the use of SERVQUAL for measuring patients' perceptions of health care quality in Hong Kong.	To examine the validity, reliability and predictive validity of SERVQUAL and analyze its applicability to the health care sector in Hong Kong.	To indicate that SERVQUAL appears to be a consistent and reliable scale to measure health care service quality. However, the proposed five dimensions of SERVQUAL are not confirmed.	tangible, reliability, responsiveness, assurance and empathy	physical elements are highest, while Timely, professional and competent service need be improved
26	(Lee, 2005)	to test the applicability of the SERVQUAL conceptualization to a less studied area–medical service in a developing country.	A modified version of SERVQUAL was designed for this study. Data were collected from residents of a major city in Ukraine.	failed to either confirm the presence of the five dimensions of SERVQUAL or demonstrate the contextual stability of those dimensions.	tangible, reliability, responsiveness, assurance and empathy	a new factor dealing with "access convenience" emerged

27	(Li et al., 2015a)	To investigate patients' perception of service quality at hospitals in nine Chinese cities and propose some measures for improvement.	the ServQual scale method was used in a survey involving patients at out- patient and in-patient facilities in nine hospitals across china.	Visitors to out-patient facilities re-ported more positive perception than visitors to in-patient facilities on tangibles and reliability. Patients of 60 years of age and above reported more positive perception than those between 40 and 49 on reliability, assurances and empathy. Empathy and reliability most strongly predicted perception of service quality.	tangible, reliability, responsiveness, assurance and empathy	Empathy and reliability most strongly predicted perception of service quality.
28	(Lonial, Menezes, Tarim, Tatoglu, & Zaim, 2010)	To evaluate the overall reliability, validity, dimension importance of SERVQUAL in an economic and cultural environment different from the US, that is Turkey, in the context of a hospital setting.	confirmatory factor analysis, measures of internal consistency and discriminant validity, the relationships between the various dimensions of SERVQUAL, an overall measure of service quality and patient loyalty are evaluated using structural equations modeling and path analysis.	SERVQUAL and its dimensions of perceived service quality are reliable and valid across cultural and economic environments in the context of healthcare/hospital	tangibility, reliability, responsiveness, assurance, courtesy and empathy	'assurance' was the most important dimension
29	(Manulik, Rosińczuk , & Karniej, 2016)	to determine if patients from state and private health care facilities differed in terms of their qualitative priorities and assessments of received	The study included a total of 412 patients: 211 treated at a state facility and 201 treated at a private facility. Each of the respondents	The private facility respondents had the highest expectations with regard to equipment, and the state facility ones regarding contacts with the medical	tangible, reliability, responsiveness, assurance and empathy	Nonpublic facility customers have the highest expectations concerning quality in respect of equipment and infrastructure, while

		services.	completed a 5-domain, 22-item SERVQUAL questionnaire.	personnel.		public facility customers have the highest expectations in respect of relations with medical staff.
30	(Mashhadi abdol, Sajadi, & Talebi, 2014)	to identify and assess the factors affecting hospitals' service quality besides assessing the presence or absence of dissension among patients' perspectives and staffs' viewpoints.	After studying the literature, the factors affecting hospitals' service quality are identified and the significance of these factors has been examined from the perspective of patients and staff through a questionnaire.	although staff considered the current service unfavorable, the patients evaluated the available service quality was higher than the average level.	tangible, reliability, responsiveness, assurance and empathy	'keeping the patients' records confidentially', of assurance dimension, has the highest scores
31	(Matin, Rezaei, Moradinazar, Mahboubi, & Ataee, 2016)	to evaluate the quality of health services provided in urban health centers in Kermanshah province, West of Iran.	Among fourteen towns of Kermanshah province, three towns were randomly chosen. then, three health center were chosen in each town and each health center included 45 participants. Data was collected by SERVQUAL questionnaire. The collected data was statistically analyzed by STATA V.12 Software.	it is suggested that the planners and managers of health centers must improve the timeliness of the delivery of care and enhance the communication skills of staff members in order to increase the quality of the services provided.	tangible, reliability, responsiveness, assurance and empathy	The highest and lowest gaps were found in the assurance and empathy dimensions. The highest and lowest mean score of perception were associated with assurance and responsiveness. Also, the highest and lowest mean score of expectation were associated with assurance and empathy, respectively.

32	(Oliaee et al., 2016)	to investigate the quality of midwifery services from the viewpoint of the clients, under coverage of health care centers in Isfahan, through SERVQUAL model.	This descriptive and analytical study was conducted on 218 subjects in 2014. Study population comprised the women referring to midwifery services clinics in health care centers in Isfahan.	The widest gap was tangibles, and the narrowest gap was assurance. There was no significant association between the scores of expectations and perceptions, and age, education level, occupation, and marital status.	tangibles, reliability, responsiveness, assurance, and empathy	The widest gap was tangibles, and the narrowest gap was assurance.
33	(Pakdil & Harwood, 2005)	To measure patients' expectations and perceptions about services delivered in a hospital-based preoperative assessment clinic.	To develop a paper-and-pencil and self-administered questionnaire based upon SERVQUAL. Spearman rank correlations with an alpha level statistical significance of 0.05 were performed to test for associations between age group, visit number, gender, and the survey questions.	most highly ranked expectation is ‘adequate information about their anesthesia and surgery’, and the second one is ‘adequate friendliness, courtesy’. These areas contained relatively low gaps between perceptions and expectations. The largest gap occurred between the expectation of clinic waiting time and overall quality perceived. SERVQUAL is useful.	tangibles, reliability, responsiveness, Competence, Courtesy, Credibility, Security, Access, Communication, Understanding the customer	Long waiting time, Crowded waiting area, Lack of magazines in the waiting area are the three aspects patients think need improve most.
34	(Pansiri & Mmereki, 2010)	To use the SERVQUAL model to evaluate the implementation of Work Improvement Teams (WITs) in the hospitals/clinics as a reform initiative adopted by the Botswana government	To measure the level of service quality and customer satisfaction using the SERVQUAL model through data that were collected from 151 hospital/clinic customers in Gaborone, the capital city of the Republic of	the adoption and implementation of reforms in the public health sector have not improved the level of service quality and customer satisfaction	tangibles, reliability, responsiveness, assurance, and empathy	Expectation is lower than perception across dimensions. The largest gap lies in assurance while the lowest gap in tangibles.

			Botswana. Descriptive and inferential statistics were used to analyze the data			
35	(Purcărea, Gheorghe, & Petrescu, 2013)	to explore the application of the original SERVQUAL scale in the context of public health care services in Romania.	To select the sample respondents from a list of a gynecological health care forum members, namely women from Bucharest who should have posted messages on the chosen forum no more than three months before the study was conducted and the messages should have comprised their experiences with certain physicians. The internal consistency, validity and reliability of the SERVQUAL scale were assessed with the Cronbach's alpha values and factor analysis.	the biggest gap score was registered by the tangibles dimension followed by responsiveness dimension and reliability dimension.	tangibles, reliability, responsiveness, assurance, and empathy	the biggest gap score was registered by the tangibles dimension followed by responsiveness dimension and reliability dimension.
36	(Reidenbach & Sandifer-Smallwood, 1990)	To employ a modified SERVQUAL approach to understanding the relationships among patients' perceptions of inpatient, outpatient, and emergency room services and their	Applying SERVQUAL scale of 10 dimensions to measure the service quality perception of 300 patients by telephone survey.	"patient confidence", which is patients' sense of wellbeing, security, expectations, the skill of persons attending the patient, and several items relating to the extent and thoroughness	Patient confidence, business competence, treatment quality, support services, physical appearance, waiting time, empathy	Outpatient: patient confidence; emergency room: patient confidence; inpatient: patient confidence, physical appearance

		overall perceptions of service quality, satisfaction with their care, and willingness to recommend the hospital's services to others.		of communication, has a significant impact on nearly all measures of patient satisfaction.		
37	(Rezaei et al., 2016)	to assess the quality of the service of educational hospitals affiliated with Kermanshah University of Medical Sciences in 2015	the perspectives of 400 patients were assessed about the quality of the services provided by educational hospitals in Kermanshah (western Iran) in 2015. The quality was assessed by the SERVQUAL questionnaire with five dimensions.	To improve the quality of healthcare is possible by various policies, such as good responsiveness, access to health workers, and delivering healthcare in less time.	tangibles, reliability, responsiveness, assurance, and empathy	There were negative gaps in all five dimensions. The highest and lowest gaps in the mean score were found in the assurance and responsiveness dimensions. The patients ranked responsiveness as the most important dimension of the quality of healthcare.
38	(Węgłowski, Zwolińska, Karniej, Nocuń-Wasilewska, & Polak-Jonkisz, 2016)	to determine differences in service quality, as evaluated by hospitalized patients.	a standard sheet of 22 SERVQAUL statements was used, and an analysis of the validity of 5 quality areas important for the patient was conducted in a lower silesian hospital in a group of 29 young patients (women: 16, men: 13, average age: 16) diagnosed with kidney disease.	The gaps were visible in all five service quality dimensions. the most important dimension is reliability， the least is material dimension, tangibles.	tangibles, reliability, responsiveness, assurance, and empathy	The gaps were visible in all five service quality dimensions. the most important dimension is reliability， the least is material dimension, tangibles.

39	(Kalaja, Myshketa, & Scalera, 2016)	to assess the quality of services in the public regional hospital of Durres	use SERVQUAL to measure the perceived quality of 200 hospitalized patients between July and September 2015.	without significant differences between expectations and actual perceptions of patients. All five dimensions of service quality were significant in explaining patient satisfaction.	empathy, tangibility, responsiveness, assurance and reliability	the highest impact has the empathy dimension
40	(Li et al., 2015b)	to establish criteria for evaluating satisfaction of medical staff and patients of Chinese hospitals and propose measures for improvement.	use SERVQUAL to measure the perceived quality among medical staff and patients of infectious disease hospitals in three locations	The clinicians were less satisfied with the hospitals than the patients. Medical staff and patients in Shanghai were relatively more satisfied.	tangibles, reliability, responsiveness, assurance, and empathy	At all three hospitals, patients showed low levels of satisfaction with responsiveness and empathy
41	(Mečev & Goleš Kardum, 2015)	to examine customers' perceptions of primary healthcare service quality in public institutions in the city of Šibenik.	Empirical study conducted in primary care service by SERVQUAL	primary healthcare public institutions need to improve all the dimensions of SERVQUAL. age and gender do not generate significant differences in the perception of service quality, yet employment status and frequency of using services do.	tangibles, reliability, responsiveness, assurance, and empathy	examinees had the highest expectations from tangible elements of medical services
42	(Papanikolaou & Zygiaris, 2014)	To test the internal consistency and applicability of SERVQUAL in primary health care centers in	Empirical study conducted using SERVQUAL in particular public Primary Health Care center of	There were gaps in all dimensions measured by SERVQUAL and also differences depending on gender, age and education	tangibles, reliability, responsiveness, assurance, and empathy	The largest gap was detected in empathy.

		Greece.	IKA located in a heavily populated urban area of Attica between July and September 2009	levels.		
43	(John, Yatim, & Mani, 2011)	To investigate patients' perceived service quality in public dental health care	A modified SERVQUAL 20-item instrument was used to assess 481 dental outpatients' expectations before and perceptions after receiving dental treatment in Kelantan, Malaysia.	patients visiting for management of dental pain were more satisfied than those visiting with appointment. There was a significant difference between the patients' expectations and their perceptions of service provided regarding all dimensions.	tangibles, reliability, responsiveness, assurance, empathy, service outcome, caring service, teamwork, and professionalism	the most significant service quality dimensions were related to responsiveness, assurance, and empathy
44	(Ye & Direktör, 2010)	to test the dimensionality of the SERVQUAL instrument in the Northern Cyprus health care industry, to assess the service quality provided in public and private hospitals in Northern Cyprus and to identify the service quality dimensions that play important role on patient satisfaction.	Empirical study conducted using SERVQUAL to measure 806 systematically selected people above the age of eighteen.	revealed a three-factor solution, namely; reliability-confidence, empathy and tangibles.	tangibles, reliability, responsiveness, assurance, and empathy	reliability- confidence dimension is significantly effective on satisfaction both in public and private hospitals.
45	(Borges, Carvalho, & Silva,	To evaluate the quality of service provided to patients of heart surgery	The SERVQUAL-Card scale was validated statistically. The preoperative expectations	a significant relationship between quality of service and gender, and age,	Reliability, Safety, Assistance, Empathy, Tangibility	reliability

	2010)	during their hospital stay, in the SUS service	and perceptions of care received in the 6th day after surgery measured by applying the modified SERVQUAL (SERVQUAL-Card).	reliability		
46	(Miranda, Chamorro, Murillo, & Veja, 2010)	To measure the perceptions of the service quality by both the users and the health center managers in Spain	The adapted SERVQUAL to measure service quality	The significant associations were found between the service quality dimensions and patient satisfaction.	Health staff, Efficiency, Non-health staff, Facilities	the health staff and the healthcare center's efficiency are the most important attributes for user satisfaction.
47	(Lee & Yom, 2007)	to compare the nursing service quality, satisfaction and intent to revisit the hospital perceived by hospitalized patients and nurses in Korea.	SERVQUAL scale, an overall satisfaction and intent to revisit the hospital questionnaires were used. The sample consisted of 272 patients and 282 nurses.	Overall, nurses' expectations and performance were higher than those of patients, while patients' overall satisfaction with nursing and medical care was higher than that of nurses.	tangibles, reliability, responsiveness, assurance, and empathy	The reliability is the most important of the five dimensions of service quality, and that tangibility is the least important.
48	(Lin, Xirasagar, & Laditka, 2004)	To compare patient perceptions of service quality at solo and group practices, and to examine the association of perceptions with 'potential patient loyalty' (PPL)	A self-administered, cross-sectional survey of clinic outpatients, using an adapted SERVQUAL on overall satisfaction and intent to return/recommend the clinic to others.	group practice patients perceived significantly higher service quality on all dimensions relative to solo practice patients	tangibles, reliability, responsiveness, assurance, and empathy	The reliability influence PPL most.
49	(Geertzen et al., 2002)	to assess consumer/patient satisfaction with the services of the prosthetics and orthotics (P&O) facilities in	measuring patients perceived quality by using a modified SERVQUAL and an overall rating of	The degree of consumer overall satisfaction was not related to age, gender, and type of assistive device or "length of relationship of	tangibles, reliability, responsiveness, assurance, and empathy	The tangibles influence satisfaction most.

		the north of the Netherlands	satisfaction	consumer" and P&O facility.		
50	(Andaleeb , 2001)	To identify the service quality factors that are important to patients and to examine their links to patient satisfaction in the context of Bangladesh.	A field survey was conducted by modified SERVQUAL	The significant associations were found between the five dimensions and patient satisfaction.	Responsiveness, Assurance, Communication, Discipline and Baksheesh	Discipline, as an extension of the ‘‘tangibles’’ dimension, had the greatest impact on customer satisfaction
51	(Pot, Van Harten, Seydel, & Snoek, 1999)	to develop a standardized, valid and reliable instrument for determining needs of patients and quality of care as perceived by patients	An empirical study was conducted by modified SERVQUAL for twenty-four spinal cord injured patients, staying at a Dutch rehabilitation center	the developed questionnaire the perceived quality of care according to the service quality Model can be assessed.	Credibility, tangible, access, communication, understanding/knowing the patient, flexibility, courtesy, security, competence and information supply	Reliability and access related to global judgment about quality of care most
52	(Aliman & Mohamad, 2013)	to examine the mediation effect of satisfaction on service quality perception and intentions behavior of private hospital outpatients in Malaysia.	300 hospital outpatients were selected as the sample size. Regression analysis was run to test the hypotheses.	the results provide support for the association between perceived service quality dimensions (tangibles, assurance, and empathy) and behavioral intentions. The results also confirm that service quality perception is an antecedent of intentions.	tangibles, reliability, responsiveness, assurance, and empathy	Assurance affect satisfaction most

Table 2-3 The sum of the most influential service quality dimension of each study

			Service Quality Dimensions							
	No.		Ta	Rl	Rp	As	Em	Co	In	CP
Articles involving information technology	1	(Akter et al., 2012)						X		
	2	(Akter et al., 2013)							X	
	3	(Cegarra-Navarro et al., 2011)							X	
	4	(Chang et al., 2015)						X		
	5	(Chang & Chang, 2008)				X		X		
	6	(Johnson & Russell, 2015)							X	
	7	(Joseph & Ganesan, 2015)						X	X	
	8	(Lanka, 2016)			X				X	X
	12	(Yin et al., 2016)		X		X	X		X	
subtotal			0	1	1	2	1	4	6	1
Articles without involving information technology	9	(Meesala & Paul, 2016)	X		X					
	10	(Panchapakesan et al., 2015)	X							X
	11	(Kim et al., 2008),	X	X						X
	13	(Aghamolaei et al., 2014)			X	X				
	14	(Ajamet al., 2014)			X		X			
	15	(Al-Borie & Damanhouri, 2013)	X			X		X		
	16	(Al-Neyadi et al., 2016)				X				
	17	(Altuntas et al., 2012)					X			
	18	(Artt et al., 2012)			X					
	19	(Anbari et al., 2014)			X					
	20	(Ayoubian et al., 2015)					X			
	21	(Babakus & Mangold, 1992)				X				
	22	(Christoglou et al., 2006)	X			X				
	23	(Gholami et al., 2016)			X					
	24	(Güllü et al., 2017)	X							
	25	(Lam, 1997)	X	X				X		
	26	(Lee, 2005)						X		
	27	(Li et al., 2015a)		X			X			
	28	(Lonial et al., 2010)				X				
	29	(Manulik et al., 2016)	X	X						
	30	(Mashhadiabdol et al., 2014)				X				
	31	(Matin et al., 2016)				X				
	32	(Oliaee et al., 2016)	X							
	33	(Pakdil & Harwood, 2005)						X		
	34	(Pansiri & Mmereki, 2010)				X				
	35	(Purcărea et al., 2013)	X							

	36	(Reidenbach & Sandifer-Smallwood, 1990)				X				
	37	(Rezaei et al., 2016)			X					
	38	(Węgłowski et al., 2016)		X						
	39	(Kalaja et al. 2016)					X			
	40	(Li et al., 2015b)			X		X			
	41	(Mečev & Goleš Kardum, 2015)	X							
	42	(Papanikolaou & Zygiaris, 2014)					X			
	43	(John et al., 2011)			X	X	X			
	44	(Ye & Direktör, 2010),		X						
	45	(Borges et al., 2010)		X						
	46	(Miranda et al., 2010)		X						
	47	(Lee & Yom, 2007)		X						
	48	(Lin et al., 2004)		X						
	49	(Geertzen et al., 2002)	X							
	50	(Andaleeb, 2001)	X							
	51	(Pot et al., 1999)		X						
	52	(Aliman & Mohamad, 2013)				X				
Subtotal			13	11	9	12	8	4	0	2
Total			13	12	12	14	9	8	6	3

Note: Ta=Tangibility; Rl=Reliability; Rp=Responsiveness; As=Assurance; Em=Empathy; Co=Convenience; In=Interaction; CP=Care Process

Table 2-4 The relationship between patient demographical information and service quality

Articles		Association between patient demographical information and service quality					
		age	gender	education	marital status	employment	income
9	(Meesala & Paul, 2016)	X	O		X		
13	(Aghamolaei et al.,	X	X	X		X	
15	(Al-Borie & Damanhouri, 2013)		O	O		O	O
23	(Gholami et al., 2016)						
24	(Güllü et al., 2017)	X	X	O		X	O
27	(Li et al., 2015b)	X					
32	(Oliaee et al., 2016)	X		X	X	X	
41	(Mečev & Goleš Kardum, 2015)	X	X			O	
42	(Papanikolaou & Zygiaris, 2014)	O	X	O			
43	(John et al., 2011)	O	O	O		O	O
45	(Borges et al., 2010)	O	O				
49	(Geertzen et al., 2002)	X	X				

Note: “O” denotes that the demographical item has association with service quality; “X” denotes that the demographical item has no association with service quality

Table 2-5 SERVQUAL or its adapted as dependent variable in the studies

Articles		Independent variables	Mediating variables	Dependent variables (dimensions of SERVQUAL or its adapted)	Results
3	(Cegarra-Navarro et al., 2011)	Organizational learning	health information technologies (HITs)	quality of service	the relationship between organizational learning and quality of service can be mediated by HITs.
5	(Chang & Chang, 2008)	technology-based service encounters, network security		service quality	Technology-based service encounters have a positive impact on service quality, but not patient satisfaction.
53	(Steffen & Nystrom, 1997)	Ownership, major source of payment, facility size, nurse staffing		service quality	Service quality existed significant associations with each of the four organizational factors.
54	(Niedz, 1998)	human resource practices, autonomy in practice, patient satisfaction with nursing care, organizational climate for service		service quality	Patient satisfaction with nursing care and patients' perceptions of organizational climate for service were each positively related to patients' perceptions of service quality.
55	(Ancarani et al., 2009)	Organizational climate		Satisfaction (service quality)	both a model stressing openness, change and innovation and a model emphasizing cohesion and workers' morale are positively related to patient satisfaction, while a model based on managerial control is negatively associated with patient satisfaction.

56	(Ancarani et al., 2011)	managers' climate orientation	Organizational climate	Satisfaction (service quality)	there is evidence in favor of the mediating effect of climate between the managers' climate orientation and patient satisfaction.
57	(Wang, Cheng, & Huang, 2013)	Technology-based Service Encounters	Hospital image	Patient Satisfaction (service quality)	OAS technology-based service encounters, compared with hospital image, has a stronger effect on OAS patient satisfaction.
58	(Chen, Liu, Li, & Yen, 2013)	Perceived usefulness, perceived ease of use	Perceived usefulness	Relationship quality	perceived ease of use and perceived usefulness have significant influence on relationship quality
59	(Chen, Jong, & Lai, 2014)	Technology readiness		Relationship quality	both optimism and innovativeness significantly and positively influenced continuance intention through the mediating effect of relationship quality.
60	(Wu, Li, & Li, 2016)	Interaction Quality, Physical Environment Quality, Outcome Quality, Administration Quality, Perceived enjoyment		Experiential Quality	5 dimensions positively influence overall experiential quality. the effect of outcome quality on overall experiential quality is not supported

Note: the dimensions of (Ancarani et al., 2009 & 2011) are traditional five dimensions of service quality; the measuring items of Patient Satisfaction(Wang et al., 2013) belong to the concept of patients-physician encounter in service quality.

Table 2-6 SERVQUAL or its adapted as independent variable in the studies

Articles		Independent variables (dimensions of SERVQUAL or its adapted)	Mediating variables	Dependent variables (e.g., satisfaction, relationship, treatment outcome)	Results
1	(Akter et al., 2012)	mHealth service quality		satisfaction (SA), continuance intentions (CI) and quality of life (QOL)	Overall service quality is a significant predictor of SA, CI and QOL
2	(Akter et al., 2013)	mHealth service quality	satisfaction	continuance	The strong impact of service quality on satisfaction and continuance, in which satisfaction was recognized as a strong mediator
4	(Chang et al., 2015)	service quality	perceived usefulness, perceived ease of use	intension of use	There is no prominent influence of service quality on “perceived usefulness” and “perceived ease of use”, and “perceived usefulness” is positively related to the “intention of use”.
5	(Chang & Chang, 2008)	service quality		patient satisfaction	Service quality has a positive effect on patient satisfaction.
6	(Johnson & Russell, 2015)	service quality (Process quality)	care provider, nurse assistant	overall satisfaction	care provider and nurse/assistant are significant predictors of overall patient satisfaction
7	(Joseph & Ganesan, 2015)	service quality (eight determinants)		patient satisfaction	Positively influence the overall satisfaction.
8	(Lanka, 2016)	service quality (four determinants)		patient satisfaction	Positively influence the overall satisfaction.
9	(Meesala & Paul, 2016)	service quality	patient satisfaction	patient loyaty to hospital	Reliability and responsiveness impact patients’ satisfaction. Patient's satisfaction is directly related to patients’ loyalty to the hospital.

10	(Panchapakesan et al., 2015)	service quality	patient satisfaction	behavior intention	A partial mediation effect of patient satisfaction on the relationship between service quality and patient's behavioural intention.
11	(Kim et al., 2008)	medical services quality	value of care, patient satisfaction	re-visit intention	Medical services quality is shown partially to precede the value of care, and the value of care is shown to have a significant influence on patient satisfaction and re-visit intention.
21	(Babakus & Mangold, 1992)	service quality		overall quality perceptions, intention-to-return	Both behavioural intentions and overall ratings correlated with perceptions and difference scores almost identically
28	(Lonial et al., 2010)	service quality	overall quality of hospital, feelings toward the hospitals' services	repatronage intention	all the relationships in the conceptual model, other than the relationship between perceived service quality and repatronage intention are supported. high perceived service quality does not necessarily translate into high repeated patronage (patient loyalty).
36	(Reidenbach & Sandifer-Smallwood, 1990)	service quality	satisfaction	recommendation	The service quality influences the satisfaction and recommendation positively and strongly, also the satisfaction affects recommendation.
47	(Lee & Yom, 2007)	service quality	Overall satisfaction	intent to revisit the hospital	There was a strong positive relationship between satisfaction with nursing and medical care and intent to revisit the hospital for both groups.
48	(Lin et al., 2004)	service quality		Potential patient loyalty	All service quality dimensions except assurance were significantly positively associated with PPL
49	(Geertzen et al., 2002)	service quality		overall satisfaction	The degree of consumer overall satisfaction was not related to age, gender, and type of assistive device or "length of relationship of consumer" and P&O facility.
50	(Andaleeb, 2001)	service quality		Satisfaction	significant associations were found between the five dimensions and patient satisfaction.
52	(Aliman &	service quality	patient	behavioral intentions	tangibility, reliability and assurance are important predictors of

	Mohamad, 2013)		satisfaction		satisfaction, and satisfaction has a strong positive relationship with intentions.
57	(Wang et al., 2013)	Patient Satisfaction (service quality)		patient loyalty	hospital image, compared with OAS technology-based service encounters and OAS patient satisfaction, has the largest influence on patient loyalty.
58	(Chen et al., 2013)	Relationship quality		continuance intention	The direct impact of relationship quality on continuance intention is also significant; the effect of mediation of relationship quality in the model is so strong.
59	(Chen et al., 2014)	Relationship quality		Continuance intention	both optimism and innovativeness significantly and positively influenced continuance intention through the mediating effect of relationship quality.
60	(Wu et al., 2016)	Experiential Quality	Patient trust, Perceived value, Patient satisfaction	behavioural intentions	Interaction quality, physical environment quality, administration quality, and perceived enjoyment positively affect overall experiential quality, which in turn, influences patient trust, patient satisfaction and perceived value, respectively. Secondly, experiential quality, patient trust and perceived value positively influence patient satisfaction. Finally, perceived value positively influences behavioural
61	(Faria & Mendes, 2013)	perceived service quality	Organizational Image	Satisfaction	Perceived service quality has both positive direct and indirect effects on satisfaction, confirming the partial mediation role played by organizational image in the relationship between service quality and customer satisfaction
62	(Kim et al., 2017)	service quality	treatment effectiveness, patient satisfaction	loyalty (intent to revisit)	The measured factors of physician performance and quality of service procedures had a positive effect on treatment effectiveness. Treatment effectiveness and satisfaction both positively influenced intent to revisit.

Note: the measuring items of Patient Satisfaction(Wang et al., 2013) belong to the concept of patients-physician encounter in service quality.

2.4.5 Convenience

Convenience is referred to the service supported by the hardware and software of hospitals that can facilitate the patients meeting their demands, such as reducing waiting time, easy information enquiry, convenient payment, etc. It's more tangibility-based but not the same as Tangibility in contents. For example, The Convenience has been defined by many authors or in different names. They are Convenience (Chang & Chang, 2008; Akter et al., 2010; Akter et al., 2012), Patient Flow (Johnson & Russell, 2015) and Waiting Time (Reidenbach & Sandifer-Smallwood, 1990; Faria & Mendes, 2013).

Concluded from the reviewed articles related to service quality in hospitals, we find the service quality dimension that patients care most is varying under the different contexts. Thus, we believe the definition of service quality is a dynamic conception that the dimensions contributing to the service quality are varied in different context. For example, the Tangibility and Assurance are the most concerned aspects from the patient point of view in general context. Yet in the context of hospitals or patients applying information technology, the Tangibility is the least patients care about while the concept of Convenience is what concern the patients most. Thus, the information technology plays the key role in promoting service quality by enhancing the convenience for the patients. In addition, among the measuring items of these constructs related to Convenience in literature, the items can basically be summarized by two sorts, "waiting time during clinical process" and "accessibility to clinical information", which are totally different from the items of five dimensions of SERVQUAL. So, Convenience can be added in service quality as a new dimension, especially in the hospital context. Because the patients who suffer the diseases intend to require more help to shorten the clinical process.

From what above analysed, we can know the service quality is a dynamic conception that its dimensions are different in varying contexts. The Convenience as a new dimension need be considered in the definition of service quality in healthcare sector.

2.4.6 Clinical process change and service encounter

The clinical process is usually regarded as one of the dimensions of service quality by researchers. It refers to patients' evaluation of medical process and their interaction with medical staff during their visits. The relevant variables introduced by the researchers in the

systematic literature review include Administrative Processes (Johnson & Russell, 2015), Administrative Procedures (Padma, Raiendran, & Sai, 2010; Panchapakesan et al., 2015), Process of Clinical Care (Padma, Raiendran, & Sai, 2010), Service Procedures (Kim et al, 2017), Quality of Administration Process (Rakhmawati & Sumaedi, 2013), Patient Flow (Johnson & Russell, 2015).These variables or dimensions mainly measure two aspects: one is about how patients experience the convenience or time-saving of the whole clinical process, such as queuing for consultation, queuing for taking medication, registration, examination process, payment, appointment; the other is about how efficient or rapid communication between patients and medical staff is, such as telephone help, consultation with doctors, medical advice and instructions from doctors.

As for the definition of the clinical process, it has the same meaning as the Service Encounter. The model of service encounter evaluation is mainly based on the definition of Shostack (1985), that is, the time when the customer interacts directly with the service, and the content can cover all aspects of the company that interact with the customer for a certain period of time, including employees and physical facilities. In the Marketing Mix theory, companies usually pay attention to four elements in order to achieve the purpose of selling products: product, price, promotion, place. However, services are produced and consumed at the same time, therefore, when customers interact with employees, they can only rely on tangible factors, such as physical facilities and employees (Shostack, 1977), to judge the ability of the company. Based on the above reasons, Booms and Bitner (1981) proposed an extended marketing mix model, which includes four traditional elements and three new elements: physical evidence (physical environment and all tangible clues), participants (all relevant human factors in service encounter, such as employees and customers) and process (activities, procedures, and mechanisms). The above seven elements constitute the dimensions of the model of service encounter evaluation.

With the progress of science and technology and marketing management, great changes have taken place in the way the company contacts customers. In recent years, some scholars use terms such as technology-based services, technology-driven service delivery and e-service contacts to describe technology-centered service encounter. More and more companies are using E-commerce and Internet technology to deliver their services, such as online retail shopping, ticket booking, and tracking mail packages (Babulak, 2006).

Similarly, the introduction of information technology in the medical field will inevitably change the way patients contact hospitals and medical staff, and changes the patient's

perception of the experience of the clinical process. Thus, the changes in the clinical process are a description of how patients perceive changes in the clinical process after using information technology. Considering the concept of clinical process, patients feel that changing services must be related to time savings and information acquisition in the clinical process, similar to the concept of convenience and interaction (Bitner, Brown, & Meuter, 2000) or the responsiveness, assurance and empathy of SERVQUAL. Therefore, the change of patients' experience in clinical process is inevitably related to the perception of service quality. If patients use information technology to change the perception of clinical processes or clinical services, it may affect patients' perception of quality of service. The hospitals that use information technology have indeed changed the way they serve patients and created new ways of communicating between patients and medical staff. As a result, patients will feel that new clinical services are very different from the past, which may change the patient's perception of quality of service.

Chapter 3: Research Framework and Hypothesis

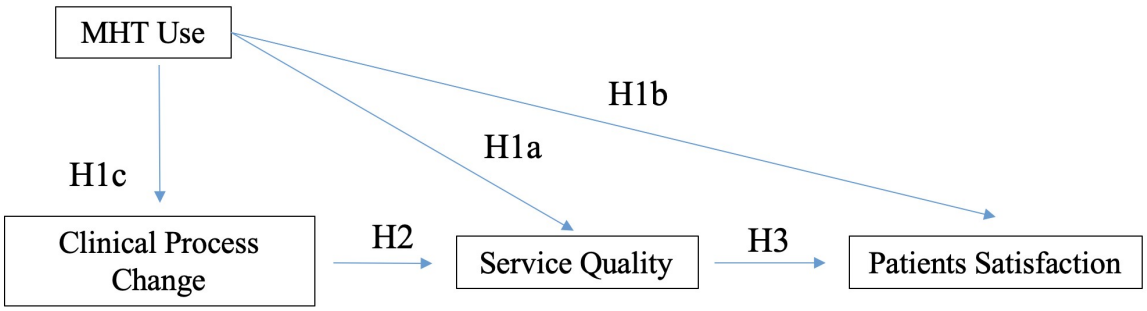
3.1 Establishment of research model

Based on the literature review and analysis results in the second chapter, we propose a model of the impact of mobile health technology on hospital service quality and patient satisfaction, and identifies four variables, which include 10 dimensions totally. They are Mobile Health Technology Use (MHTU), Clinical Process Change (CPC), Service Quality (SQ) and Patient Satisfaction (PS). Clinical Process Change include two dimensions: Physician-patient Interaction (PI) and Information Accessibility (IA); Service Quality includes six dimensions: Tangibility (Ta), Empathy (Em), Assurance (As), Convenience (Co), Reliability (Rel) and Responsiveness (Rel); Patient Satisfaction includes two dimensions: Treatment Outcome (TO) and Visit Time (VT).

Nowadays in China, there are increasingly medical institutes beginning to apply mobile health technology (MHT) used both by patients and medical staffs in the clinical process. So, to explore the factors affecting the service quality and patient satisfaction and to elucidate the relationship between them in context of the hospitals applying MHT is pivotal to the decision-making process both for the investigator and the hospital managers. The research model that we propose explains how the MHT use influence the service quality, directly to service quality or mediated by clinical process change. The model extends the knowledge by integrating the MHT use and service quality by the mediating variable as the consequence of the MHT adoption, such as the change of clinical process. In addition, the clinical process change is considered as the input factor to service quality rather than the one of dimensions of SQ in other already explored theoretical framework (Kim et al., 2008; Padma, Raiendran & Sai 2010; Rakhmawati & Sumaedi, 2013; Itumalla, 2014; Johnson & Russell, 2015; Kim et al., 2017).The service quality in proposed conceptual model is applied based on SERVQAUL and its modified model in literature we have reviewed in systematic literature review.

In the conceptual model, as illustrated in Figure 3-1, firstly, the MHTU can influence the SQ and PS directly and indirectly by the mediating role of CPC. Then, SQ affects the PS. Also, MHTU can directly influence PS as well.

Figure 3-1 Research model: The impact of mobile heath technology (MHT) adoption on service quality and patients satisfaction



3.2 Interpretation of research variables

In order to design questionnaire and its items scientifically and improve the validity of questionnaire, it is necessary to confirm the operational definitions of each four variables.

3.2.1 Mobile health technology use

In this study, MHTU refers to how well do patients use the functions of mobile health Apps in clinical process, including making appointment, online consultation, and inquiring information through the mobile health Apps (for example, Wechat health client); payment for medical expenses through the mobile health Apps; doctors and patients communicate online through the mobile health Apps; inquiry and acquiring of medical information. The measurement indicators are divided into objective and subjective indicators. The former counts the number of times the patient actually uses the mobile health Apps and the functions of the software within three years, and the latter subjectively measures the degree of how well patients use various functions of the mobile health Apps.

This variable mainly refers to the System Usage in the theory of Technology Acceptance Model (TAM). The conceptual and theoretical sources are shown in Table 3-1.

3.2.2 Clinical process change

Clinical Process Change refers to the change in the experience of the patient in clinical process after the hospital has adopted the mobile health Apps. The experience includes two aspects: the patient's enthusiasm for interaction with medical staff and the change of patients feel about obtaining relevant information in each link of clinical process. They correspond to two dimensions:

Table 3-1 The concepts and theoretical sources of MHTU

Variable	Operational definition	Referred variable and literature	Referred definition of variables
Mobile Health Technology Usage (MHTU)	Measure the frequency and extent of patients using mobile health Apps	System Usage (Petter & Fruhling, 2011)	Depth of system function usage
		System Usage (Davis et al., 1989)	Personal attention to the use of some information technology systems

Physician-patient Interaction and Information Acquisition. Therefore, this study refers to the relevant variables or dimensions employed by other researchers, as shown in Table 3-2.

3.2.3 Service quality

The service quality in this study is based on the SERVQUAL theory, so the service quality refers to the patient's perception of the gap between the expected and actual performance of the hospital service, including six dimensions. The five measurement dimensions refer mainly to the SERVQUAL model proposed by Parasuraman et al. (1988), namely Tangibility, Reliability, Responsiveness, Assurance and Empathy. The items refer mainly to the improved SERVQUAL scale of Babakus and Mangold (1992); the other dimension, Convenience, refers to the relevant measurement variables or dimensions. The concepts and sources of specific variable and dimension are shown in Table 3-3.

3.2.4 Patient satisfaction

Patient Satisfaction refers to the overall feeling of the difference between the actual performance and expectation of the whole medical service provided by the hospital after using mobile health Apps. There are many researchers who ever have used Patient Satisfaction as variables in literature. However, in this study, the concept of Patient Satisfaction is different from those in literature as result of patients are most concerned about the results of medical treatment and the waiting time under the environment of Chinese hospitals. Therefore, this study introduces two dimensions in the variable of Patient Satisfaction, namely Treatment Outcome and Visit Time. The concepts and sources of specific variable and dimension are shown in Table 3-4.

Table 3-2 The concepts and theoretical sources of CPC

Variable	Dimension	Operational definition	Referred variable and literature	Referred definition of variables
Clinical Process Change (CPC)	Physician-patient Interaction	Measure changes in the interaction between patients and physicians after using mobile health Apps	Doctors (Faria & Mendes, 2013)	The attention and willingness shown by a doctor, such as the ability to listen to your voice and understand the message you want to convey to him
			Communication (Andaleeb, 2001)	Doctors offer patients answers and help on their own initiative
			Patient Communication (Itumalla, 2014)	Medical staff provide patients with sufficient and clear information
	Information Accessibility	Measure the patient's perception of change in access to information during each link of clinical process after using mobile health Apps.	Administrative Processes (Johnson & Russell, 2015)	Major different activities of patients before treatment
			Administrative Procedures (Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)	Admission procedure and hospitalization and discharge of patients
			Administrative Services (Itumalla, 2014)	
			Process of Clinical Care (Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)	Core or main service or technical quality of hospital services
			Procedure of Care (Kim et al., 2008)	The process of queuing, registering, making an appointment, examination, and paying for patients
			Patient Flow (Johnson & Russell, 2015), (Chahal & Mehta, 2013), (Russell, Johnson, & White, 2014).	Activities and waiting times before or during communication with medical staff, in the waiting room or in the examination room
			Service Procedures (Kim et al., 2017)	Appointment, registration, waiting time for treatment, payment, information interaction, etc.
			Quality of Administration Process (Rakhmawati & Sumaedi, 2013)	Performance in terms of speed and ease of management

Table 3-3 The concepts and theoretical sources of SQ

Variable	Dimension	Operational definition	Referred variable and literature	Referred definition of variables
Service Quality (SQ)	Tangibility (Ta)	Measures how well the hardware of hospitals is, such as physical facilities, equipment, and appearance of personnel	Tangibility (Parasuraman et al., 1988), (Babakus & Mangold, 1992)	physical facilities, equipment, and appearance of personnel
	Reliability (Rel)	Measures the ability of hospitals to perform the promised service dependably and accurately	Tangibility (Parasuraman et al., 1988), (Babakus & Mangold, 1992)	ability to perform the promised service dependably and accurately
	Responsiveness (Res)	Measures the willingness of hospitals to help customers and provide prompt service	Responsiveness (Parasuraman et al., 1988), (Babakus & Mangold, 1992)	willingness to help customers and provide prompt service
	Assurance (As)	Measures the knowledge and courtesy of medical staff and their ability to inspire trust and confidence	Assurance (Parasuraman et al., 1988), (Babakus & Mangold, 1992)	knowledge and courtesy of employees and their ability to inspire trust and confidence
	Empathy (Em)	Measures the caring and individualized attention hospitals provide their patients	Empathy (Parasuraman et al., 1988), (Babakus & Mangold, 1992)	caring, the individualized attention the firm provides its customers
	Convenience (Co)	Measures how well the service is supported by MHT that can facilitate the patients meeting their demands	Convenience (Akter et al., 2010), (Akter et al., 2012)	The degree to which the mHealth service platform is available 'anytime' and 'anywhere' basis.
			Convenience (Chang & Chang, 2008)	Hospital waiting time
			Patient Flow (Johnson & Russell, 2015)	Activities and waiting times before or during communication with medical staff, in the waiting room or in the examination room
			Waiting Time (Reidenbach & Sandifer-Smallwood, 1990)	The perceptions of the timeliness of the various services and processes the patient must experience
			Service Procedures (Kim et al., 2017)	Appointment, registration, waiting time for treatment, payment, information interaction, etc.

Table 3-4 The concepts and theoretical sources of PS

Variable	Dimension	Operational definition	Referred variable and literature	Referred definition of variables
Patient Satisfaction (PS)	Visit Time	Measure patients' overall perception of the difference between actual performance and expectation of hospital service time after using mobile health Apps	Waiting Time (Reidenbach & Sandifer-Smallwood, 1990)	The perceptions of the timeliness of the various services and processes the patient must experience
			Waiting Time (Faria & Mendes, 2013)	Time between patient appointment and completion of treatment
			Service Procedures (Kim et al., 2017)	Appointment, registration, waiting time for treatment, payment, information interaction, etc.
	Treatment Outcome	Measure patients' overall perception of the difference between actual performance and expectation of medical outcomes after using mobile health Apps	Satisfaction (Akter et al., 2012), (Spreng et al., 1996), (Bhattacherjee, 2001), (Lonial et al., 2010), (Reidenbach & Sandifer-Smallwood, 1990), (Kim et al., 2017), (Faria & Mendes, 2013), (Lee & Yom, 2007), (Geertzen et al., 2002)	an affective response to the cognitive service quality approach
			Patient Satisfaction (Chang & Chang, 2008)	an evaluation of emotional commitment; the interpersonal interaction between a customer and service providers in retrospect.
			Overall Satisfaction (Johnson & Russell, 2015), (Panchapakesan et al., 2015), (Wu et al., 2016), (Andaleeb, 2001)	the level of quality healthcare provided
			Patient Satisfaction (Meesala & Paul, 2016), (Aliman & Mohamad, 2013)	consumer's response to the evaluation of the perceived discrepancy between prior expectations and the actual performance of the product or service after consumption.

3.3 Research hypothesis

The following hypotheses are based on the relationship between the variables in the literature review in Chapter 2.

3.3.1 The relationship between MHTU, SQ and PS

In the systematic literature review, which uses SERVQUAL or its adapted model as dependent variable, the independent variable of service quality is mainly based on physician-patient interaction and information technology acceptance. Chang and Chang (2008) use the term “technology-based service encounters” to describe the interaction between medical staffs and patients during clinical process by e-Commerce (electronic commerce) and internet technology, such as online appointment system and electronic medical record systems, and reveal that technology-based service encounters positively influence SQ, yet not PS. After the adoption of technology-based service encounters by patients, the perception of SQ has a positive impact on patient SAT. Also, in a study of impact of online appointment system(OAS) on PS, Wang (2013) claims that OAS technology-based service encounters, compared with hospital image, has a stronger effect on patient SAT. Chen (2013) assesses the impact of technology acceptance on relationship quality that is defined as the outcome from interactions between two parties (Crosby, 1990), and find that perceived ease of use and perceived usefulness have significant influence on relationship quality. The satisfaction and trust are selected as constructs for measuring relationship quality. Further, Chen (2014) investigate the impact of technology readiness on relationship quality. The technology readiness, which has four dimensions, namely optimism, innovativeness, discomfort and insecurity, refers to the tendency of an individual to accept and use technologies to accomplish home or work goals (Parasuraman, 2000). Both optimism and innovativeness significantly and positively influenced continuance intention through the mediating effect of relationship quality. The construct of “interaction quality” applied by Wu (2016) is referred to how the service is delivered (Grönroos, 1984; Czepial, Solomon, & Suprenant, 1985; Brady & Cronin, 2001), which is the patient’s cognition of SQ in communication with doctors and nurses. The study finds that interaction quality positively influences overall experiential quality.

Based on the above conclusions, we propose the following hypotheses:

H1a: MHTU has a positive impact on patient's perception of SQ.

H1b: MHTU has a positive impact on PS.

3.3.2 The relationship between MHTU, CPC and SQ

The variable of Clinical Process Change in this research is meant to measure how the clinical process changing perceived by patients after using MHT in terms of the procedures of information searching, consultation, making appointment, registering, access to diagnosis and treatment report and payment. All of above procedures are mainly concerned with the concept of physician-patient interact and information accessibility, therefore we refer to the items of different dimensions or variables, which are Administrative Processes (Johnson & Russell, 2015), Administrative Procedures (Padma, Raiendran, & Sai, 2010; Panchapakesan et al., 2015), Process of Clinical Care (Padma, Raiendran, & Sai, 2010), Service Procedures (Kim et al., 2017), Quality of Administration Process (Rakhmawati & Sumaedi, 2013), Patient flow (Johnson & Russell, 2015).

In literature, Chen (2013) find that technology acceptance has significant influence on relationship quality that is defined as the outcome from interactions between two parties (Crosby, 1990). Wu (2016) applies the construct of "Interaction Quality" described to how the service is delivered (Grönroos, 1984; Czepial et al., 1985; Brady & Cronin, 2001), which is the patient's cognition of SQ in communication with doctors and nurses, and claims that interaction quality positively influences overall experiential quality.

In addition, Petter and Fruhling (2011) indicate that the System Use, a variable to measure use of STATPackTM, an information system used to aid in the diagnosis of pathogens in hospitals, has positive influence on Individual Impact and Organizational Impact, two variables to describe how effective and useful to the individual and organization using STATPackTM. The variable of Clinical Process Change, to measure the changing of the clinical process perceived by patients, is similar meaning as Individual Impact and Organizational Impact in terms of definition.

Consequently, based on the discussion above, we may conclude and put forward hypothesizes as follow.

H1c: The MHTU is positively related to CPC.

H2: The CPC has positive influence on perceived SQ in hospitals.

3.3.3 The relationship between SQ and PS

Numerous researchers believe that customer satisfaction (CS) is a customer's instant feelings for specific services and that SQ is a customer's comprehensive comment on the service in a long term (Hoffman & Bateson, 1997). Undoubtedly, SQ and CS are mutually connected (Cronin & Taylor, 1992). Some maintain that CS facilitates the perception of service quality. The others suppose that SQ results in customer satisfaction.

In the systematic literature review of SQ, Some authors state that SQ directly impact on PS (Reidenbach & Sandifer-Smallwood, 1990; Andaleeb, 2001; Geertzen et al., 2002; Geertzen et al., 2002; Lee & Yom, 2007 Kim et al., 2008; Chang & Chang, 2008; Akter et al., 2012; Akter, D'Ambra & Ray, 2013; Aliman & Mohamad, 2013; Panchapakesan et al., 2015; Joseph & Ganesan, 2015; Lanka, 2016; Meesala & Paul, 2016; Wu et al., 2016; Kim et al., 2017), while others argue that SQ influences the PS by mediating factors. Faria and Mendes (2013) confirm that in addition to directly impact of SQ on PS, the organizational image also mediates the relationship between SQ and SAT. Johnson and Russell (2015) find the mediating role of care provider and nurse/assistant between SQ and PS.

Therefore, we propose the hypothesis as follows:

H3: The perceived SQ is positively related to PS.

Chapter 4: Research methodology

4.1 Research design

4.1.1 Questionnaire design

In this study, empirical research method is used to investigate patients' perception of visiting a doctor by questionnaire, and then hypothesis model is tested based on data. To design questionnaires scientifically and ensure the validity and reliability of the questionnaires, the design procedures are as follows:

Aiming at the research dilemma and research purposes, we conduct an extensive reading of domestic and foreign literatures, and a systematic literature review about the concept of service quality in hospitals, then summarize the factors affecting service quality and the factors affected by service quality and discover the measurement scales or items consistent with the variables applied in this research model. Considering that the literature review is based on the publication of articles in English as search restrictions, all cited questionnaires or items are in English. To this end, we organize English professionals to translate the questionnaire into Chinese and then translated it into English to confirm the consistency of meaning before and after, so as to avoid changing the meaning of the original measurement questionnaire.

1. The research group invite four experts, two management professors and two clinical experts from the hospitals as subjects to revise and supplement the contents of the questionnaire items to ensure that the contents of the questionnaire items are closer to the concepts of corresponding variables.

2. After the initial questionnaire is formed, a total of 10 people, including instructors, doctors and administrators in hospitals, a few patients, and students who issue the questionnaires are invited to pre-test the questionnaires to find out the problems and make timely revisions.

3. The pilot test is conducted by sending the revised questionnaires to patients, then exploratory factor analysis is performed to confirm the dimensions of each variable in the

research model. After the modification of the items, a measurement scale corresponding to the measurement model is finally formed.

4. The large-scale survey is conducted using the final revised questionnaire.

4.1.2 Questionnaire structure

The questionnaire in pilot test for this study consisted of five parts, as shown in the Appendix 1.

The first part, the background information of the patient. This part mainly includes five kinds of information, including patient background information (gender, age, occupation and education), the use of mobile information Apps by patients (the earliest time of using Wechat, the average time of using Wechat in a day), the basic situation of using health Apps by patients (the types of mobile health Apps, the first time of using mobile health Apps, the time of the first visit to the hospital), the function-using of the mobile health Apps (the number of visits in the past three years, the number of each function of mobile health Apps) and the related medical information of the patients (the types of ocular diseases and purposes of the visits).

The second part is the general situation about how patients use mobile health Apps. This part is to measure how patients use different function of mobile health Apps, such as making appointment, paying for medical related expenses, inquiring of laboratory reports and medical records, real-time interactive consultation with doctors who patients want to see, communication with other patients, asking medical staff questions through short messages, and acquiring health education information and medical information pushed by hospitals.

The third part is the patient's evaluation of clinical experience through seeing a doctor after using mobile health Apps in a hospital. This part is to measure the changes of patients' experience in clinical process when mobile health Apps is adopted. The experience of clinical process includes two aspects: the enthusiasm of information communication between patients and medical staff and the information acquisition in each link of the clinical process. The corresponding dimensions are Physician-patient Interaction and Information Accessibility.

The fourth part, the patient satisfaction about clinical experience. This section measures the patient satisfaction in the clinical process, including two dimensions: Treatment Outcome and Visit Time.

The fifth part is the patient's expectation and actual experience of hospital service quality. This section is based on the SERVQUAL scale to measure the gap between patient

expectations and actual perceptions of hospital service quality. The measurement dimensions include five original dimensions of SERVQUAL: Tangibility, Reliability, Responsiveness, Assurance and empathy. In addition, according to the results of literature review, Convenience is expected to be involved, therefore, there are six dimensions totally at last.

4.2 Items design

In this study, we firstly investigate the general status about the use of mobile health Apps by patients, then inquire about patients' perception of changes in the clinical process, and study how it affects the quality of hospital services and patient satisfaction. Through reviewing a large number of literatures, we directly introduce and modify the relevant mature variable scale to design variable and items of this study. The total number of variables is four, dimensions totally 10, they are: Mobile Health Technology Use, Clinical Process Change (Physician-patient Interaction and Information Accessibility), Service Quality (Tangibility, Reliability, Responsiveness, Assurance, Empathy, Convenience) and Patient Satisfaction (Treatment Outcome and Visit Time).Each items uses the Likert 7-point record method, with 1 being “very disagree” and 7 being “very agree”. The design of specific measurement items is as follows:

Table 4-1 Items design of MHTU

Variable	Number	Items	Source
Mobile Heath Technology Use （MHTU）	a	Make an appointment for doctor	(Johnson & Russell, 2015)
	b	Pay for medical related expenses	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015), (Kim et al., 2008) , (Kim et al., 2017)
	c	Check laboratory reports and medical records	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	d	Interact with the doctor you want to consult online at any time	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	e	Communicate with other patients	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	f	Ask medical staff questions via SMS	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	g	Learn about health education information and medical information pushed by hospitals	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)

4.2.1 Items design of MHTU

MHTU refers to the System Use scale applied by Petter and Fruhling (2011), which is used to measure the use of various functions of STATPack system. The system is used to help the laboratory diagnose pathogens. Involving the function of mobile health Apps, the design of question items is shown in Table 4-1.

4.2.2 Items design of CPC

CPC scale refers to the variables of hospital management process and patient consultation process. These variables are Administrative processes (Johnson & Russell, 2015), Administrative Procedures (Padma, Raiendran, & Sai 2010; Panchapakesan et al., 2015), Administrative Services (Itumalla, 2014), Process of Clinical Care (Padma, Raiendran, & Sai, 2010; Panchapakesan et al., 2015), Procedure of Care (Kim et al., 2008), Patient flow (Johnson & Russell, 2015), Service Procedures (Kim et al., 2017), Quality of Administration Process (Rakhmawati & Sumaedi, 2013) . The items mainly refer to the interaction initiative between patients and medical staff in the clinical process, and the validity of patients' access to medical information in various stages of clinical process. The corresponding dimensions are Physician-patient Interaction and Information Accessibility. The design of the question items is shown in Table 4-2.

4.2.3 Items design of PS

The patient satisfaction items mainly refer to the relevant research on patient satisfaction, especially to quote the relevant patients' evaluation of medical quality and time of treatment. The design of the question items is shown in Table 4-3.

Table 4-2 Items design of CPC

Variable	Dimension	Number	Items	Source
Clinical Process Change （CPC）	Physician-patient Interaction	a	Now I can make an appointment to the doctor who I want to see every time	(Kim et al., 2017)
		b	When I choose a doctor, I can get information about the doctor's background and experience online	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		c	When I choose a doctor, I can see other patients' scores and assessments on the Internet	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		d	After seeing the doctors, I can rate the doctor online.	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		k	Now I can manage and treat my disease more effectively	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		l	Now I can keep in touch with other patients online	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		m	I can now ask the medical staff questions via SMS on the Internet	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		n	Every link in my medical treatment process is now more coherent	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		o	I am maintaining a continuous communication relationship with my doctor	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		cc	Now the queue has been reduced in every link of my medical treatment	(Johnson & Russell, 2015)
		dd	I took the initiative to participate in discussions with doctors about treatment options	(Kim et al., 2017)， (Faria & Mendes, 2013)
		ee	I actively seek other information related to my health	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		ff	I take the initiative to participate in learning preventive treatment	(Padma, Raiendran, & Sai, 2010), (Panchapakesan

		information	et al., 2015)
	gg	After I see a doctor, I will take the initiative to follow up and complete all the required treatments	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	hh	I took the initiative to help the doctor determine my health and problems	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	ii	The medical staff in the hospital now know the records of every link of my visit very well	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	jj	In every aspect of my medical treatment process, the data related to me can be checked in time	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	kk	In every aspect of my medical treatment, medical staff are now in harmony with each other	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	ll	It's easy for me and the medical staff to make a common agreement now	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
Information Accessibility	e	I can easily access and store my medical information now	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	f	I can now access and process my medical information anytime and anywhere	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	g	Now, when I am in the hospital, the medical staff in different departments are well coordinated with each other	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	h	Now even if I am looking for a different doctor in the hospital, the process of diagnosis and treatment is consistently standardized	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	i	I can now check the medical records of the past at each stage of the hospital	(Reidenbach & Sandifer-Smallwood, 1990)
	j	Now if the medical staff I'm looking for is not there, other medical staff can meet my needs	(Akter et al., 2012)
	p	Now the doctor can give me the most suitable treatment according to my personal condition and complete historical information	(Reidenbach & Sandifer-Smallwood, 1990)
	q	Now my doctor's treatment plan is consistent with my changing	(Faria & Mendes, 2013)

	needs and conditions	
r	Now that I'm in the hospital, I know exactly who I'm looking for at every step	(Faria & Mendes, 2013)
s	The doctor encouraged me to ask questions	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
t	The doctor will answer my questions adequately	(Akter et al., 2012)
u	The doctor actively encouraged me to participate in discussions with the doctor about treatment options	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
v	Doctors offer other information about my condition and treatment on their own initiative	(Akter et al., 2012)
w	Doctors actively provide information on preventive treatment	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
x	I can understand the explanation given by the doctor	(Padma, Raiendran, & Sai 2010), (Panchapakesan et al., 2015), (Kim et al., 2017)
y	The doctor was very considerate of me	(Carman, 1990); (Lonial et al., 2010)
z	The doctor made me feel at ease discussing my condition	(Carman, 1990); (Lonial et al., 2010)
aa	I feel that the doctor knows my medical history very well	(Carman, 1990); (Lonial et al., 2010)
bb	I feel that doctors know very well about my health care needs	(Carman, 1990); (Lonial et al., 2010)

Table 4-3 Items design of PS

Variable	Dimension	Number	Items	Source
Patient Satisfaction （PS）	Treatment Outcome	a	I am satisfied with the medical services I received during my stay in this hospital	(Meesala & Paul, 2016), (Aliman & Mohamad, 2013)
		b	I'm very satisfied with the doctor's attitude	(Meesala & Paul, 2016), (Aliman & Mohamad, 2013)
		c	I am very satisfied with the quality of the doctor's treatment	(Meesala & Paul, 2016), (Aliman & Mohamad, 2013)
		d	My illness has been properly treated	(Meesala & Paul, 2016), (Aliman & Mohamad, 2013)
		e	After seeing the doctor, I have a better understanding of my condition	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		f	After talking with the doctor, I feel a lot better about my condition	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		g	The doctor's choice of treatment is the most appropriate for me	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		h	My condition will be completely improved	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		l	I'm satisfied with the doctor's consultation time	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		m	I am satisfied with the waiting time in the hospital	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
		n	I'm satisfied with the total time spent on this visit	(Padma, Raiendran, & Sai, 2010), (Panchapakesan et al., 2015)
	Visit Time	i	I'm very clear about how to recover when I get home	(Faria & Mendes, 2013), (Johnson & Russell, 2015)
		j	I am very clear about how to use the medicine	(Faria & Mendes, 2013), (Johnson & Russell, 2015)
		k	I know exactly when to see the doctor next time.	(Faria & Mendes, 2013), (Johnson & Russell, 2015)

4.2.4 Items design of SQ

The five dimensions of service quality in hospital, namely, Tangibility, Reliability, Responsiveness, Assurance, and Empathy, mainly refer to the mature scale of Babakus and Mangold (1992), which is used by many scholars to measure service quality in hospitals (Steffen & Nystrom, 1997; Lam, 1997; Niedz, 1998; Geertzen et al., 2002; Lin et al., 2004; Lee, 2005; Christoglou et al., 2006; Lee & Yom, 2007; Ancarani et al., 2009; Ye & Direktör,

2010; Pansiri & Mmereki, 2010; Ancarani et al., 2011; Altuntas et al., 2012; Purcărea et al., 2013; Aliman & Mohamad, 2013; Aghamolaei et al., 2014; Mashhadiabdol et al., 2014; Papanikolaou & Zygiaris, 2014; Anbari et al., 2014; Ayoubian et al., 2015; Li et al., 2015a; Li et al., 2015b; Mečev & Goleš Kardum, 2015; Meesala & Paul, 2016; Yin et al., 2016; Al-Neyadi et al., 2016;; Gholami et al., 2016;; Manulik et al., 2016; Matin et al., 2016; Oliaee et al., 2016; Rezaei et al., 2016; Węgłowski et al., 2016; Kalaja et al., 2016; Güllü et al., 2017). In addition, through literature review, another dimension, Convenience, is applied in variable of service quality. The question items are mainly cited from Convenience (Chang & Chang, 2008; Akter et al. 2010, Akter et al., 2012), Patient Flow (Johnson & Russell, 2015), Waiting Time (Reidenbach & Sandifer-Smallwood, 1990; Faria & Mendes, 2013), and Service Procedures (Kim et al., 2017). The design of the items is shown in Table 4-4.

4.3 Data collection and analysis methods

4.3.1 Case selection

In this study, we select Shenzhen eye hospital, a public specialty hospital, as the investigation subject. There two main reasons: 1. Shenzhen eye hospital has good environments where many patients use mobile health Apps to see doctors. 2.the specialty hospital may eliminate the variance of SQ caused by the different diseases.

Shenzhen Eye Hospital, founded in September 1985, is directly under the supervision of Public Hospital Administration of Shenzhen Municipality, which is the sub-unit of Health and Family Planning Commission of Shenzhen Municipality. It is also a designated hospital of Shenzhen Municipal Social Insurance, where the patients may use medical insurance for the cost of consultation, medications, treatment, etc. The hospital covers an area of more than 17,000 square meters and the construction area of 28,000 square meters, with the capacity of 200 beds. The hospital establishes the multi-disciplinary departments, such as ocular trauma, fundus disorders, glaucoma, cataract, corneal transplantation, pediatric amblyopia & strabismus, optometry, orbital eye plastic surgery, vitreoretinopathy, Chinese medical ophthalmology, refraction & glasses-dispensing center, etc. There are 410,000 emergency patients in year 2018, more than 15,000 hospitalized patients, and more than 30,000 surgeries (including surgeries for outpatient).

Table 4-4 Items design of SQ

Variable	Dimension	Number	Items	Source
Service Quality （SQ）	Tangibility	a	The hospital is clean	(Babakus & Mangold, 1992)
		b	The hospital's medical equipment is very advanced	(Babakus & Mangold, 1992)
		c	Doctors and nurses dress professionally and neatly	(Babakus & Mangold, 1992)
		d	The signs of hospital facilities are very clear	(Carman, 1990); (Lonial et al., 2010)
		e	The TV screen in the waiting area shows useful information for the patient	(Carman, 1990); (Lonial et al., 2010)
		f	In many places in the hospital, you can see promotional materials that guide how to use the hospital WeChat application	(Carman, 1990); (Lonial et al., 2010)
	Reliability	g	My doctor is very concerned about my personal situation	(Babakus & Mangold, 1992))
		h	My doctor is based on my special condition	(Albori et al. 2010)
		i	My doctor understands my specific needs	(Carman, 1990); (Lonial et al., 2010)
		j	My doctor is concerned about my unique needs	(Babakus & Mangold, 1992)
		k	My doctor showed great sympathy for my condition	(Albori et al. 2010)
	Assurance	l	My doctor has the ability to treat me well	(Babakus & Mangold, 1992)
		m	When the doctor came to see me, I felt safe	(Babakus & Mangold, 1992)
		n	The way and behavior of my doctor give me great confidence	(Babakus & Mangold, 1992)
		o	My doctor has good medical knowledge	(Babakus & Mangold, 1992)
		p	My doctor is trustworthy	(Carman, 1990); (Lonial et al., 2010)
		q	My doctor is very experienced	(Andaleeb, 2001)
	Convenience	r	I can easily make an appointment with the doctor I want to see	(Kim et al., 2017)
		s	I can easily make an appointment to the time I want to see a doctor	(Kim et al., 2017)
		t	It's easy for me to find where I need to go in the hospital	(Kim et al., 2017)
		u	I don't have to wait long in hospital	(Johnson & Russell, 2015)
		v	Every step of seeing a doctor in my hospital is very convenient and easy	(Kim et al., 2017)
		w	The hospital staff will always help me whenever I need	(Babakus & Mangold, 1992)
	Reliability	x	My doctor seldom makes mistakes	(Babakus & Mangold, 1992)
		y	My doctor always explains the diagnosis and treatment to me very clearly	(Babakus & Mangold, 1992)
		z	My medical record in the hospital is always accurate	(Carman, 1990); (Lonial et al., 2010)
		aa	There are few inconsistencies in my medical records	(Babakus & Mangold, 1992)
		bb	The service of medical staff is always reliable	(Babakus & Mangold, 1992)
	Responsiveness	cc	My doctor can answer my question quickly	(Albori et al., 2010)
		dd	I always get prompt answers when I contact the hospital	(Albori et al., 2010)
		ee	Doctors and nurses are not too busy to answer my questions in time	(Albori et al., 2010)
		ff	My doctor will keep updated of my condition changes	(Albori et al., 2010)
		gg	My doctor will make quick adjustments to my condition	(Albori et al., 2010)

Shenzhen Eye Hospital provides patients with the functions of mobile health Apps, including consultation registration, payment, medical guidance, report review, hospital deposit payment, hospitalization list, medical feedback, etc. Its services form a type of closed-loop services, by the way from outpatient to hospitalization, from capital flow to information flow, from pre-hospital to post-hospital. Patients do not have to download, install or register APP. They can call all functions only by following the hospital public number or Alipay service window. The procedure for patients using mobile health Apps includes the following seven steps.

First, patients scan the QR through Wechat App on mobile phone to follow Wechat public number of Shenzhen eye Hospital and log in.

Second, to bind medical cards: Patients click on “Interaction” → “My Information” to bind the medical card in turn. Patients without a medical card can register a new card online, and then go to the registration window/counter or self-help machine to acquire the physical card on the same day.

Third, to register: according to the need, the patients clicks on “Guidance” → “Reservation Registration” / “Registration on the Day”→ “Selection of Departments”→ “Selection of Doctors” → “Selection of Time”→ “Payment” → “Collection of Registration Form”. The ever-registered number can be inquired by clicking through “Guidance” → “My Register”.

Fourth, to pay during clinical process: after the patients visit the clinic, the Apps platform will push the payment reminder to patients or patients click “Diagnosis and Treatment” → “My bill” → “To be paid” → “Complete payment”. After successful payment, the patients receive payment receipts, then to take medication, receive examinations and treatment or other services according to the guidance information.

Fifth, to inquire examination and treatment reports: after the patients complete the examinations or the results turn out, the App platform will push the report reminder to patients or patients click on “Diagnosis and Treatment” → “Examination” to view the report result through the platform.

Sixth, to check information about hospitalization: inpatients can check the advance payment, daily list and cost details in “Diagnosis and Treatment” → “My Hospitalization”.

Seventh, to acquire medical feedback: after consultation, the platform will push “Medical Feedback Reminder” to patients or patients enter “Interactive”→ “Medical

Feedback" on the day of consultation to evaluate the overall environment of the hospital and the doctors, and patients are welcome to make valuable comments.

4.3.2 Sampling

Firstly, before the questionnaire is issued, a team of eight-person is established. The members include three optometrists and five college students working as interns in Shenzhen Eye Hospital. Each member is trained with the questionnaire-issuing method and informed of the following matters:

1. Only with the consent of the patient and the willingness to assist, can the patient fill in the questionnaire. When the patient fills in, the team members should observe whether the patient carefully behaves and thinks about it. If he just scores directly without thinking, then the questionnaire will be regarded as the void.

2. The questionnaires will only be issued to the patients who use mobile health Apps, such as WeChat Health Client terminal, Health 160 and other similar software.

3. The distribution of age, sex and disease type should be taken into account when selecting patients. That is to say, the above three items should represent the overall sample of the outpatients in the hospital.

In order to improve the validity of the questionnaire as much as possible, the paper version of the questionnaire is adopted. From December 19, 2018 to January 22, 2019, 647 questionnaires are issued. 618 valid questionnaires were excluded. The rate of sample validity was 95.5%. The reasons for the invalid questionnaires are: The patients are eager to answer questions, and the filling time is significantly lower than the estimated filling time of 20 minutes; The patients were very serious at the beginning, but they could not continue filling in anymore because of urgency need to be dealt with; Some critical questions are missed to answer. The demographic information of patients, such as gender, age, occupation, and education, are summarized in Table 4-5.

From the perspective of gender, the proportion of patients with gender is 39% and 61% respectively. Male patients are more than females, but there is no significant difference of ratio between male and female, which is basically the same as the 45% (male) and 55% (female) in the hospital last year.

In terms of age, the majority of patients aged between 31 and 40, accounts for 46.3% of the total patients interviewed, followed by those aged between 21-30 and 11-20, accounting for 27% and 10.2% respectively, and those aged over 60 is accounting for 1.9% of the total.

The age distribution shows that the group of patients using mobile health Apps is younger, and basically accords with the age distribution of overall patients in the hospital.

From the perspective of educational background, the ratio of the patients who have bachelor degree and diploma is the largest, accounting for 41% and 21.4% of the total number, respectively; a slightly lower proportion of educational level is vocational technical schools, high schools, junior middle schools and primary schools, accounting for 26.2% totally; the number of patients who have master degree and above is the least, accounting for 6.5% of the total number; It can be seen that the education level of the patients interviewed are generally high.

Table 4-5 Summary of the demographic information of patients

Variable	Category Description	Sample size	Ratio
Gender	M	241	39%
	F	377	61%
Age	10 and under	19	3.1%
	11~20	63	10.2%
	21~30	167	27%
	31~40	286	46.3%
	41~50	51	8.3%
	51~60	20	3.2%
	61 and above	12	1.9%
Occupation	Government	11	1.8%
	Government-affiliated Institutions	49	8%
	State-owned Enterprises	44	7.1%
	Private-owned Company	149	24.2%
	Foreign Enterprises	54	8.8%
	Private Enterprises	64	10.4%
	Self-employed Households	99	16.1%
	Farmers	30	4.9%
	Students	62	10.1%
	Others: Retirement, Unemployment, Full-time mother	54	8.9%
Education	Doctor	5	0.8%
	Master	35	5.7%
	Bachelor	253	41%
	Diploma	132	21.4%
	Vocational Technical School	37	6%
	High School	73	11.8%
	Junior Middle School	52	8.4%
	Primary School	28	4.5%
	Kinder garden	2	0.4%

From the perspective of occupation, the highest proportion is non-government-related enterprises, such as private-owned company, foreign enterprises, private enterprises and self-employed households, accounting for 59.5%, followed by government, government-affiliated institutions and state-owned enterprises, accounting for 16.9% totally, students account for 10.1%, The proportion of farmers is the lowest, accounting for 4.9%.

In summary, the distribution of the demographic information of the patient samples in this study is even and reasonable and can represent the overall patient population of the hospital.

4.3.3 Data analysis method

The data analysis tool of this study is applied with SPSS 24.

Firstly, descriptive statistical analysis of patient's basic characteristic information is carried out by SPSS, and the current situation of patients using mobile health Apps is summarized and described. Then, reliability and validity of the data are analyzed. Finally, correlation and regression analysis are carried out to verify the five hypotheses proposed in this study.

1. Sample background, characteristics and behaviour analysis

The purpose of sample background, characteristics and behavior analysis is to analyze and describe the basic background information, characteristics, behaviors or attitudes of samples. The SPSS is used to describe the demographic information and behavioral characteristics of patients, including the types of eye diseases, the purpose of hospitalization, age, gender, occupation, education, basic situation of mobile health Apps use and model variables. The frequency distribution of sample data is understood through statistical indicators such as maximum, minimum, mean and standard deviation.

2. Reliability analysis

The purpose of reliability analysis is to know whether the sample data is true and reliable, that is, whether the patients answer each question truthfully. This study uses SPSS and Cronbach Alpha coefficient method to analyze the reliability. When using this method, the αcoefficient value is better than over 0.8 and also acceptable between 0.6-0.8, and if less than 0.6, the scale needs to be revised. In addition, the more question items the variables have and the larger the sample size is, the larger the αvalue will be.

3. Validity analysis

The purpose of validity analysis is to confirm whether the questionnaire items can effectively measure the variables of the research model. When the reliability is not up to standard, the validity cannot be achieved. Validity analysis mainly includes content validity and structural validity.

Content validity refers to the concept of whether a questionnaire item can measure the corresponding variables. Expert judgment and questionnaire pre-test are usually used to determine content validity. In this study, four management and clinical experts confirm and revise the variables, and then some experts in management, hospital doctors and hospital managers, some patients and students who sent out questionnaires are invited to test the questionnaire.

Structural validity refers to the corresponding relationship between questionnaire items and measured variables, and it can be tested by exploratory factor analysis and confirmatory factor analysis. In exploratory factor analysis, SPSS is first used to determine whether it is suitable for factor analysis using Bartlett spherical test and KMO value. The passing values of the two indicators are 0.6 and the P value is less than 0.05, then the index of the number of factors and the interpretation rate of variance are explained. Finally, the variance rotation is performed, and the factor loading coefficient is used to judge the correspondence between the items and the factor. If the value is higher than 0.4, the effect is better.

4. Correlation analysis

The purpose of correlation analysis is to determine whether there is a close relationship between variables. If the variables show normal or approximate normal distribution, Pearson correlation coefficient is analyzed by SPSS, otherwise Spearman correlation coefficient is used. Pearson correlation coefficient is used in this study, because normal distribution is an ideal state. Even if the variables present non-approximate normal distribution, the results of Pearson correlation coefficient method and Spearman correlation coefficient method are basically the same. If a coefficient value greater than 0.6 indicates a strong positive correlation; a value greater than 0.4 indicates a relative strong correlation; a value less than 0.4 indicates a low correlation between the two variables.

5. Regression analysis and hypothesis verification

The purpose of regression analysis is to study the influence of independent variables on dependent variables. In this study, SPSS 24 was used to carry out multiple linear regression analysis on the variables and dimensions of the measurement model, and to verify the relationship between independent variables and dependent variables.

Multiple linear regression analysis mainly focuses on three indicators, namely F test, R^2 test and t test. The first indicator focuses on whether the model passes the F test (also known as ANOVA test). If the corresponding p-value is less than 0.05, then the F test means that the model is meaningful: at least one of the independent variables will have an impact on the dependent variables. Next, we need to look at the second index, R^2, whose value is between 0 and 1. It represents the fitting of regression equation model. If this value is 0.4, then 40% of the samples are distributed in the regression model. R^2 indicates the explanatory strength of independent variable X to dependent variable Y. The higher the index, the better, and there is no fixed standard by itself. The third indicator focuses on whether each independent variable passes the t-test. The criterion is whether the P value of the independent variable is less than 0.05 and greater than 0.01. If it is less than 0.05, the relationship between the independent variable and the dependent variable is significant at the level of 0.05. If it is less than 0.01, the relationship between the independent variable and the dependent variable is significant at the level of 0.01. Sometimes 0.1 or 0.001 is used as the P value standard, but this kind of situation is relatively rare in the questionnaire research. If the relationship between independent variables and dependent variables is significant, we should continue to look at the regression coefficient, non-standardized regression coefficient or standardized coefficient of independent variables. If the regression coefficient is greater than 0, then the corresponding independent variable will have a positive impact on the dependent variable, and vice versa. If it is necessary to compare the degree of impact, it can be judged by comparing the values of standardized regression coefficients.

In multiple linear regression analysis, D-W value is also worthy of concerns. The D-W value represents the indicator of autocorrelation, which means whether the filling of the previous sample will affect the filling of the next sample. The closer the D-W value is to 2, the better. Usually, if the value is between 1.8 and 2.2, there is no autocorrelation. In the questionnaire study, this indicator can basically meet the standard, unless there is a mutual impact between the samples.

6. Variance analysis

The purpose of analysis of variance (ANOVA) is to understand the relationship between categorized data and quantitative data, such as the impact of different categories or characteristics on patient satisfaction. Variance analysis compared with t-test can study the differences of samples of multiple groups, such as the differences of hospital satisfaction among patients of different occupations. SPSS was used to analyze variance, and P value was judged, if less than 0.05, indicating that there are differences between groups.

Chapter 5: Data Analysis and Hypothesis Validation

5.1 Descriptive statistical analysis

The descriptive statistical analysis of samples in this chapter mainly focuses on the general status of how patients use mobile information software (e.g. the year when to start using Wechat, the time of Wechat used every day), mobile health Apps (e.g. the type of Apps used, the beginning year of the Apps used in investigated hospital), various functions of mobile health Apps (using health Apps to make appointments, registration, payment, inquiry for laboratory reports and medical records, consultation with doctor, inquiry and acquiring of medical information), and information related to patients visits (the type of disease, the purpose of visiting the hospital, the year of patients visiting first time, the number of visits in the past three years), the related variables or variables dimension of research model (such as MHTU, Physician-patient Interaction, Information Accessibility, Tangibility, Empathy, Assurance, Convenience, Reliability, Responsiveness, Visit Time and Treatment Outcome). The average value, standard deviation, maximum value, minimum value, percentage and frequency of each variable and their dimensions are described and shown in Table 5-1.

Table 5-1 The summary of general status of how patients use mobile information apps

Variable	Category description	Sample size	Ratio
the year when to start using Wechat	2011~2012	140	22.8%
	2013~2014	223	36.3%
	2015~2016	226	36.7%
	2017~2018	26	4.2%
the time of Wechat used every day	In2 hrs	159	25.7%
	In 4 hrs	166	26.9%
	In 6 hrs	127	20.6%
	In 8hrs	75	12.1%
	In 10hrs	55	8.9%
	10 hrs above	36	5.8%
the type of Apps used	Health 160	452	73.1%
	Wechat health client terminal	153	24.8%
	Alipay	12	1.9%
	others：Baidu	1	0.2%
the beginning year of the Apps used in investigated hospital	2010~2011	4	6.5%
	2012~2013	26	4.2%

	2014~2015	117	18.9%
	2016~2017	275	44.5%
	2018~2019	196	31.9%
the type of Apps used	Health 160	452	73.1%
	Wechat health client terminal	153	24.8%
	Alipay	12	1.9%
	others：Baidu	1	0.2%
the beginning year of the Apps used in investigated hospital	2010~2011	4	6.5%
	2012~2013	26	4.2%
	2014~2015	117	18.9%
	2016~2017	275	44.5%
	2018~2019	196	31.9%
types of ocular disease	ametropia	158	25.6%
	visual fatigue	85	13.8%
	ocular surface diseases	95	15.4%
	cataract	15	2.4%
	glaucoma	8	1.3%
	fundus diseases	54	8.7%
	strabismus and amblyopia	164	26.5%
	trauma	39	6.3%
the purpose of visiting the hospital	initial diagnosis	198	32%
	follow-up	250	40.5%
	company	168	27.2%
	hospitalization	2	0.3%
the year of patients visiting first time	2000~2010	22	3.6%
	2011~2013	43	7%
	2014~2016	140	22.7%
	2017~2019	413	66.7%
number of visits in the past three years	1~3 times	367	61.2%
	4~6 times	157	26.2%
	7~9 times	24	4%
	10 times above	52	8.6%

5.1.1 Use of mobile information apps by patients

The situation in which patients use mobile information Apps, such as the year when to use of Wechat and the time of daily use by patients, are summarized in Table 5-1.

As can be seen from the table, the earliest year for patients to use Wechat is in 2011. The majority of the patients surveyed, accounting for 95.8%, begins to use Wechat from 2011 to 2016, indicating that the majority of patients has more than three to eight years of experience in using Wechat. 47.5% of the patients use Wechat for 4-6 hours a day, and 5.8% of the patients use Wechat for more than 10 hours a day.

5.1.2 Use of mobile health Apps by patients

The following is a description of the basic situation of patients using the health Apps, with reference to the results of Table 5-1.

Most of the mobile health Apps used by the surveyed patients is Health 160, accounting for 73.1%, which can also be used by logging into the WeChat App platform. Followed by WeChat, accounting for 24.8%, this App is the most popular social media App used by the Chinese people, and also the important carrier of mobile health App. In addition, 2.1% of the patients use Alipay or Baidu or other software or platforms to make an appointment to see the doctor.

As for the first year for patients to use mobile health Apps, the earliest is 2010 while the latest is 2019. Nearly half of patients (44.5%) uses mobile health Apps for the first time between 2016 and 2017. Another 31.9% uses mobile health Apps for the first time between 2018 and 2019. Therefore, the high growth period of patients using health Apps begins in 2014.

5.1.3 Information related to patients visits

The information concerning patients visits, such as the type of disease, the purpose of visiting the hospital, the year of patients visiting first time and the number of visits in the past three years, is summarized in Table 5-1.

As can be seen from the table, the types of ocular diseases can be divided into two categories, functional ocular diseases and organic ocular diseases. The former, such as ametropia and strabismus, accounts for 25.6% and 26.5% respectively, while the latter, such as glaucoma, cataract, trauma and fundus diseases, accounts for 18.7%. The distribution of ocular diseases category in the sample fully accords with the that of whole population of patients in Shenzhen eye hospital.

The purpose of patients coming to the hospital is divided into initial diagnosis, follow-up and company, accounting for 32%, 40.5% and 27.2% respectively, and another 0.3% were hospitalized patients.

There is 89.4% of patients treated in Shenzhen Eye Hospital for the first time in 2014~2019; the proportion of patients who had 1-3 times in the past three years is 61.2%; 4~6 times is 26.2%; more than 10 times is 8.6%.

5.1.4 Functions of mobile health Apps used by patients

We describe the specific functions of patients using mobile health Apps in Shenzhen eye hospital, including the minimum, maximum and average frequency of each function, and the distribution of the frequency of each function. The results are summarized in Table 5-2.

Table 5-2 Summary of each function of patients using mobile health apps

Function	times	Sample size	Ratio	Least time	Most time	Average time
make appointments & registration	1~3	400	68.3%	0	50	3.22
	4~6	117	20%			
	7~9	29	4.9%			
	10 above	40	6.8%			
payment	1~3	304	72.4%	0	50	2.16
	4~6	78	18.6%			
	7~9	14	3.3%			
	10 above	24	5.7%			
inquiry for laboratory reports and medical records	1~3	183	77.2%	0	100	1.26
	4~6	32	13.5%			
	7~9	7	3%			
	10 above	15	6.3%			
consultation with doctors	1~3	216	71.8%	0	23	1.60
	4~6	49	16.3%			
	7~9	9	3%			
	10 above	27	8.9%			
inquiry and acquiring of medical information	1~3	227	74.9%	0	20	1.45
	4~6	45	14.9%			
	7~9	6	2%			
	10 above	25	8.2%			

From the table, we can see that the proportion of patients who use each of functions for 1-3 times is the most, 68.3%, 72.4%, 77.2%, 71.8%, 74.9% respectively. The proportion of patients who use each of functions for more than 10 times is 6.8%, 5.7%, 6.3%, 8.9%, 8.2% respectively, indicating that the surveyed patient population has a good experience of using the mobile health Apps to visit the hospital, which ensures the reliability of the survey data.

Appointment and registration are the most used function by patients, followed by payment function, and the other three functions are used equally.

5.1.5 Description of statistical analysis of research variable

In order to understand patients' attitudes towards variables or dimensions of the study model and their distribution, we summarize the relevant indicators of variables and dimensions, such as minimum, maximum, average and standard deviation, as shown in the Appendix 5.

According to the information in the Appendix 5, the average score of each variables and dimensions is from 4.5286 to 6.1493. The score of Responsiveness and Assurance of hospital service quality are the highest, which are 6.1493 and 6.0685, respectively, indicating that the authority of doctors and the service timeliness of medical staff in the hospital are fully affirmed by patients; the lower scores are the MHTU, Information Accessibility and Visit Time, which are 4.5286, 4.5833 and 4.678, respectively, indicating that patients were generally accepted. The average scores of other variables range from 5.5328 to 5.8716, which are well recognized by patients. The standard deviation of Responsiveness is lowest, only 0.64356, comparing with other five dimensions.

5.2 Reliability and validity analysis of scale

Reliability reflects the consistency of the data measured by the scale, that is, the consistency of the results measured by the scale after many times. Reliability analysis can be divided into four classes of estimates: Cronbach's alpha, split-half reliability, parallel-forms reliability and test-retest reliability. The reliability analysis of the questionnaire mostly uses the alpha coefficient.

The α coefficient, which is the internal consistency coefficient, is greater than 0.8, indicating that the reliability is quite high, and 0.7 to 0.8 indicates that the reliability is good. If it is lower than 0.6, the scale needs to be revised. In the study, the α coefficient is usually greater than 0.7, indicating that the reliability is acceptable (Henseler, Ringle, & Sinkovics, 2009). Judging from the calculation formula of the α coefficient, if the sample size is larger than 200, and the more questions of the variable, the α coefficient is usually higher. To determine the question items that affects the reliability, you can calculate the Corrected Item-

Total Correlation (CITC) value. If the CITC is lower than 0.4, or the alpha coefficient is increased after the deletion, you can consider deleting the corresponding question.

Reliability analysis requires a separate analysis of each variable. Following, we will use SPSS 24 software to analyze the reliability of four variables and their dimensions: Mobile Health Technology Use, Clinical Process Change (Physician-patient Interaction and Information Accessibility), Service Quality (Tangibility, Reliability, Responsiveness, Assurance, Empathy, Convenience) and Patient Satisfaction (Treatment Outcome and Visit Time). The question items of each variable have already been the result of exploratory factor analysis in pilot test. The α coefficients of the variables or dimensions are summarized in Tables 5-3.

Table 5-3 Reliability analysis of variables and dimensions

Variables	Dimensions	No.	Items	Corrected Item-Total Correlation (CITC)	Cronbach's Alpha if item Deleted	Cronbach's Alpha
MHTU		2a	Make an appointment for doctor	.500	.835	0.839
		2b	Pay for medical related expenses	.571	.821	
		2c	Check laboratory reports and medical records	.679	.799	
		2d	Interact with the doctor you want to consult online at any time	.719	.790	
		2e	Communicate with other patients	.649	.806	
		2g	Learn about health education information and medical information pushed by hospitals	.587	.818	
CPC	Information Accessibility	3f	Now I can keep in touch with other patients online	.652	.825	0.848
		3g	I can now ask the medical staff questions via SMS on the Internet	.727	.790	
		3t	I can easily access and store my medical information now	.703	.804	
		3u	I can now access and process my medical information anytime and anywhere	.688	.808	
	Physician-patient Interaction	3a	Now I can make an appointment to the doctor who I want to see every time	.404	.710	0.713
		3l	I actively seek other information related to my health	.436	.692	
		3dd	The doctor will answer my questions adequately	.590	.601	
		3ff	Doctors offer other information about my condition and treatment on their own initiative	.594	.595	
PS	Treatment Outcome	4b	I'm very satisfied with the doctor's attitude	.736	.811	0.861

		4c	I am very satisfied with the quality of the doctor's treatment	.722	.817	
		4d	My illness has been properly treated	.718	.818	
		4f	After talking with the doctor, I feel a lot better about my condition	.654	.845	
	Visit Time	4j	I am satisfied with the waiting time in the hospital	.869		0.930
		4k	I'm satisfied with the total time spent on this visit	.869		
SQ	Tangibility	5a2	The hospital is clean	.713	.843	0.872
		5b2	The hospital's medical equipment is very advanced	.779	.816	
		5c2	Doctors and nurses dress professionally and neatly	.756	.826	
		5d2	The signs of hospital facilities are very clear	.664	.862	
	Empathy	5g2	My doctor is very concerned about my personal situation	.750	.855	0.886
		5h2	My doctor is based on my special condition	.766	.849	
		5i2	My doctor understands my specific needs	.751	.854	
		5j2	My doctor is concerned about my unique needs	.739	.859	
	Assurance	5o2	My doctor has good medical knowledge	.691	.835	0.857
		5p2	My doctor is trustworthy	.777	.755	
		5q2	My doctor is very experienced	.723	.806	
	Convenience	5r2	I can easily make an appointment with the doctor I want to see	.693	.719	0.815
		5s2	I can easily make an appointment to the time I want to see a doctor	.751	.659	
		5u2	I don't have to wait long in hospital	.565	.850	
	Reliability	5z2	My medical record in the hospital is always accurate	.710	.795	0.848
		5aa2	There are few inconsistencies in my medical records	.755	.751	
		5bb2	The service of medical staff is always reliable	.687	.816	
	Responsiveness	5dd2	I always get prompt answers when I contact the hospital	.546	.776	0.796
		5ee2	Doctors and nurses are not too busy to answer my questions in time	.616	.743	
		5ff2	My doctor will keep updated of my condition changes	.653	.722	
		5gg2	My doctor will make quick adjustments to my condition	.620	.739	

According to the above statistical Tables 5-3, the α coefficient of MHTU is 0.839; the α coefficient of two dimensions of CPC, the Information Accessibility and Physician-patient Interaction, is 0.848 and 0.713 respectively; The six dimensions of SQ, Tangibility, Empathy, Assurance, Convenience, Reliability and Responsiveness, have α coefficient of 0.872, 0.886,

0.857, 0.815, 0.848, and 0.796, respectively. The two dimensions of patient satisfaction are treated. The α coefficient of the two dimensions of PS, Treatment Outcome and Visit Time, are 0.861 and 0.930 respectively. The above results show that the reliability of each variable and dimension is very high, and the CITC values of all the questions are greater than 0.4 and deleting any one of the questions does not improve the overall α coefficient. Therefore, the above 11 variables (including all dimensions), 41 question items are not modified or deleted.

The questionnaire needs to be analyzed for content validity and structure validity. Content validity is determined by literature reference, expert interviews and pre-test. The items used in this study mainly refer to the scales used by previous researchers, as well as the experience and opinions of experts, and after revision, the content fully conforms to the conceptual description of relevant variables.

In this study, SPSS 24 statistical software was used to conduct exploratory factor analysis to verify the validity of the questionnaire structure. Before exploratory factor analysis, KMO (Kaiser-Meyer-Olkin) statistics and Bartlett spherical test are used to determine whether the data were suitable for factor analysis. If the KMO value is greater than 0.6, which is the general standard, and the P value of Bartlett spherical test is 0.000, less than 0.01, it is suitable for factor analysis. Through the structure validity analysis of four variables: Mobile Health Technology Use (MHTU), Clinical Process Change (CPC), Service Quality (SQ) and Patient Satisfaction (PS), the results are as follows:

In Table 5-4, the KMO value is 0.793, which passes through Bartlett spherical test, and one factor is extracted by setting up in advance. According to the correlation of the items and the load coefficient, the question items are removed successively, so that the load coefficients of all the remaining question items are greater than 0.6, the minimum is 0.638, and the cumulative variance interpretation rate of the factors is 55.584%. Considering that the main functions of mobile medical software are appointment, registration, payment and information exchange, the corresponding relationship between the item and the factor is in line with the professional situation, and the MHTU variable has good structural validity.

When validating the structural validity of 38 items of the variable of CPC, with the eigenvalue greater than 1, five factors are extracted. The question items with loading coefficient less than 0.6 and those with "double loading" phenomenon are deleted round by round. After several round factor analysis, two factors are finally extracted. The corresponding dimensions are Physician-patient Interaction and Information Accessibility. In Table 5-5, the KMO value is 0.731. Passing through Bartlett spherical test, the load

coefficients of all question items are greater than 0.6, the minimum is 0.635, and cumulative variance interpretation rate is 62.623%. The corresponding relationship between item design and factor conforms to the professional knowledge, so the CPC variable has good structural validity.

Table 5-4 Summary of structural validity analysis of MHTU[a]

No.	Items	Factor 1
2a	Make an appointment for doctor	.638
2b	Pay for medical related expenses	.720
2c	Check laboratory reports and medical records	.796
2d	Interact with the doctor you want to consult online at any time	.822
2e	Communicate with other patients	.767
2g	Learn about health education information and medical information pushed by hospitals	.715
Eigenvalue		3.335
Cumulative Variance Interpretation Rate		55.584
KMO		.793
Bartlett's Test of Sphericity		1658.439
Sig		0.000

Extraction Method: Principal Component Analysis
a:1 component extracted.

When validating the structural validity of 14 items of PS, three factors were extracted based on eigenvalue greater than 1. The question items with loading coefficient less than 0.6 and those with "double loading" phenomenon are deleted round by round. After a few round factor analysis, two factors are finally extracted. The corresponding dimensions were: Treatment Outcome and Visit Time. In Table 5-6, the KMO value is 0.739, passing through Bartlett spherical test, the loading coefficients of all question items are greater than 0.8. The cumulative variance explanatory rate after factor rotation is 78.417%. The corresponding relationship between item design and the factors conforms to the professional knowledge, so the PS variable has good structural validity.

Table 5-5 Summary of structural validity analysis of CPCa

No.	Items	Factor 1	2
3f	Now I can keep in touch with other patients online	.817	
3g	I can now ask the medical staff questions via SMS on the Internet	.844	
3t	I can easily access and store my medical information now	.807	
3u	I can now access and process my medical information anytime and anywhere	.800	
3a	Now I can make an appointment to the doctor who I want to see every time		.635
3l	I actively seek other information related to my health		.647
3dd	The doctor will answer my questions adequately		.817
3ff	Doctors offer other information about my condition and treatment on their own initiative		.783
	Rotated Eigenvalue	2.760	2.250
	Rotated Variance Interpretation Rate	34.501	34.501
	Cumulative Variance Interpretation Rate	28.123	62.623
	KMO	.731	
	Bartlett's Test of Sphericity	2224.485	
	Sig	0.000	

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalizion
a: Rotation converged in 3 iterations.

Table 5-6 Summary of structural validity analysis of PS[a]

No.	Items	Factor 1	2
4b	I'm very satisfied with the doctor's attitude	.837	
4c	I am very satisfied with the quality of the doctor's treatment	.815	
4d	My illness has been properly treated	.842	
4f	After talking with the doctor, I feel a lot better about my condition	.807	
4j	I am satisfied with the waiting time in the hospital		.950
4k	I'm satisfied with the total time spent on this visit		.950
Rotated Eigenvalue		2.785	1.920
Rotated Variance Interpretation Rate		46.409	32.008
Cumulative Variance Interpretation Rate		46.409	78.417
KMO		.739	
Bartlett's Test of Sphericity		2128.748	
Sig		0.000	

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalizion
a: Rotation converged in 3 iterations.

In the verification of structural validity for the 33 question items of SQ, the six factors are extracted, and the question items with the loading coefficient less than 0.6 and the questions with the "double loading" phenomenon are gradually deleted. After multiple rounds of factor analysis, the final six factors are extracted, and the corresponding dimensions are:

Tangibility, Empathy, Assurance, Convenience, Reliability and Responsiveness. In Table 5-7, the KMO value is 0.943, passing through the Bartlett spherical test, the loading factor of all question items is greater than 0.6, and the cumulative variance interpretation rate after the factor rotation is 73.785%. The correspondence between the item design and the factor is in line with the professional knowledge, so the SQ variable has good structural validity.

Table 5-7 Summary of structural validity analysis of SQ[a]

No.	Items	Factor 1	2	3	4	5	6
5a2	The hospital is clean	.784					
5b2	The hospital's medical equipment is very advanced	.814					
5c2	Doctors and nurses dress professionally and neatly	.799					
5d2	The signs of hospital facilities are very clear	.755					
5g2	My doctor is very concerned about my personal situation		.755				
5h2	My doctor is based on my special condition		.730				
5i2	My doctor understands my specific needs		.723				
5j2	My doctor is concerned about my unique needs		.765				
5o2	My doctor has good medical knowledge				.665		
5p2	My doctor is trustworthy				.730		
5q2	My doctor is very experienced				.768		
5r2	I can easily make an appointment with the doctor I want to see					.812	
5s2	I can easily make an appointment to the time I want to see a doctor					.834	
5u2	I don't have to wait long in hospital					.602	
5z2	My medical record in the hospital is always accurate						.709
5aa2	There are few inconsistencies in my medical records						.754
5bb2	The service of medical staff is always reliable						.618
5dd2	I always get prompt answers when I contact the hospital			.600			
5ee2	Doctors and nurses are not too busy to answer my questions in time			.787			
5ff2	My doctor will keep updated of my condition changes			.773			
5gg2	My doctor will make quick adjustments to my condition			.651			
Rotated Eigenvalue		3.187	3.011	2.623	2.292	2.256	2.125
Rotated Variance Interpretation Rate		15.177	14.340	12.491	10.912	10.744	10.121
Cumulative Variance Interpretation Rate		15.177	29.517	42.008	52.920	63.665	73.785
KMO		.943					
Bartlett's Test of Sphericity		7726.062					
Sig		0.000					

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalizion
a: Rotation converged in 6 iterations.

Through the factor analysis above, the corresponding relationship between the four variables and the factors basically meets the professional requirements. The factor loading coefficient is higher than 0.6, indicating that the validity of the questionnaire is good, and the data is valid.

5.3 Correlation analysis

The correlation analysis is to study whether there is a correlation between the two variables, and to use the correlation coefficient to express the degree of closeness of the relationship between the two variables. In this study, Pearson correlation coefficient was used for correlation analysis. The correlation coefficient ranged from 0.8 to 1.0 for very strong correlation; 0.6 to 0.8 for strong correlation; 0.4 to 0.6 for moderate correlation; 0.2 to 0.4 for weak correlation; and less than 0.2 for very weak correlation or no correlation.

In the correlation analysis, firstly, the four variables of Mobile Health Technology Use (MHTU), Clinical Process Change (CPC), Service Quality (SQ) and Patient Satisfaction (PS) are analyzed. Then, the four variables are analyzed at the dimension level, including MHTU, Physician-patient Interaction, Information Accessibility, Tangibility, Empathy, Assurance, Convenience, Reliability, Responsiveness, Treatment Outcome and Visit Time, totally 11 variables. All the related results above are summarized in the Appendix 3 and the Appendix 4.

Judging from the data in the correlation analysis, we can see that at the level of variables, the correlation coefficients between MHTU and CPC, MHTU and SQ, MHTU and PS are 0.647, 0.312 and 0.438, respectively, and are significant at the level of 0.01 confidence. Among them, MHTU is strongly correlated with CPC, and is moderately related to PS, and weakly related to SQ. The correlation coefficient between CPC and SQ is 0.495, which is significant at the level of 0.01 confidence, indicating that there is a moderate correlation between the two. The correlation coefficient between SQ and PSis 0.675, and it is significant at the level of 0.01 confidence. There is a strong correlation between the two, and there is a significant correlation between each dimension of SQ and PS.

The correlation analysis shows that at the dimension level, the correlation between MHTU and Information Accessibility is the strongest (correlation coefficient is 0.813, $P < 0.01$). Except for the moderate correlation with Visit Time (correlation coefficient is 0.401, $P < 0.01$), the others are weak or no correlation. Except for the strong correlation with MHTU, Information Accessibility is weakly or irrelevant to all other dimensions. There is a weak

correlation between Physician-patient Interaction and Tangibility (correlation coefficient is 0.368, $P < 0.01$), and there is a moderate correlation between Physician-patient Interaction and other five dimensions of service quality. There are weak correlations between the six dimensions of service quality and Visit Time. The most relevant is convenience (correlation coefficient is 0.396, $p<0.01$), while the six dimensions of service quality and Treatment Outcome are all moderately correlated.

According to the results of correlation among the variables and dimensions above, the models H1a, H1b, H1c, H2 and H3 have been preliminarily validated. Although the correlation analysis initially shows that the research hypothesis is established, indicating that there is a significant correlation between the variables, whether the correlation has a causal relationship, further analysis is needed by conducting regression analysis

5.4 Regression analysis and model hypothesis validation

In order to study the relationship between model variables, linear regression analysis or structural equation model (SEM) can be used. In this study, multiple linear regression analysis will be used to verify the relationship between independent variables and dependent variables. In validating the hypothesis of the model, the significance of the independent variable is verified first to prove whether the independent variable has an impact on the dependent variable, then judge whether the regression coefficient is positive or negative. If it is positive, it indicates the positive influence relationship. If it is negative, it indicates that it is negative. In order to prevent the interference caused by the sample demographic information, the study includes the patient's age, gender, occupation and education as control variables in the model for analysis, which are only displayed in the tables of regression analysis at variables level.

We will analyze the relationship between model variables from two levels. The first level is between four variables, and the second level is between the dimensions of variables. The following are three groups of independent variables and dependent variables for regression analysis. The three groups of independent variables and dependent variables are respectively:

Group 1: Independent variables: MHTU; Dependent variables: CPC (Physician-patient Interaction (PI) and Information Accessibility (IA))

Group 2: Independent variables: MHTU, CPC (Physician-patient Interaction (PI) and Information Accessibility (IA)); Dependent variables: SQ (Tangibility (Ta), Empathy (Em), Assurance (As), Convenience (Co), Reliability (Rel) and Responsiveness (Rel))

Group 3: Independent variables: MHTU, SQ (Tangibility (Ta), Empathy (Em), Assurance (As), Convenience (Co), Reliability (Rel) and Responsiveness (Rel)); Dependent variables: PS (Treatment Outcome (TO) and Visit Time (VT))

The results of the three groups at variables levelare summarized in Tables 5-8, 5-10, 5-12, respectively.

The results of the three groups at dimensions level are summarized in Tables 5-9, 5-11, 5-13, respectively.

Table 5-8 Coefficients[a/b] of group 1 at variable level

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R^2	Adjusted R^2	F	Durbin-Watson
		B	Std. Error	Beta						
1	(Constant)	2.701	.201		13.452	.000				
	Gender	-.021	.081	-.009	-.257	.797				
	Age	.004	.005	.034	.802	.423				
	Doctor	.341	.461	.027	.740	.460				
	Master	.096	.167	.021	.576	.565				
	Diploma	.098	.101	.037	.973	.331				
	High School	.183	.141	.052	1.298	.195				
	Junior Middle School	.188	.167	.046	1.122	.262				
	Primary School	.215	.200	.042	1.072	.284				
	Government	.129	.286	.017	.453	.651				
	Government-affiliated Institutions	.090	.150	.023	.602	.547	.404	.384	20.008**	1.952
	State-owned Enterprises	-.132	.154	-.033	-.861	.389				
	Foreign Enterprises	.015	.141	.004	.103	.918				
	Private Enterprises	-.022	.142	-.006	-.153	.879				
	Self-employed Households	-.034	.130	-.011	-.264	.792				
	Farmers	-.047	.212	-.009	-.223	.823				
	Students	.042	.162	.012	.258	.796				
	MHTU	.456	.026	.619	17.549	.000				

a. Predictors: (Constant), MHTU, Gender, Age, Government, Government-affiliated Institutions, State-owned Enterprises, Private-owned Company, Foreign Enterprises, Private Enterprises, Self-employed Households, Farmers, Students, Doctor, Master, Bachelor, Diploma, Vocational Technical School, High School, Junior Middle School, Primary School
b. Dependent Variable: CPC

Table 5-9 Regression analysis of group 1 at dimensions level

Dependent variable	Independent variable	Unstandardized		Standardized Coefficients	t	Sig.				
		B	Std. Error	Beta			R^2	Adjusted R^2	F	Durbin-Watson
IA	MHTU	.717	.037	.660	19.436	.000	.447	.428	23.810**	1.854
PI	MHTU	.196	.029	.284	6.693	.000	.138	.109	4.719**	1.848

*P<0.05, **P<0.01

Table 5-8, 5-9 shows that R^2 is 0.404, 0.447 and 0.138 in the relationship between the MHTU and CPC and its two dimensions. It shows that control variables and MHTU can explain 40.4% of the change of CPC, 44.7% of the change of Information Accessibility, 13.8% of Physician-patient Interaction, and the relationship models are fitted. The D-W values are 1.952, 1.854 and 1.848 respectively, which are close to 2, indicating that there is no autocorrelation. The p-values of F test are all 0.000. Therefore, at least one of the independent variables is determined to have an impact on CPC. In the independent variables, the regression coefficients of MHTU in Table 5-8 shows significant difference at the confidence level of p-value 0.01, and the regression coefficients were 0.456, which were greater than 0, indicating that MHTU has a positive impact on CPC, while the other variables have no effect. Therefore, H1c is valid.

In the regression analysis of the two dimensions of CPC, it is found in Table 5-9 that MHTU has a significant positive impact on both Information Accessibility (regression coefficient 0.717, P<0.01) and Physician-patient Interaction (regression coefficient 0.196, P < 0.01).

In Table 5-10 R^2 is 0.272 in the relationship between SQ and MHTU, CPC. It shows that the control variables and CPC can explain 27.2% of the changes of SQ. The model fits well. The D-W value is 1.882, close to 2, indicating that there is no autocorrelation, and the p-value of F test is 0.000. Therefore, at least one of the independent variables can be determined to have an impact on SQ. In the independent variables about patient demography, age and foreign enterprises have significant influence on the p-value of 0.01 confidence level. High schools and government-affiliated institutions have significant influence on the confidence level of p-value of 0.05, and the regression coefficient is 0.01. -.304, 0.238, -.221, indicating that age and high school have a positive impact on SQ, and government-affiliated institutions and foreign enterprises have a negative impact on SQ.

Table 5-10 Coefficients[a/b] of group 2 at variable level

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.				
		B	Std. Error	Beta			R^2	Adjusted R^2	F	Durbin-Watson
1	(Constant)	4.063	.174		23.354					
	Gender	-.045	.060	-.029	-.742	.458				
	Age	.010	.003	.134	2.887	.004				
	Doctor	-.386	.343	-.045	-1.128	.260				
	Master	-.049	.124	-.016	-.399	.690				
	Diploma	.040	.075	.023	.536	.592				
	High School	.238	.105	.100	2.269	.024				
	Junior Middle School	.213	.124	.077	1.715	.087				
	Primary School	.163	.149	.048	1.096	.274				
	Government	-.022	.212	-.004	-.105	.916				
	Government-affiliated Institutions	-.221	.112	-.083	-1.975	.049	.272	.246	10.392	1.862
	State-owned Enterprises	-.121	.114	-.045	-1.061	.289				
	Foreign Enterprises	-.304	.105	-.123	-2.895	.004				
	Private Enterprises	.020	.105	.008	.185	.853				
	Self-employed Households	-.101	.096	-.050	-1.053	.293				
	Farmers	-.186	.157	-.056	-1.187	.236				
	Students	.071	.120	.030	.592	.554				
	MHTU	-.011	.025	-.021	-.434	.665				
	CPC	.316	.033	.471	9.533	.000				

a. Predictors: (Constant), MHTU, CPC, Gender, Age, Government, Government-affiliated Institutions, State-owned Enterprises, Private-owned Company, Foreign Enterprises, Private Enterprises, Self-employed Households, Farmers, Students, Doctor, Master, Bachelor, Diploma, Vocational Technical School, High School, Junior Middle School, Primary School

b. Dependent Variable: SQ

Table 5-11 Regression analysis of group 2 at dimensions level

Dependent variable	Independent variable	Unstandardized		Standardized Coefficients	t	Sig.	R^2	Adjusted R^2	F
		B	Std. Error	Beta					
SQ	MHTU	.044	.024	.089	1.809	.071	.349	.325	14.110**
	IA	.032	.023	.069	1.391	.165			
	PI	.342	.029	.477	11.961	.000			
Ta	MHTU	.093	.035	.149	2.688	.007	.169	.137	5.330**
	IA	.047	.032	.081	1.445	.149			
	PI	.212	.041	.236	5.219	.000			
Em	MHTU	.029	.037	.040	.766	.444	.254	.225	8.925**
	IA	.065	.035	.099	1.853	.064			
	PI	.399	.044	.388	9.080	.000			
As	MHTU	.019	.033	.031	.581	.562	.219	.190	7.380**
	IA	.035	.031	.062	1.128	.260			
	PI	.331	.039	.369	8.437	.000			
Co	MHTU	.068	.042	.083	1.599	.111	.267	.239	9.554**
	IA	-.031	.040	-.041	-.775	.439			
	PI	.520	.050	.441	10.415	.000			
Rel	MHTU	.048	.034	.073	1.407	.160	.282	.255	10.308**
	IA	.065	.032	.105	2.008	.045			
	PI	.409	.041	.423	10.077	.000			
Res	MHTU	.008	.023	.018	.328	.743	.207	.177	6.856**
	IA	.003	.022	.007	.127	.899			
	PI	.240	.027	.389	8.819	.000			

*P<0.05, **P<0.01

In the study of the impact of MHTU and CPC on the dimensions of SQ, as shown in Table 5-11, according to the results of R^2 analysis, the models fit well, and the D-W value is close to 2, indicating that there is no autocorrelation and the p-value of F test is 0.000. Therefore, at least one of the independent variables had an impact on the dimensions of SQ. We find that the MHTU has a positive effect on Tangibility only (regression coefficient 0.093, $P = 0.007 < 0.01$), Physician-patient Interaction has a significant positive effect on the six dimensions of SQ, and Information Accessibility has a positive effect only on the Reliability of SQ (regression coefficient 0.065, $P = 0.045 < 0.05$).

Table 5-12 Coefficients[a/b] of group 3 at variable level

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R^2	Adjusted R^2	F	Durbin-Watson
		B	Std. Error	Beta						
1	(Constant)	.112	.271		.413	.680				
	Gender	-.018	.065	-.009	-.272	.786				
	Age	-.001	.004	-.014	-.381	.703				
	Doctor	-.325	.370	-.029	-.878	.381				
	Master	.423	.134	.103	3.164	.002				
	Diploma	.102	.081	.044	1.262	.208				
	High School	.055	.114	.017	.479	.632				
	Junior Middle School	.360	.135	.098	2.677	.008				
	Primary School	.027	.161	.006	.170	.865				
	Government	.211	.229	.031	.921	.357				
	Government-affiliated Institutions	.156	.121	.044	1.289	.198	.521	.504	30.201	1.965
	State-owned Enterprises	-.188	.123	-.053	-1.526	.128				
	Foreign Enterprises	.102	.114	.031	.896	.371				
	Private Enterprises	-.024	.114	-.007	-.214	.831				
	Self-employed Households	-.059	.104	-.022	-.567	.571				
	Farmers	-.201	.170	-.045	-1.181	.238				
	Students	-.086	.130	-.027	-.662	.508				
	MHTU	.162	.022	.246	7.479	.000				
	SQ	.784	.044	.589	17.651	.000				

a. Predictors: (Constant), SQ, MHTU, Gender, Age, Government, Government-affiliated Institutions, State-owned Enterprises, Private-owned Company, Foreign Enterprises, Private Enterprises, Self-employed Households, Farmers, Students, Doctor, Master, Bachelor, Diploma, Vocational Technical School, High School, Junior Middle School, Primary School

b. Dependent Variable: Patient Satisfaction

Table 5-13 Regression analysis of group 3 at dimensions level

Dependent variable	Independent variable	Unstandardized B	Unstandardized Std. Error	Standardized Coefficients Beta	t	Sig.	R^2	Adjusted R^2	F
	MHTU	.156	.022	.236	7.062	.000			
	Ta	.185	.042	.175	4.379	.000			
	Em	.192	.043	.207	4.477	.000			
PS	As	.068	.049	.064	1.382	.168	.525	.503	23.780**
	Co	.120	.033	.148	3.635	.000			
	Rel	.133	.048	.135	2.745	.006			
	Res	.042	.067	.027	.621	.535			
	MHTU	.075	.022	.119	3.472	.001			
	Ta	.175	.041	.173	4.216	.000			
	Em	.174	.042	.196	4.127	.000			
TO	As	.233	.048	.230	4.828	.000	.499	.475	21.395**
	Co	.012	.032	.015	.365	.715			
	Rel	.143	.048	.152	3.004	.003			
	Res	.033	.066	.022	.496	.620			
	MHTU	.317	.047	.274	6.719	.000			
	Ta	.205	.090	.110	2.271	.024			
	Em	.228	.092	.140	2.491	.013			
VT	As	-.262	.105	-.140	-2.495	.013	.297	.264	9.087**
	Co	.336	.071	.236	4.764	.000			
	Rel	.113	.104	.065	1.091	.276			
	Res	.060	.144	.022	.416	.678			

*P<0.05, **P<0.01

In the regression analysis of the influence of MHTU, SQ on PS, the Table 5-12 shows that R^2 is 0.521, which indicates that the control variables and CPC can explain 52.1% changes of PS, and the model fits well. The DW value is 1.965, which is close to 2, indicating no autocorrelation, and the p-value of the F test is 0.000, so at least one of the independent variables has an effect on PS. Also we can know from the correlation analysis that among the independent variables of patient demographic information, only the Master (regression coefficient of 0.423, p=0.002<0.01) and Junior high school (regression coefficient of 0.360, p=0.008<0.01) have positive effects on PS.

The regression coefficients of MHTU and SQ as independent variables are 0.162 and 0.784, respectively. The p-value of 0.01 confidence level shows significance, indicating that the above two variables have positive effects PS. Therefore, the assumptions of H1b and H3 are supported.

In the study of the impact of various dimensions of SQ on PS, as shown inTable 5-13, we findthat Tangibility (regression coefficient is 0.185, P = 0.000 < 0.01), Empathy (regression coefficient is 0.192, P = 0.000 < 0.01), Convenience (regression coefficient is 0.120, P = 0.000 < 0.01), Reliability (regression coefficient is 0.133, P = 0.006 < 0.01), has positive impacts on PS, while Assurance. (regression coefficient was 0.068, P = 0.168 > 0.01) and Responsiveness (regression coefficient was 0.042, P = 0.535 > 0.01) had no effect.

In the study of the influence of MHTU and the dimensions of SQ on Treatment Outcome and Visit Time, we find in Table 5-13that MHTU, Tangibility and Empathy have significant positive effects on the treatment results and the treatment time; assurance and reliability only had a positive effect on Treatment Outcome, but had no significant effect on Visit Time; Convenience only has a significant effect on Visit Time, while has no effect on Treatment Outcome; Responsiveness has no effect on both Treatment Outcome and Visit Time.

In conclusion, the validation results of the five hypotheses presented in this study are as follows.

H1a: MHTU has a positive impact on patient's perception of SQ, is not supported.

H1b: MHTU has a positive impact on PS, is supported.

H1c: The MHTU is positively related to CPC, is supported.

H2: The CPC has positive influence on perceived SQ in hospitals, is supported.

H3: The perceived SQ is positively related to PS, is supported.

5.5 Analysis of the gap between expectation and perception in terms of service quality

To understand the gap between patient expectations and actual performance of service quality in Shenzhen Eye Hospital, we use paired sample t test to analyze six dimensions of service quality. The whole results are attached in the Appendix 2 of thesis and the main outcomes are summarized as follows.

In the six dimensions of service quality, the average gap of each dimension is from 0.01564 to 0.44862, and the patients' actual perception of hospital service quality minus expectation is greater than zero, which indicates that patients' perceived service quality of Shenzhen Eye Hospital is higher than expectation. There are significant differences in Tangibility, Empathy, Assurance, Reliability and Responsiveness, P = 0.000 < 0.01, while

Convenience has no statistically significant difference, and the gap of Responsiveness between expectation-performance is the largest (0.44862) and Convenience is the smallest (0.01564).

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Chapter 6: Conclusions and Prospects

6.1 Summary of research results

“Three long and one short”, that is, long registration time, long waiting time, long medication-taking time and short consultation time are the management problems that Chinese hospitals need to solve urgently. Before dawn, the hospital outpatient hall has been crowded with patients from all over the country. During the peak period, patients may not be able to see the doctor even if the doctors are busy for the whole day. "Queuing for two hours and seeing a doctor for five minutes" is almost a terrible experience for all patients, which will inevitably lead to tense physician-patient relationship and intensified physician-patient contradiction. In order to solve the above problems and improve hospital management level, major hospitals continue to improve the management service mode, adopt the concept of patient-centered service, actively invest in the construction of mobile health Apps, so to improve the medical environment, optimize patient appointment, registration, medical treatment, payment, examination and treatment, medication and other processes, in order to reduce patient waiting time. With the rapid development of Internet information technology and the wide application of mobile health technology in hospitals, information exchange between patients and medical staff and hospitals becomes more efficient and efficient, which has a positive effect on improving the quality of hospital services and patients' experience of medical treatment process. Therefore, it is very important to study how the use of mobile health technology affects the quality of hospital services and improve patient satisfaction.

This study has reviewed the research results of the predecessors, reviewed the dimensions of hospital service quality and the influencing factors affecting patient satisfaction, and constructed a theoretical model of how the use of mobile health Apps affects patient satisfaction through expert interviews. Then the theoretical model and five hypotheses are tested by statistical method, and the relevant conclusions and suggestions are finally obtained. In the research measurement model, we believe that the use of mobile health Apps can positively affect the quality of hospital service (H1a) and patient satisfaction (H1b), respectively. In addition, the use of mobile health Apps can positively affect the quality of hospital service (H1c, H2) through the intermediate role of clinical process change perceived

by patients. Finally, the quality of hospital service positively affects patient satisfaction (H3). After the analysis of the questionnaire data, except hypothesis H1a is not supported, the other four hypotheses are confirmed. The results of each hypothesis are as follows:

When validating H1a and H1b, the study found that the use of mobile health Apps was moderately correlated with patient satisfaction (correlation coefficient 0.4, $p<0.01$), and weakly correlated with hospital service quality (correlation coefficient 0.292, $p<0.01$). Mobile health Apps use had no effect on service quality but had a positive effect on the tangible dimension of service quality (regression coefficient was 0.093, $P = 0.007$ $p<0.01$), but it has a positive impact on patient satisfaction, and both of two dimensions, Treatment Outcome and Visit Time. This is in line with Wang (2013) in the study of the impact of technology-based physician-patient service contact on patient satisfaction and Jen, Chao, Hung, Li, and Chi (2007) in the study of the use of mobile information communication equipment on patient satisfaction. The results of service quality and patient satisfaction were consistent. This study believes that the use of mobile health Apps has a positive impact on patient satisfaction but has no impact on service quality because of the conceptual differences in satisfaction and service quality. Satisfaction is the overall evaluation of the hospital's service through the actual experience. This feeling is short-lived and immediate. The perception of service quality is the patient's understanding of the hospital's service content. The understanding is long-term, not necessarily through personal experience. Experiences such as patients who think that the level of a doctor in a hospital or the quality of a hospital is high can be learned through the notification or publicity of others, advanced equipment technology or a beautifully renovated building. This is why the use of medical software will be the tangible nature of service quality has a positive impact. It can be seen that the use of mobile health Apps is the patient's personal experience, and the perception it produces must be more closely related to satisfaction than the quality of service. This can also be confirmed by the correlation analysis results.

In the verification of H1c and H2, the study finds that there is strong correlation and moderate correlation, respectively, between MHTU and CPC (correlation coefficient 0.647, $p<0.01$), and CPC and SQ (correlation coefficient 0.495, $p<0.01$). MHTU has a positive effect on CPC and its two dimensions, which is consistent with the results of Petter and Fruhling (2011) in studying the changes in clinical processes perceived by patients after using the Statpack TM system to help diagnose pathogens in hospitals. However, only physician-patient interaction has a significant positive impact on service quality and its dimensions, which is

consistent with Hung (2016) finding that physician-patient interaction has a positive impact on patient service quality. In addition, since the use of mobile health Apps has no effect on the quality of service, this indicates that the change in the patient's experience in clinical process is an intermediate variable affecting the quality of service used by mobile health Apps. That is, the use of mobile health Apps first changes the patient's experience in clinical process, thereby changing the patient's perception of hospital service quality, the investment of mobile health Apps itself will not lead to an increase in service quality.

When validating H3, the study finds that there is a strong correlation between service quality and patient satisfaction (correlation coefficient was 0.675, $p<0.01$). Hospital service quality had a positive impact on patient satisfaction (regression coefficient was 0.784, $p<0.01$). This result is consistent with the results of many scholars (Reidenbach & Sandifer-Smallwood, 1990; Andaleeb, 2001; Geertzen et al., 2002; Geertzen et al., 2002; Lee & Yom, 2007; Chang & Chang, 2008; Kim et al., 2008; Akter et al., 2012; Aliman & Mohamad, 2013; Akter, D'Ambra & Ray, 2013; Panchapakesan et al., 2015; Joseph & Ganesan, 2015; Lanka, 2016; Meesala & Paul, 2016; Wu et al., 2016; Kim et al., 2017). When discussing the impact of various dimensions of hospital service quality on patient satisfaction, we found that in addition to Assurance and Responsiveness, the other four dimensions have a positive impact on patient satisfaction. But when we study the effect of service quality on two dimensions of patient satisfaction (Treatment Outcome and Visit Time), we find that Assurance has a positive effect on satisfaction of treatment results, and Convenience has a positive effect only on satisfaction of time to see a doctor.

We analyze that the possible reason that the Assurance has no effect on the overall satisfaction of the patient but has an influence on the dimension of the Treatment Outcome is that the Assurance measurement content is mainly the evaluation of the doctor's knowledge and ability level. In view of the complexity of medical knowledge and skills, it is impossible for the patient to understand the true professional level of the medical staff, but only through the hospital's relevant publicity to the doctor to know the professional level of the doctor. For example, the hospital will disseminate each doctor's academic qualifications, professional titles, rewards and other information through the mobile health Apps or the hospital's publicity boards to pass on to the patients. Usually, the information about the doctor's technical level is positive, which makes the patients tend to highly evaluate each doctor. This is also obtained in this study, where as evidence, we find that the Assurance ranks second in the six dimensions, 6.0154, at a higher evaluation level. However, patient satisfaction is the

immediate feeling after the patient experience visit, and it is irrelevant to the patient's perception of the doctor's professional skill level. It is only related to the patient's feelings about the treatment outcome, which may explain why the dimension of Assurance has a positive impact on the treatment outcome.

The possible reasons why Responsiveness has no effect on patient satisfaction and its dimensions in this study are analyzed as follows. In the environment of Chinese hospitals, patients not only attach importance to the treatment results, but also care about the feeling of the treatment process, especially the time of seeing a doctor. This is an important reason why this study regards the time dimension of seeing a doctor as the patient's satisfaction. The Responsiveness measures the timeliness of the medical staff to serve patients, which is different from the treatment outcomes that patients most concerned about, and also is irrelevant with the visit time. The satisfaction of the visit time is mainly affected by the convenience, of which, the main content is the time of medical treatment and waiting, as well as the difficulty of making an appointment with a doctor. Because in a Chinese hospital, it is possible to make an appointment to a doctor to greatly reduce the time of medical treatment and waiting. Responsiveness is not unimportant to patients, perhaps because other dimensions are more important. When we remove convenience dimension in regression analysis, responsiveness will have a significantly positive impact on satisfaction. The above analysis may be the reason why the responsiveness of patients in this study does not affect their satisfaction evaluation.

In addition, in the analysis of the relationship between patient demographic information and service quality, the findings of this study are as follows:

Most studies have shown that age has no effect on service quality, while other studies have concluded that the younger the age, the greater the gap between service quality expectation and performance perception (Papanikolaou & Zygiaris, 2014). This study finds that the older the age, the higher the service quality perception. As for gender, Meesala and Paul (2016) find that women who are satisfied with their services are more likely to visit hospitals again. Geertzen et al. (2002) observe significant differences in overall satisfaction between men and women, but this study does not find that gender has an impact on service quality. Güllü et al. (2017) show that patients with lower levels of education have higher perceived quality of service than those with higher education. In this study, although statistics show that high school students have a positive impact on service quality, on the whole, there is no significant impact of education on service quality. Income is related to quality of service

(John et al., 2011). The higher the patient's income, the higher the patient's perception of quality of service (Güllü et al., 2017). Although there is no statistical information on patients' income in this study, we find that public institutions and foreign enterprises have a significant negative effect on the perception of service quality. The income of employees in these two units normally is not high, ranking at average level in Shenzhen. From the above results, we can see that the impact of patient demographic information on service quality is various in different studies. Researchers need to consider the impact of patients' personal characteristics on service quality in a specific context.

6.2 Research contribution

The academic and practical contributions of this study to the field of hospital management in China are as follows:

In terms of academic contributions, there are three main points:

Firstly, in China's medical environment, four variables are redefined, including Mobile Health Technology Use, Clinical Process Change, Service Quality and Patient Satisfaction, and the corresponding scale is improved or developed. At the same time, the relationship between the four variables is studied, which has not appeared in previous research reports.

Secondly, in China's special medical environment, it is proposed that patients use mobile health Apps to influence the quality of service through the perceived changes of clinical process as an intermediate variable, which has never appeared in previous literature reports.

In this study, the main measurement content of Clinical Process Change is the interaction between doctors and patients and the change of patient access to relevant medical information after the application of mobile health Apps. According to the results of data analysis, only physician-patient interaction has a positive effect on improving the perception of all dimensions of service quality. From this, it can be seen that patients' perception of service quality is enhanced by the degree of interaction and communication between doctors and patients. The effect is greater than that of patients' information acquired after physician-patient interaction. Interactive communication is reflected in patients' ability to appoint the doctor they want, the initiative of communications between doctors and patients. Secondarily, patients can actively communicate with medical staff and patients through the medical Apps to obtain information related to medical treatment, which makes it easier to understand the

medical records and all kinds of medical records are correct, which has a positive role in improving the reliability of hospital service quality.

In a word, only by improving the efficiency of patients' use of mobile health Apps, can we change patients' experience of diagnosis process, and then improve the quality of hospital services and patient satisfaction.

Thirdly, in view of the background of difficult medical treatment and poor medical environment in Chinese hospitals, this paper proposes to increase convenience as the dimension of hospital service quality, which has been verified and supplemented the original five dimensions of SERVQUAL scale. In factor analysis, the convenience dimension extracts three questions and is co-loaded under the same factor. The contents are easy to make appointments with doctors, easy to reserve time for wanting to see a doctor, and do not need to wait for a long time. These contents are just what the current Chinese patients feel most difficult about seeing a doctor. Therefore, the patients in this study use the convenience content as an important aspect to evaluate the quality of hospital services. In the hospital where information technology is applied, convenience is one of the most influential dimensions of service quality. The reason behind this may be that the patient has a phenomenon of “interest shift”. This study defines “interest shift” as a change in patient interest. Information technology used by hospitals or patients can shorten the time of clinical treatment and promote information exchange between patients and hospitals. Chang and Chang (2008) argued that "among the factors affecting the quality of service, hospital visiting time (convenience) is the most direct factor affecting patients' and patients' perception of hospital service quality". As a result, patients can feel that using information technology has more advantages than not using information technology, so the most concerned problems of patients will be transferred from other clinical aspects to the level of convenient and interactive communication.

Therefore, in the future, researchers can consider convenience as one of the evaluation dimensions when designing a scale for measuring the quality of hospital services in China.

In terms of practical contributions, there are three main points:

First, when a hospital uses a new technology or new equipment, in order to ensure the effectiveness of technology or equipment investment, managers should pay attention to the evaluation method of technology or equipment use process. Patients who use new technology or equipment to experience satisfaction have some progressive influence factors. For example, through this study, we learn that after using the software, the patient first feels the change of

the clinical process, and then perceives the change of hospital service quality, and ultimately affects satisfaction changes. Therefore, when hospital managers invest in equipment or system, they should not only pay attention to the management of system use, but also pay attention to the factors affecting the results of system use. According to the conclusion of this study, after the new technology and equipment are put into use, we should first pay attention to the changes of patients' experience in the clinical process, such as the appointment and registration function of mobile health Apps, which can alleviate the crowded queue phenomenon in front of the registration window, rationally arrange the waiting management and reduce the waiting time of patients; the online payment function can avoid the queuing of patients to pay registration fees, treatment fees and medical fees; online medical staff information inquiry, access to examination and treatment reports and interaction with medical staff, can improve the efficiency of physician-patient information exchange and consultation process. In this study, the appointment registration and online payment are the most commonly used functions of mobile eye-care Apps for patients in Shenzhen Eye Hospital. Therefore, the change in the clinical process mainly lies in the fact that the patient's visit process before using the mobile health Apps is: registration-payment—entrance test - payment - examination - taking reports - payment - taking medicine / treatment, the change in the clinical process after using mobile health Apps is: consultation - examination - taking medicine / treatment, this change greatly reduces hospital management costs, promotes management efficiency and improves patient satisfaction with excellent clinical experience.

In addition, according to the research results, managers should pay attention to enhancing the initiative of physician-patient interaction, because it is an important factor affecting patients' perception of hospital service quality. Therefore, the functions of mobile health Apps or similar information technology should be developed around enhancing the initiative of physician-patient interaction. For example, managers could improve the platform of physician-patient communication of mobile health Apps, so that patients can be there easily. On the platform, it would be easier to make appointments with the medical staff you want, and could communicate effectively at any time, send pictures, videos and other information, so as to increase the enthusiasm and initiative of communication between the two sides.

Second, in the face of hospitals with large outpatient visits in China, the evaluation of hospital service quality should be considered for convenience added in to the five dimensions commonly used for SERVQUAL. In this study, we find that hospitals serving larger populations and patients in larger hospitals are more concerned about convenience. Two

hospitals in the literature (Cegarra-Navarro, 2011; Chang et al., 2015) have a capacity of 880 and 600 beds, which can be considered as large hospitals. The patients consider convenience as the primary factor affecting service quality. It may be that large hospitals in high-density populations tend to have crowded patients, making clinical processes inefficient and patients feeling terrible clinical experience. As the research object, Shenzhen Eye Hospital is a public hospital in Shenzhen. More patients gather for treatment, and the annual outpatient volume is more than 400,000, which makes patients consider the convenience much more of their concerns. Therefore, in this context, convenience may be a dimension that patients have a greater impact on service quality perception. In addition, we do not find the convenience dimension in the systematic literature to study the quality of service in private hospitals. We conclude that private hospitals may not have the problem of the crowded, usually with very few patients and spacious spaces.

In a word, as hospital managers in China, when evaluating the quality of hospital service in the future, we need to consider adding convenience dimension, especially for hospitals with large outpatient volume, while applying the five dimensions of SERVQUAL.

Third, through the empirical research, it shows that the use of mobile health Apps has a certain effect on alleviating the difficulty of seeing a doctor and the disorder of medical treatment in a public hospital in China and improving the quality of hospital services and patient satisfaction. In this study, we analyze the gap between patient's perception of service quality and expectations. The gap is often used to study the status of service quality in a hospital and the aspects that need to be improved for managers. In this study, the actual experience of patients in Shenzhen Eye Hospital is higher than expected, which shows that the hospital can adopt the management concept centered on the patient experience, improve the medical environment and improve the efficiency and level of hospital service management. This also proves from another angle that after the Shenzhen Eye Hospital adopts the mobile health Apps, the experience of the patient's clinical process is significantly improved, and it has a significant impact on the improvement of satisfaction.

Fourth, the patient's perception of service quality can directly affect patient satisfaction. According to the conclusion of this study, hospital administrators need to pay special attention to the quality of service content closely related to patient experience, such as Responsiveness and Empathy related to physician-patient interaction, Convenience and Reliability associated with access to information, because patient satisfaction is closely related to the actual experience in clinical process.

6.3 Research limitations

Due to the weak points of the author's research ability and case data, this study still has some limitations in the research model integrity, sample selection and research methods.

1. The research model is not comprehensive enough. This research model mainly explores the influence mechanism of mobile health Apps usage on patient satisfaction, which involves three independent variables: mobile health Apps usage, clinical experience changes and service quality, but does not consider the relevant factors that affect the use of mobile health Apps, because these factors are bound to have an impact on patient satisfaction.

2. There are many question items in questionnaire, which tend to interfere with the quality of the survey. Although 4 variables and 10 dimensions are introduced into the measurement model in this study, 92 items are involved in the pilot test, which made it difficult for patients to control their cooperation in answering questions, thus affecting the quality of the questionnaire.

3. The case selection is single. The case of this study is only a public hospital, Shenzhen Eye Hospital, so the sample source is rather single, the representativeness and comprehensiveness of the research results are not enough.

4. The relationship between variables is not subdivided enough. Although this study extracts and validates the dimensions of various variables, such as changes in clinical process experience, quality of service and patient satisfaction, it does not elaborate the impact between the question items.

6.4 Future research directions

In view of the conclusions and limitations of this study, the following aspects could be paid more attention to in future research:

1. In investigating the impact of mobile health technology on patient satisfaction, other influencing factors should be considered, such as factors affecting the use of mobile health technology, including the patient's ability to learn about science and technology, social influence factors, and perceived features of mobile technology, which make the research model more comprehensive and deeper into understanding the mechanisms by which mobile health technologies affect patient satisfaction.

2. Choosing research objects could be more comprehensive, such as considering general hospitals as research objects, conducting comparative studies between public and private hospitals, and considering comparative studies of similar hospitals in different regions, and then finding more factors affecting patients' satisfaction.

3. Further in-depth analysis of the variables involved in this study, such as interviews with more experts, in order to hope that the variables and their questionnaires can better fit in with the research of patient satisfaction in the context of mobile technology use.

4. Investigate the functions of mobile health Apps and the design of user interface, especially the design and development of interactive interfaces that can enhance the communication enthusiasm between doctors and patients and improve the usability of software.

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Appendix 1: Questionnaire

Study on Evaluation, Use and Application Result of Mobile Health Apps in Hospitals

Respected patients:

Thank you for participating in this Ph.D. thesis survey. The data collected in this questionnaire is purely used for the purpose of doctoral thesis research. Our statistical analysis is based on the comprehensive results of all questionnaires, and no personal data will be analyzed and stored. Therefore, please answer all your questions based on your own personal experience and real feelings. This questionnaire consists of five parts:1) Background information, 2) patient opinions and usage of the mobile health Apps, 3) patients' evaluation of the hospital's experience of seeing a doctor after using the mobile health Apps, 4) patient satisfaction with the experience of seeing a doctor, 5) patients' expectations and actual feelings of the hospital's service quality. It takes about 20 minutes to complete the questionnaire. Thank you very much for your support and help in this doctoral dissertation.

In this study, the functions of the mobile health Apps include making appointment, online consultation, and inquiring information through the mobile health Apps (for example, Wechat health client); payment for medical expenses through the mobile health Apps; doctors and patients communicate online through the mobile health Apps; inquiry and understanding of medical information and so on.

Name of hospital: Questionnaire Date:

Part I: Background Information

Please provide the following background information to help us better understand your medical needs and the specific situation of using Wechat health client:

a. The types of ocular disease (please choose one): ametropia; visual fatigue; ocular surface diseases; cataract; glaucoma; fundus diseases; strabismus and amblyopia; trauma

b. What is the purpose of coming to this hospital today? (Please choose one): Initial Re-visit

Accompanied, Other (please note): _____

c. Gender:male; female

d. Age:

e. Your occupation: Government Government-affiliated institutions State-owned Enterprises Private-owned company Foreign Enterprises Private Enterprises Self-employed Households Farmers__ Other (please specify): _____

f. Highest Education: _ Doctor _ Master _ Bachelor _ Diploma _ Vocational Technical School _ High School Junior Middle School Primary School

g. What mobile software do you use to see a doctor: Wechat Health Client; Health 160; Others (please specify):_____

h. When do you first start using Wechat (e.g. 2015): _____

i. The average time you use Wechat every day is about _____mins

j. Which year did you first use the Wechat Health Client: _____

k. Which year was your first visit to this hospital: _____

l. How many times have you visited this hospital in the last three years? Times

m. In the total number of visits you filled out in the previous question, how many times have you applied Wechat Health Client to do the following things?

(1) Making appointment times

(2) Payment times

(3) Inquiry for laboratory reports and medical records times

(4) Consulting doctors times

(5) Inquiry and understanding of medical information (such as health education information, vaccine information, doctor's profile, etc.) times

Note: If no mobile health Apps is used, stop answering questions. If you use the Wechat Apps, and answer all questions based on the Wechat Health Client. If you use Health 160 or other similar software, answer all questions based on Health 160 or other similar software.

Part II: Patient's Views and Use of Wechat Health Client

Please circle "O" and choose a number to indicate your agreement with each of the following statements (1 for disagreement, 7 for agreement). There are no objective answers or criteria for scoring. Please judge and estimate according to your experience, feelings and observations. Please answer all the questions.

2. I am going to the hospital to see a doctor now, basically using the Wechat Health Client..

a.	Make an appointment for doctor	1	2	3	4	5	6	7
b.	Pay for medical related expenses	1	2	3	4	5	6	7
c.	Check laboratory reports and medical records	1	2	3	4	5	6	7
d.	Interact with the doctor you want to consult online at any time	1	2	3	4	5	6	7
e.	Communicate with other patients	1	2	3	4	5	6	7
f.	Ask medical staff questions via SMS	1	2	3	4	5	6	7
g.	Learn about health education information and medical information pushed by hospitals	1	2	3	4	5	6	7

Part III: Evaluation of patients experience of seeing a doctor after using Wechat Health Client

3 Since the hospital started the Wechat Health Client, it has changed the experience of my experience compared with before.

a.	Now I can make an appointment to the doctor who I want to see every time	1	2	3	4	5	6	7
b.	When I choose a doctor, I can get information about the doctor's background and experience online	1	2	3	4	5	6	7
c.	When I choose a doctor, I can see other patients' scores and assessments on the Internet	1	2	3	4	5	6	7
d.	After seeing the doctors, I can rate the doctor online.	1	2	3	4	5	6	7
e.	Now I can manage and treat my disease more effectively	1	2	3	4	5	6	7
f.	Now I can keep in touch with other patients online	1	2	3	4	5	6	7
g.	I can now ask the medical staff questions via SMS on the Internet	1	2	3	4	5	6	7
h.	Every link in my medical treatment process is now more coherent	1	2	3	4	5	6	7
i.	I am maintaining a continuous communication relationship with my doctor	1	2	3	4	5	6	7
j.	Now the queue has been reduced in every link of my medical treatment	1	2	3	4	5	6	7
k.	I took the initiative to participate in discussions with doctors about treatment options	1	2	3	4	5	6	7
l.	I actively seek other information related to my health	1	2	3	4	5	6	7
m.	I take the initiative to participate in learning preventive treatment information	1	2	3	4	5	6	7
n.	After I see a doctor, I will take the initiative to follow up and complete all the required treatments	1	2	3	4	5	6	7
o.	I took the initiative to help the doctor determine my health and problems	1	2	3	4	5	6	7
p.	The medical staff in the hospital now know the records of every link of my visit very well	1	2	3	4	5	6	7
q.	In every aspect of my medical treatment process, the data related to me can be checked in time	1	2	3	4	5	6	7
r.	In every aspect of my medical treatment, medical staff are now in harmony with each other	1	2	3	4	5	6	7
s.	It's easy for me and the medical staff to make a common agreement now	1	2	3	4	5	6	7
t.	I can easily access and store my medical information now	1	2	3	4	5	6	7
u.	I can now access and process my medical information anytime and anywhere	1	2	3	4	5	6	7
v.	Now, when I am in the hospital, the medical staff in different departments are well coordinated with each other	1	2	3	4	5	6	7
w.	Now even if I am looking for a different doctor in the hospital, the process of diagnosis and treatment is consistently standardized	1	2	3	4	5	6	7
x.	I can now check the medical records of the past at each stage of the hospital	1	2	3	4	5	6	7
y.	Now if the medical staff I'm looking for is not there, other medical staff can meet my needs	1	2	3	4	5	6	7
z.	Now the doctor can give me the most suitable treatment according to my personal condition and complete historical information	1	2	3	4	5	6	7
aa.	Now my doctor's treatment plan is consistent with my changing needs and conditions	1	2	3	4	5	6	7
bb.	Now that I'm in the hospital, I know exactly who I'm looking for at every step	1	2	3	4	5	6	7
cc.	The doctor encouraged me to ask questions	1	2	3	4	5	6	7
dd.	The doctor will answer my questions adequately	1	2	3	4	5	6	7
ee.	The doctor actively encouraged me to participate in discussions with the doctor about treatment options	1	2	3	4	5	6	7
ff.	Doctors offer other information about my condition and treatment on their own initiative	1	2	3	4	5	6	7
gg.	Doctors actively provide information on preventive treatment	1	2	3	4	5	6	7
hh.	I can understand the explanation given by the doctor	1	2	3	4	5	6	7
ii.	The doctor was very considerate of me	1	2	3	4	5	6	7
jj.	The doctor made me feel at ease discussing my condition	1	2	3	4	5	6	7
kk.	I feel that the doctor knows my medical history very well	1	2	3	4	5	6	7

11.	I feel that doctors know very well about my health care needs	1	2	3	4	5	6	7

Part IV: Patient satisfaction

a.	I am satisfied with the medical services I received during my stay in this hospital	1	2	3	4	5	6	7
b.	I'm very satisfied with the doctor's attitude	1	2	3	4	5	6	7
c.	I am very satisfied with the quality of the doctor's treatment	1	2	3	4	5	6	7
d.	My illness has been properly treated	1	2	3	4	5	6	7
e.	After seeing the doctor, I have a better understanding of my condition	1	2	3	4	5	6	7
f.	After talking with the doctor, I feel a lot better about my condition	1	2	3	4	5	6	7
g.	The doctor's choice of treatment is the most appropriate for me	1	2	3	4	5	6	7
h.	My condition will be completely improved	1	2	3	4	5	6	7
i.	I'm satisfied with the doctor's consultation time	1	2	3	4	5	6	7
j.	I am satisfied with the waiting time in the hospital	1	2	3	4	5	6	7
k.	I'm satisfied with the total time spent on this visit	1	2	3	4	5	6	7
l.	I'm very clear about how to recover when I get home	1	2	3	4	5	6	7
m.	I am very clear about how to use the medicine	1	2	3	4	5	6	7
n.	I know exactly when to see the doctor next time.	1	2	3	4	5	6	7

Part V: Expectations and actual feelings of patients on hospital service quality

For each of the following statements, please circle "O" and make two choices: the first one represents your expectations before coming to the hospital, and the second one represents your actual experience after going to the hospital.

		expectation	performance
a.	The hospital is clean	1 2 3 4 5 6 7	1 2 3 4 5 6 7
b.	The hospital's medical equipment is very advanced	1 2 3 4 5 6 7	1 2 3 4 5 6 7
c.	Doctors and nurses dress professionally and neatly	1 2 3 4 5 6 7	1 2 3 4 5 6 7
d.	The signs of hospital facilities are very clear	1 2 3 4 5 6 7	1 2 3 4 5 6 7
e.	The TV screen in the waiting area shows useful information for the patient	1 2 3 4 5 6 7	1 2 3 4 5 6 7
f.	In many places in the hospital, you can see promotional materials that guide how to use the hospital WeChat application	1 2 3 4 5 6 7	1 2 3 4 5 6 7
g.	My doctor is very concerned about my personal situation	1 2 3 4 5 6 7	1 2 3 4 5 6 7
h.	My doctor is based on my special condition	1 2 3 4 5 6 7	1 2 3 4 5 6 7
i.	My doctor understands my specific needs	1 2 3 4 5 6 7	1 2 3 4 5 6 7
j.	My doctor is concerned about my unique needs	1 2 3 4 5 6 7	1 2 3 4 5 6 7
k.	My doctor showed great sympathy for my condition	1 2 3 4 5 6 7	1 2 3 4 5 6 7
l.	My doctor has the ability to treat me well	1 2 3 4 5 6 7	1 2 3 4 5 6 7
m.	When the doctor came to see me, I felt safe	1 2 3 4 5 6 7	1 2 3 4 5 6 7
n.	The way and behavior of my doctor give me great confidence	1 2 3 4 5 6 7	1 2 3 4 5 6 7
o.	My doctor has good medical knowledge	1 2 3 4 5 6 7	1 2 3 4 5 6 7
p.	My doctor is trustworthy	1 2 3 4 5 6 7	1 2 3 4 5 6 7
q.	My doctor is very experienced	1 2 3 4 5 6 7	1 2 3 4 5 6 7
r.	I can easily make an appointment with the doctor I want to see	1 2 3 4 5 6 7	1 2 3 4 5 6 7
s.	I can easily make an appointment to the time I want to see a doctor	1 2 3 4 5 6 7	1 2 3 4 5 6 7
t.	It's easy for me to find where I need to go in the hospital	1 2 3 4 5 6 7	1 2 3 4 5 6 7
u.	I don't have to wait long in hospital	1 2 3 4 5 6 7	1 2 3 4 5 6 7
v.	Every step of seeing a doctor in my hospital is very convenient and easy	1 2 3 4 5 6 7	1 2 3 4 5 6 7
w.	The hospital staff will always help me whenever I need	1 2 3 4 5 6 7	1 2 3 4 5 6 7
x.	My doctor seldom makes mistakes	1 2 3 4 5 6 7	1 2 3 4 5 6 7
y.	My doctor always explains the diagnosis and treatment to me very clearly	1 2 3 4 5 6 7	1 2 3 4 5 6 7

z.	My medical record in the hospital is always accurate	1 2 3 4 5 6 7	1 2 3 4 5 6 7
aa.	There are few inconsistencies in my medical records	1 2 3 4 5 6 7	1 2 3 4 5 6 7
bb.	The service of medical staff is always reliable	1 2 3 4 5 6 7	1 2 3 4 5 6 7
cc.	My doctor can answer my question quickly	1 2 3 4 5 6 7	1 2 3 4 5 6 7
dd.	I always get prompt answers when I contact the hospital	1 2 3 4 5 6 7	1 2 3 4 5 6 7
ee.	Doctors and nurses are not too busy to answer my questions in time	1 2 3 4 5 6 7	1 2 3 4 5 6 7
ff.	My doctor will keep updated of my condition changes	1 2 3 4 5 6 7	1 2 3 4 5 6 7
gg.	My doctor will make quick adjustments to my condition	1 2 3 4 5 6 7	1 2 3 4 5 6 7

Thank you very much for your support and help in our research project!

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Appendix 2: Analysis of the gap between expectation and perception of service quality

		Average	standard deviation	Standard Error Average	95% confidence level		t	freedom	significance (double-tail)
					Down limits	Up limits			
Pair1	Tangibility (P- E)	.26052	1.15638	.04652	.16917	.35187	5.601	617	.000
Pair2	Empathy (P- E)	.16424	1.23509	.04968	.06667	.26181	3.306	617	.001
Pair3	Assurance (P- E)	.26052	1.11451	.04483	.17248	.34856	5.811	617	.000
Pair4	Convenience (P- E)	.01564	1.37139	.05517	-.09269	.12398	.284	617	.777
Pair5	Reliability (P- E)	.17584	1.16170	.04673	.08407	.26761	3.763	617	.000
Pair6	Responsiveness (P- E)	.44862	1.03929	.04181	.36652	.53072	10.731	617	.000

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Appendix 3: Correlation analysis of variables in research model

Variable	MHTU	CPC	SQ	PS
MHTU	1			
CPC	.647**	1		
SQ	.312**	.495**	1	
PS	.438**	.594**	.675**	1

**. Correlation is significant at the 0.01 level (2-tailed).

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Appendix 4: Correlation analysis of dimensions in research model

Dimensions	MHTU	IA	PI	Ta	Em	Ass	Co	Rel	Res	TO	VT
MHTU	1										
IA	.813**	1									
PI	.327**	.376**	1								
Ta	.288**	.284**	.368**	1							
Em	.264**	.259**	.481**	.523**	1						
As	.205**	.220**	.434**	.600**	.605**	1					
Co	.230**	.199**	.497**	.399**	.575**	.487**	1				
Rel	.281**	.288**	.510**	.539**	.651**	.665**	.573**	1			
Res	.185**	.194**	.424**	.404**	.589**	.514**	.532**	.602**	1		
TO	.324**	.364**	.582**	.541**	.573**	.579**	.438**	.588**	.465**	1	
VT	.401**	.398**	.331**	.326**	.378**	.237**	.396**	.360**	.317**	.358**	1

**. Correlation is significant at the 0.01 level (2-tailed).

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Appendix 5: Descriptive statistics of the variables and dimensions in research model

Variables or dimensions	N	Minimum	Maximum	Average	Standard deviation
MHTU	617	1.00	7.00	4.5286	1.49153
Information Accessibility	618	1.00	7.00	4.5833	1.51202
Physician-patient Interaction	618	1.25	7.00	5.5328	1.04838
Treatment Outcome	618	1.25	7.00	5.8847	.93442
Visit Time	618	1.00	7.00	4.6780	1.70632
Tangibility	618	1.00	7.00	5.8293	.95587
Empathy	618	1.00	7.00	5.6270	1.06962
Assurance	618	1.00	7.00	6.0685	.96293
Convenience	618	1.00	7.00	5.5599	1.22585
Reliability	618	1.33	7.00	5.8716	1.03638
Responsiveness	618	4.00	7.00	6.1493	.64356
Valid N	617				